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Original Research Article

The mortality of patients with diabetes mellitus in Latvia 2000–2012

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ABSTRACT

Background and objective: In Latvia, like in other European countries, the incidence of diabetes mellitus is increasing and so it is important to find out what the trends in the mortality of diabetes mellitus in Latvia are. The aim of this study was to calculate the mortality indicators of diabetes patients in Latvia from 2000 to 2012 and compare mortality among diabetes mellitus patients with mortality among the population of Latvia.

Materials and methods: The study was carried out with a quantitative statistical analysis approach. In the study, all the registered patients with diabetes mellitus from 2000 to 2012 were included.

Results: Mortality in a population with diabetes decreased statistically significantly from 57.76 per 1000 py in 2000 to 45.33 per 1000 py in 2012. In the general population of Latvia, there were no statistically significant changes; the mortality in 2000 was 13.56 per 1000 py, in 2012 – 14.24 per 1000 py. The age-standardised mortality ratio of the population with diabetes and the population of Latvia decreased from 1.71 (95% CI = 1.62–1.81) in 2000 to 1.23 (95% CI = 1.19–1.27) in 2012.

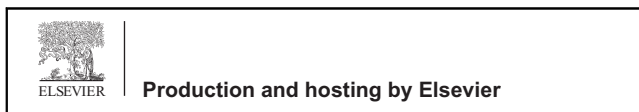
Conclusions: In Latvia the mortality of patients with diabetes exceeds mortality in the general population. Mortality rates are higher for men and older patients, however, compared to mortality in the general population, diabetes increases the risk of death; especially for women and for younger patients. There is a tendency that the mortality indicators of patients with diabetes and mortality indicators in the general population are becoming closer.

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1. Introduction

The International Diabetes Federation has estimated that 35 million adults had diabetes mellitus in Europe in 2011 and it is likely that there will be 43 million (increase will be 23%) in 2030. The estimated prevalence of diabetes mellitus differs and varies among the countries from 2.8% in Albania to 9.8% in Portugal [1]. The prevalence of diabetes mellitus was 3.8% in Latvia at the end of 2012 (79 122 patients with diabetes mellitus) [2]. With the increasing incidence of diabetes mellitus, the mortality of these patients is becoming a more and more important problem. Diabetes mellitus is in fourth and fifth place in the structure of causes of death in Europe. The studies show that diabetes mellitus patients have a higher risk of death than people without diabetes mellitus [3–13]. Most patients with diabetes mellitus die from disease related complications – about 50% of patients with diabetes mellitus die of cardiovascular diseases, 10–20% of renal insufficiency [14]. The aim of high quality diabetes care is to remove or prevent the complications of diabetes, thereby reducing the diabetes-related premature death risk. Consequently, the diabetic patient mortality or survival indicators can serve as diabetes care quality criteria [15].

In developed countries, the overall age-standardised mortality in the population is decreasing, while age-standardised mortality among diabetes mellitus patients is increasing [16,8,17]. Geiss et al. [17] found out that the age-standardised mortality of persons with diabetes mellitus is two times higher than the age-standardised mortality of non-diabetic persons. Several previous studies have shown higher relative mortality rates observed in younger age groups of type 2 diabetes mellitus patients; it suggests the relative importance of this cause compared to other causes, particularly in younger age groups. Older people, whose total mortality risk is higher, have a lower diabetes-specific death risk [13].

However, research has not shown consistency, because it has been observed in several studies that the mortality indicators are decreasing [12,13,18] not only in the general population but also among diabetes mellitus patients, which could be a sign of diabetes care improvement. However, mortality is also decreasing in the general population in many countries. Therefore, it is not self-evident that the decrease of mortality indicators among people with diabetes is consequences of better care. If preferred it can only reflect trends in the general population. Therefore, studies often use the term “relative mortality” or “relative mortality rate,” which indicates how many times the mortality among patients with diabetes mellitus exceeds mortality in the general population [4,6,7,10,11,13] or mortality among people who do not have diabetes [3,5,8,9,12].

In Latvia, like in other European countries, the incidence of diabetes mellitus is increasing and it is important to find out what the trends in mortality of diabetes mellitus in Latvia are and to compare them with trends in mortality in the general population.

The aim of this study was to calculate the mortality indicators of diabetes mellitus patients in Latvia from 2000 to 2012 and compare mortality among diabetes mellitus patients with mortality among the population of Latvia.

2. Materials and methods

The study was carried out with a quantitative statistical analysis approach. Included in the study, were all the patients with diabetes mellitus, who from 2000 to 2012, have been in the records of the “Register of patients with particular diseases, including patients with diabetes mellitus” (hereinafter – The Register of diabetes). In Latvia the Register of diabetes was launched in 1997 by Latvian Association of Endocrinologists. Since 2004 it has been under the supervision of institutions subordinate to the Ministry of Health. Currently the Register of diabetes is a part of the united Register of patients with particular diseases. The Centre for Disease Prevention and Control is the register administrator and holder. The register activity is stipulated by the regulations of The Cabinet of Ministers of the Republic of Latvia which requires that family doctors and endocrinologists give information to the register at least once a year by filling in a special form about each patient with diabetes mellitus that they take care of. The number of registered patients with diabetes mellitus is growing and hence the completeness of the register is also growing every year, so data from the first four years of the register were not included. Since 2009 the information in the Register of diabetes has been compared to the reimbursed medicine database maintained by The National Health Service. As a result of the comparison lists of patients who receive reimbursed medicine for diabetes are obtained, but there is a lack of information about them in the Register of diabetes. Information is entered in the Register of diabetes in collaboration with physicians, so the register staff estimate that the register coverage is ~90% of all patients with diabetes mellitus who receive state reimbursed medicine. Data from the Death causes database of the Centre for Disease Prevention and Control about the number of persons who died from 2000 to 2012 were also used, as well as Central Statistical Bureau data about the average number of the population of Latvia in 2000–2012 by gender and age groups.

Mortality was calculated as a rate per 1000 person-years (py). Death cases of patients with diabetes mellitus that were in the record of the register were considered a case, regardless of the cause of death. In total from 2000 to 2012 there were 34 072 death cases (12 351 for men and 21 721 for women) and the population included in the study was 691 042 person-years (229 447 for men and 461 575 for women) [2].

To calculate the mortality indicators of the general population of Latvia data were used from the Death causes database of the Centre for Disease Prevention and Control about the number of persons who died from 2000 to 2012 and officially published data on the website of the Central Statistical Bureau about the average number of the population of Latvia corresponding to the certain period of time which are recalculated according to Population Census 2011 [19]. By dividing the mortality among patients with diabetes by the mortality in the general population, the so-called relative mortality rate was obtained. All parameters were calculated separately for men and women. In addition, since the age structure of patients with diabetes and the population of Latvia differ significantly, diabetes patients are older (more than 90% of those registered are type 2 diabetic patients [2]),

the relative mortality rate was calculated by age groups. Furthermore, the age-standardised mortality ratio (SMR) was calculated using the indirect standardisation method [20]. The mortality of the Latvian population and the population of people with diabetes in 20–79 year old group with a 10-year interval were used.

In the case of the mortality rate and the standardised mortality ratio 95% confidence intervals (CI) were calculated, but in the case of the relative mortality rate – the method of comparison of two parameters of incidence rate – rate ratio [21]. The difference was statistically significant, when 95% CI of relevant indicators did not overlap or 95% CI did not included 1 as it is in the case of the relative mortality rate and the standardised mortality ratio.

The changes of parameters from 2000 to 2012 were analysed with the linear regression method. Mean changes in indicators during the year were characterised by the regression coefficient β and statistical significance – P value.

3. Results

In total during 2000–2012 the mortality rate of men in the Register of patients with diabetes was 56.41 per 1000 py (95% CI = 55.41–57.41) and among women 49.03 per 1000 py (95% CI = 48.38–49.69). The total 13-year mortality rate of the diabetic population was 51.47 per 1000 py (95% CI = 50.93–52.02). In the same period of time, mortality rate among the Latvian population was 15.35 per 1000 py (95% CI = 15.28–15.41) for men and 13.27 per 1000 py (95% CI = 13.22–13.33) for women; the overall mortality rate over a 13-year period was 14.23 per 1000 py (95% CI = 14.18–14.27).

Analysing the changes of mortality over a 13-year period, Fig. 1 shows that mortality rate in the population with diabetes decreased statistically significantly from 57.76 per 1000 py (95% CI = 54.71–60.94) in 2000 to 45.33 per 1000 py (95% CI = 43.85–46.86) in 2012. According to the regression equation in Fig. 1, it is clear that each year the mortality rate in the population with diabetes decreased by 1.16 cases per 1000 py ($\beta = -1.16$; $P < 0.001$) on average. In turn, in the general population of Latvia, there were no statistically significant changes; the mortality rate in 2000 was 13.56 per 1000 py (95% CI = 13.41–13.71), in 2012 was 14.24 per 1000 py (95% CI = 14.08–14.41) ($\beta = 0.02$; $P = 0.478$).

Analysing mortality by gender, Fig. 2 shows that both female and male mortality rate in the population with diabetes declined. Male mortality rate in the population with diabetes has decreased from 64.37 (95% CI = 58.67–70.47) in 2000 to 54.74 per 1000 py (95% CI = 51.17–58.50) in 2012. Every year the mortality rate of the diabetic male population has reduced by 1.57 cases per 1000 py ($\beta = -1.57$; $P < 0.001$). A mortality reduction in the diabetic female population was observed, but it is less than in the male population; over a 13 year period, mortality rate in the female population has decreased by 1 case per 1000 py every year ($\beta = -1.00$; $P < 0.001$). In the general population of Latvia men have had an insignificant decline in mortality which was not statistically significant ($\beta = -0.03$; $P = 0.542$) and over a 13 year period a small increase in the mortality of the general population of Latvia women – every year the increase in mortality rate was 0.06 cases per 1000 py ($\beta = 0.06$; $P = 0.024$).

Analysing the total relative mortality rate of diabetic patients compared to the general population of Latvia, Table 1 shows that it has decreased from 4.08 (95% CI = 3.87–4.30) in 2000 to 3.09 (95% CI = 2.98–3.19) in 2012. The relative mortality rate in the diabetic male population compared to the general population of Latvia has decreased from 4.14 (95% CI = 3.79–4.53) in 2000 to 3.14 (95% CI = 2.97–3.32) in 2012. The female diabetic population has also experienced a slight decrease in relative mortality rate compared to the general population of Latvia; the decrease in relative mortality rate went from 4.2 (95% CI = 3.93–4.49) in 2000 to 3.09 (95% CI = 2.96–3.23) in 2012. Comparing diabetic patient mortality between men and women by age group (Table 2), in all age groups after the age of 29, the mortality rate of men was statistically significantly higher than the mortality rate of women (the lowest 95% confidence limit of mortality rate estimate in women was higher than the upper 95% confidence limit of estimate in men). While in the age group below 20, these differences were not statistically significant. It is not unexpected that mortality rate increases with the increase of a patients' age.

The comparison of mortality rate indicators of diabetic patients with the mortality of the general population of Latvia showed that women with diabetes had higher relative mortality rate than men (Table 3). For example, in the 20- to 29-year-old women group with diabetes, the mortality rate

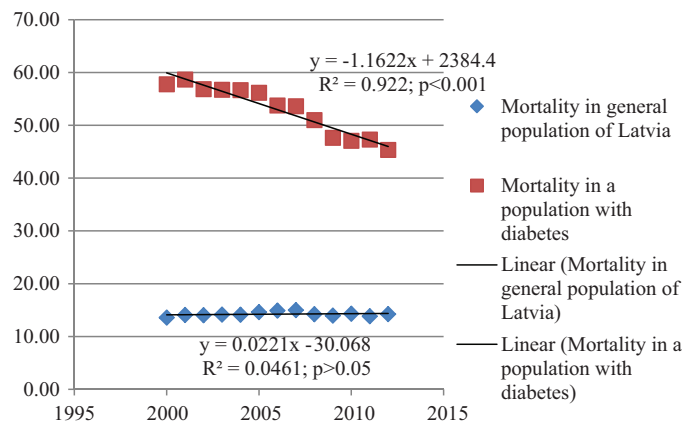


Fig. 1 – Mortality rate in a population with diabetes and general population of Latvia 2000–2012, per 1000 py.

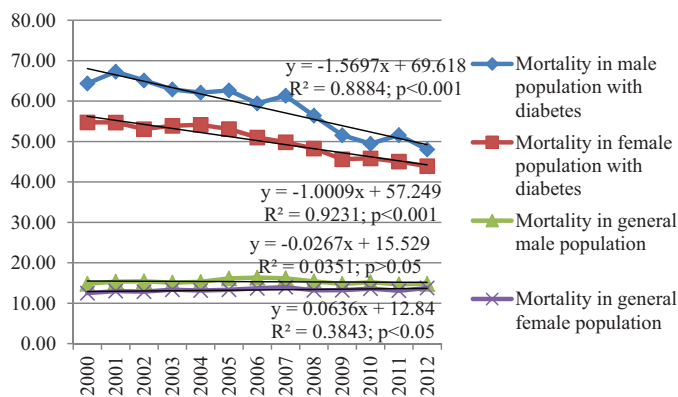


Fig. 2 – Mortality rate differences by gender in a population with diabetes and general population of Latvia 2000–2012, per 1000 py.

was 11 times higher than that of women in the population of Latvia in the same age group, but in the 30–39 age group – nearly seven times bigger. The mortality rate of men with diabetes compared to that of men in the population of Latvia was increased most in the 20–29 age group – by more than 4 times.

The mortality rates of men and women with diabetes, by increasing age group, came closer the mortality in the general population of Latvia in corresponding age groups, up to 80 years and over the mortality rate indicators of diabetic patients and the population of Latvia were similar.

Analysing the age-standardised mortality ratio of the population with diabetes and the population of Latvia, Table 4 shows that it has decreased from 1.71 (95% CI = 1.62–1.81) in 2000 to 1.23 (95% CI = 1.19–1.27) in 2012. The standardised mortality ratio of diabetic men compared to the population of Latvian men has decreased from 1.60 (95% CI = 1.46–1.74) in 2000 to 1.22 (95% CI = 1.15–1.29) in 2012. The standardised mortality ratio of the female population has decreased from 1.78 (95% CI = 1.66–1.90) in 2000 to 1.29 (95% CI = 1.23–1.34) in 2012. This means that mortality among diabetic patients

tended to move closer to mortality in the general population. It was however still 1.22 times higher for men with diabetes and for women 1.29 times higher in comparison to the corresponding gender of the population of Latvia.

Analysing the linear regression coefficient for the standardised mortality ratio by gender, Fig. 3 shows that both the total SMR, and the decrease by gender separately, was linear; it is a bit steeper for women than men. The SMR for women decreased by 0.037 ($\beta = -0.04$; $P < 0.001$), but for men by 0.032 ($\beta = -0.03$; $P < 0.001$) every year.

4. Discussion

In this study, based on the data of the Register of diabetes, the mortality of diabetic patients in Latvia in the period of 2000–2012 was calculated, and mortality changes over a 13-year period were also evaluated. The overall mortality rate in the population with diabetes was 56.41 per 1000 py for men and 49.03 per 1000 py for women, which was almost four times more than among the population of Latvia. The total 13-year mortality rate in the population with diabetes was 51.47 per 1000 py, while in the general population of Latvia it was 14.18 per 1000 py. During this period the diabetic population had a mortality rate 3.6 times higher than in the general population of Latvia.

Table 1 – Relative mortality rate (95% CI) of patients with diabetes who are in the Register of diabetes in comparison to the general population of Latvia 2000–2012.

Year	Total		Male		Female	
	RR	95% CI	RR	95% CI	RR	95% CI
2000	4.08	3.87–4.30	4.14	3.79–4.53	4.20	3.93–4.49
2001	3.99	3.80–4.19	4.10	3.85–4.52	4.00	3.80–4.30
2002	3.89	3.71–4.07	4.02	3.73–4.34	3.93	3.71–4.16
2003	3.85	3.69–4.02	3.98	3.70–4.28	3.89	3.68–4.10
2004	3.85	3.69–4.01	3.88	3.63–4.16	3.96	3.76–4.16
2005	3.69	3.55–3.84	3.71	3.48–3.96	3.83	3.65–4.03
2006	3.47	3.34–3.61	3.49	3.28–3.72	3.59	3.43–3.77
2007	3.45	3.32–3.58	3.63	3.43–3.85	3.44	3.28–3.61
2008	3.46	3.34–3.59	3.51	3.32–3.73	3.53	3.37–3.69
2009	3.31	3.19–3.43	3.36	3.17–3.57	3.34	3.19–3.50
2010	3.18	3.07–3.29	3.15	2.97–3.34	3.27	3.13–3.42
2011	3.31	3.19–3.42	3.78	3.58–3.98	3.33	3.19–3.48
2012	3.09	2.98–3.19	3.14	2.97–3.32	3.09	2.96–3.23

Table 2 – The mortality rate of patients with diabetes who are in the Register of diabetes per 1000 py (95% CI) by age group in Latvia 2000–2012.

Age group	Male		Female	
	Mortality	95% CI	Mortality	95% CI
<20	1.82	0.73–3.76	1.17	0.32–2.99
20–29	9.70	7.02–13.07	4.96	3.07–7.57
30–39	18.64	15.94–21.66	8.68	6.57–11.24
40–49	23.00	21.14–24.97	10.42	9.12–11.86
50–59	31.93	30.38–33.53	15.40	14.51–16.32
60–69	52.29	50.55–54.07	29.15	28.26–30.06
70–79	94.06	91.35–96.84	63.01	61.72–64.32
80+	164.54	157.5–171.82	144.01	140.72–147.35

Table 3 – The relative mortality rate of diabetic patients who are in the Register of diabetes in comparison to general population of Latvia by age groups.

Age group	Total		Male		Female	
	RR	95% CI	RR	95% CI	RR	95% CI
<20	2.42	1.34–4.38	2.37	1.13–4.97	2.47	0.93–6.59
20–29	5.98	4.68–7.65	4.47	3.31–6.02	11.34	7.34–17.45
30–39	5.19	5.56–5.92	4.33	3.37–5.03	6.67	5.21–8.78
40–49	2.83	2.64–3.04	2.47	2.23–2.69	3.42	2.99–3.89
50–59	1.75	1.69–1.82	1.62	1.54–1.70	2.25	2.12–2.39
60–69	1.50	1.47–1.54	1.34	1.29–1.38	1.99	1.93–2.06
70–79	1.44	1.42–1.47	1.30	1.27–1.34	1.65	1.62–1.69
80+	1.09	1.07–1.12	1.04	0.99–1.08	1.12	1.09–1.15

In developed countries, the age-standardised mortality ratio in the general population is decreasing while the standardised mortality ratio in the diabetes population is increasing [16,8,17]. In Latvia there was a tendency that mortality rate in the general population was almost unchanged, but mortality rate in the population with diabetes decreased and became level to mortality in the general population.

Geiss et al. [17] found out that the age-standardised death rate of persons with diabetes is two times higher than for those without diabetes. There were not such big differences in the age-standardised mortality observed in Latvia. The difference, measured by the SMR, decreased from 1.71 in 2000 to 1.23 in Latvia in 2012. During the entire observation period, women had higher age-standardised mortality ratios than men, but they also had a tendency to decrease. In the research, more attention is paid to the comparison of age-specific mortality rates, because the age structures of the population of diabetic patients and the general population or the population without diabetes are very different. It is natural that the older the diabetic patients are, the more mortality increases. In Latvia the mortality rate of patients who were younger than 20, was 1.82 per 1000 py for men and 1.17 per 1000 py for women, but for patients who were 80 and older – 164.54 per 1000 py for men and 144.01 per 1000 py for women.

A direct comparison of Latvia indicators with other studies limits the differences in research methods to some extent: selected age groups, patient characteristics (all patients or a

particular type of diabetes, all existing patients or only newly diagnosed patients and the duration of the study).

Several previous studies have shown that higher relative mortality rates are observed in younger age groups of type 2 diabetes patients, suggesting the relative importance of this cause compared to other causes particularly in younger age groups. The diabetes-specific risk of death is less for older persons with a higher total mortality risk [13]. In Latvia the highest relative mortality rate was in the 20- to 29-year-old group and 30- to 39-year-old group; the mortality of these groups in the population with diabetes was more than five times higher than in the general population; the difference was not so great in other age groups, and there was no difference in the mortality of the population with diabetes and the general population in the age group above 80. Such a relationship, that the relative mortality rate of diabetic patients is highest in the younger age groups and decreases with age, is confirmed in a large number of studies [3–6,8–10,13]. In the research carried out in other countries, mortality in younger age groups is significantly lower than in Latvia; for example, in the research carried out in the UK, mortality in the age group up to 39 years old was 2.59 per 1000 py for men and 2.43 per 1000 py for women [3].

The numerical values of relative mortality rate depend on the research methods used, as well as on whether the general population has been taken as a reference group (which also includes diabetic patients), or just persons without diabetes. But in any case, in creating this indicator, it is taken into

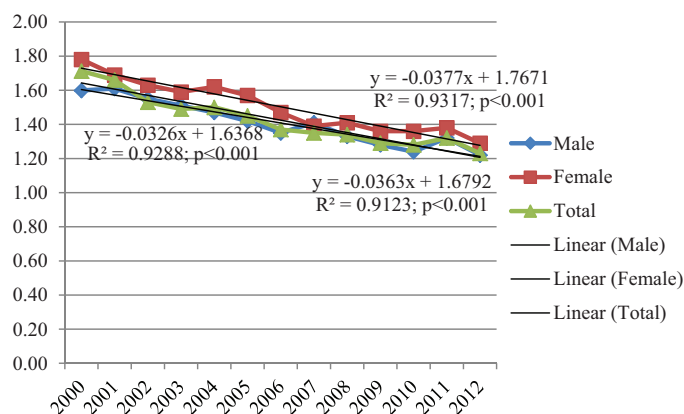
**Fig. 3 – The standardised mortality ratio (95% CI) in the period 2000–2012: linear regression of comparison of mortality of diabetic patients who are in the Register of diabetes to the mortality of the population of Latvia.**

Table 4 – Standardised mortality ratio (95% CI) in the period 2000–2012. The mortality of diabetic patients who are in the Register of diabetes in comparison to the mortality of general population of Latvia.

Year	Male		Female		Total	
	SMR	95% CI	SMR	95% CI	SMR	95% CI
2000	1.60	1.46–1.75	1.78	1.66–1.90	1.71	1.62–1.81
2001	1.61	1.48–1.75	1.69	1.59–1.80	1.66	1.58–1.75
2002	1.55	1.44–1.68	1.63	1.54–1.73	1.53	1.46–1.60
2003	1.51	1.40–1.63	1.59	1.51–1.67	1.49	1.43–1.56
2004	1.47	1.37–1.58	1.62	1.54–1.70	1.50	1.39–1.56
2005	1.42	1.33–1.52	1.57	1.49–1.65	1.45	1.39–1.51
2006	1.35	1.26–1.43	1.47	1.41–1.54	1.37	1.32–1.42
2007	1.41	1.33–1.49	1.39	1.33–1.46	1.35	1.31–1.41
2008	1.33	1.26–1.41	1.41	1.35–1.48	1.34	1.29–1.38
2009	1.28	1.20–1.35	1.36	1.30–1.42	1.29	1.24–1.34
2010	1.24	1.17–1.31	1.36	1.30–1.42	1.28	1.23–1.32
2011	1.32	1.25–1.39	1.38	1.33–1.44	1.32	1.28–1.37
2012	1.22	1.15–1.29	1.29	1.23–1.34	1.23	1.19–1.27

account what the mortality rate of the general population or in the non-diabetic population in the relevant age groups is. Thus it can be concluded that diabetes increases the premature death risk for younger people more significantly.

Research comparing the differences of diabetic patient mortality among genders, quite clearly shows that the mortality indicators of men are higher [3,9,13,22]. In Latvia the mortality of diabetic patients in all age groups was higher for men than women, and these differences were only not statistically significant up to the age of 29.

However, the gender relation to an increased risk of death looks different when comparing the relative mortality indicators and the mortality level for men and women in the general population or in the population without diabetes is taken into account.

In Latvia the relative mortality rate of women with diabetes compared to women in the general population was higher than that among men in almost all age groups, except the age group younger than 20, and the standardised mortality ratio also was higher among women than among men, for example, it was 1.29 vs. 1.22 in 2012.

An interesting question arises about the reasons for mortality changes of patients with diabetes during the period of time. Early diagnosis of diabetes, the tight/intensified control of glycemia, hypertension, dyslipidemia and other risk factors, as recommended by the diabetes treatment and care guidelines of Latvia [23–25], could not only reduce the incidence of diabetic complications but also mortality. In this research, all diabetic patient deaths, regardless of whether diabetes was or was not recorded in the causes of death certificates, were included in the calculation of diabetic patient mortality. The results show that over a 13-year period the mortality of diabetic patients in Latvia has slightly decreased, and in 2012 the mortality rates for both men and women were lower than in previous years. This 13-year period had a tendency to level out the differences between mortality among patients with diabetes and mortality in the general population of Latvia, for both men and women.

The study has the advantage of using the Register of diabetes, because a selection based on the entire population

is much more representative than a selection made, for example, from a hospital or clinical trial patients. In theory, this register should include all patients diagnosed with diabetes in Latvia; it is questionable whether the registry is so comprehensive, the register staff estimate that the register coverage is ~90% of all patients with diabetes mellitus who receive state reimbursed medicine. It is difficult to say whether and how potential registry failures may affect the results of the given research. If we assume that the register is relatively less represented with patients with a mild form of diabetes (for example, using only diet as a treatment) and wealthier persons using private services, then in this research, calculated mortality indicators could be higher than in reality. But it could also be vice versa. If the primary care physicians who are less interested in diabetes treatment and provide a lower quality of care, have not given information about their diabetic patients to the register, then according to the register data the calculated mortality indicators are better.

In this study, the mortality of patients with diabetes was compared to mortality in the general population, which includes people with diabetes, not only people without diabetes. Thus calculated, the diabetes-related premature death risk is a bit lower. It depends on the extent to which the prevalence of diabetes in the general population by age group reduces the numerical value of the relative risk. However, this approach – to compare with the general population – is widely used [4,6,7,10,11,13], because demographic statistics on population and deaths in age groups in the countries are available. Moreover, even if the reference group – people without diabetes – is established (for example, by subtracting the number of diabetics patients in each age group from the number of the population, or on the basis of the health authorities' databases), it can still include currently unknown type 2 diabetes mellitus patients in the latent phase of disease.

To make the results of the research applicable in clinical practice, aspects such as the type of diabetes, duration of diabetes, causes of death, and even factors such as lifestyle habits should be included in the analysis. For example, studies have shown that cardiovascular diseases are the leading cause of an increased death risk of patients with diabetes [3,5,7,9–12]. However, the relatively small population of Latvia and hence the small number of people with diabetes, makes it difficult to create indicators for smaller sub-groups. Right now a small number of cases in younger age groups prevent the interpretation of the estimated age-specific mortality rates. Besides, there is no information on lifestyle habits or co-morbidities (apart from diabetes complications) reported to the Register of diabetes. Thus, this approach can be used to objectively evaluate the diabetic patients' health in total and to follow the changes in the period of time, but not claim on deep causal explanations.

5. Conclusions

In Latvia the mortality of patients with diabetes exceeds mortality in the general population by nearly 1.5 times.

Mortality rates are higher for men and older patients, however, compared to mortality in the general population, especially for women, and for younger patients, diabetes increases the risk of death.

During the period of 2000–2012 the mortality of patients with diabetes has decreased and there is a tendency that the mortality indicators of patients with diabetes and the mortality indicators in the general population are becoming closer.

Conflict of interest

The authors state no conflict of interest.

Acknowledgment

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