

THE EVOLUTION OF MORTALITY AND DEATH CAUSES IN TYPE 2 DIABETES PATIENTS FROM TIMISOARA DIABETES CENTRE BETWEEN 1970 AND 1999

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Abstract

Background and Aims: Cardiovascular disease represents the principal cause of death in type 2 diabetes (T2DM) patients. The aim of our study was to evaluate the all cause mortality and the main causes of death in T2DM patients and their trend of evolution between 1970 and 1999. **Material and methods:** 3719 T2DM patients newly diagnosed between 1970-1979 in the Timisoara Diabetes, Nutrition and Metabolic Diseases Centre were followed until 1999. The study group included 2084 women (56.0%) and 1635 men (44%), with a mean age at diagnosis of 58.2±11.5 years. **Results:** Throughout the analyzed period we noticed a tendency of decrease for all cause mortality, the main causes of death being cardiovascular diseases. **Conclusions:** The results of the study confirm the tendency of reduced mortality in T2DM patients and maintenance of cardiovascular diseases as the main cause of death in T2DM patients.

key words: Type 2 diabetes mellitus, all-causes mortality, cause specific-mortality.

Background and Aims

In type 2 diabetes (T2DM), the main causes of death are the cardiovascular diseases (CVD): myocardial infarction (MI), stroke and heart failure [1,2], these being responsible for 70-75% of the deaths (30% for MI) [3]. Thus, the main mortality cause is coronary heart disease, the number of deaths caused by it being three times higher in diabetics compared with non diabetics [4]. T2DM raises the risk of fatal MI by 2-4 times [3,5].

In the worldwide hierarchy of mortality causes, cancer takes second place and diabetes (DM) the twelfth place [6]. Not only the risk for cancer is high in patients with DM, but also the risk of all cause mortality rises in diabetics after being diagnosed with cancer [7,8].

In developed countries, the third place among death causes (after MI and cancer) is stroke. Out of the total number of deaths due to stroke, the global risk induced by DM was

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of 23.4%. DM was considered responsible for the stroke induced death of 16% of men and 33% of women. DM does not only induce a significant increase of the stroke risk but it is also a predictor for the reduced survival after stroke. In most studies, the mortality rate due to stroke was much higher in diabetics than non-diabetics [9-11].

The aim of our study was to analyze the evolution trend of all cause mortality and of the main causes of death in T2DM patients between 1970 and 1999.

Material and Methods

3719 newly diagnosed T2DM patients from the Timisoara Diabetes, Nutrition and Metabolic Disease Centre were included in the study during the period 1970-1999, out of whom 2084 women (56.0%) and 1635 (44%) men. The average age at diagnosis was 58.2 ± 11.5 years. The study had three consecutive stages, including patients registered between 1970 and 1979 (1623 patients, 896 women and

727 men, average age at diagnosis 60.4 ± 10.59 years); between 1980 and 1989 (1100 subjects, 606 women and 494 men, average age at diagnosis 55.5 ± 11.82 years), and between 1990-1999 (996 patients, 582 women and 414 men, average age at diagnosis 58.2 ± 11.45 years).

At the end of each period analyzed, the percentage of all cause deaths was calculated as well as the percentage of deaths due to specific causes, both on the whole group and on sexes.

Statistical analysis was performed using the SPSS program.

Results

Between 1970-1979, out of the 1623 persons under observation, 24.1% (n=391) died, 55.5% (n=217) in females and 44.5% (n=174) in males (Figure 1). Out of 896 women observed in this period, 24.2% (n=217) died, while out of 727 men, 24% (n=174) died.

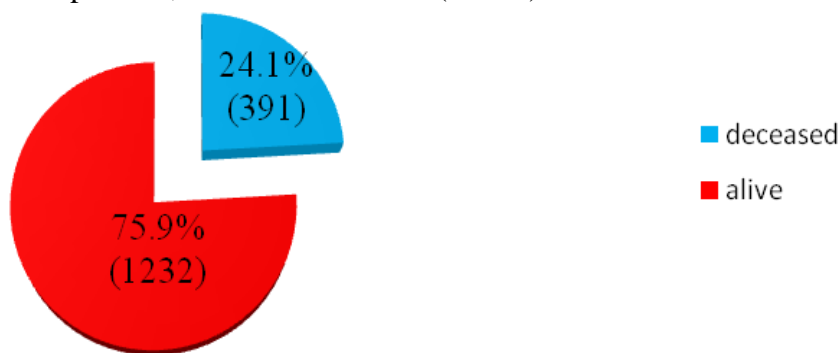


Figure 1. Percentage of deaths recorded between 1970 and 1979.

First place among death causes was held by CVD (cardiac causes and stroke). There were no significant differences between sexes, in the causes of death, though there was a trend for a greater share of neoplasms in men, while in women other causes of death (chronic renal failure, digestive and respiratory disease,

psychic disorders) were more frequent, as detailed in Table 1.

Out of the 1100 patients registered between 1980-1989, 16.6% (n=183) had died till the end of the period under study (Figure 2). Out of 606 women enrolled in this period, 14.7% (n=89) died, while from the 494 men, 19% (n=94) died.

Table 1. Main causes of death between 1970-1979.

Cause of death	Total number of deaths /Percentage	Men	Women	Significance
Cardiac causes	196 (50.1%)	87 (50.0%)	109 (50.2%)	Ns
Stroke	88 (22.5%)	38 (21.8%)	50 (23.0%)	Ns
Infections	15 (3.8%)	6 (3.4%)	9 (4.1%)	Ns
Neoplasms	38 (9.7%)	21 (12.1%)	17 (7.8%)	Ns
Hypoglycemic coma	7 (1.8%)	5 (2.9%)	2(0.9%)	Ns
Hyperglycemic coma	1 (0.3%)	0 (0.0%)	1 (0.5%)	Ns
Other causes	46 (11.8%)	17 (9.8%)	29 (13.4%)	Ns
TOTAL	391 (100%)	174 (100%)	217 (100%)	Ns

ns=non significant

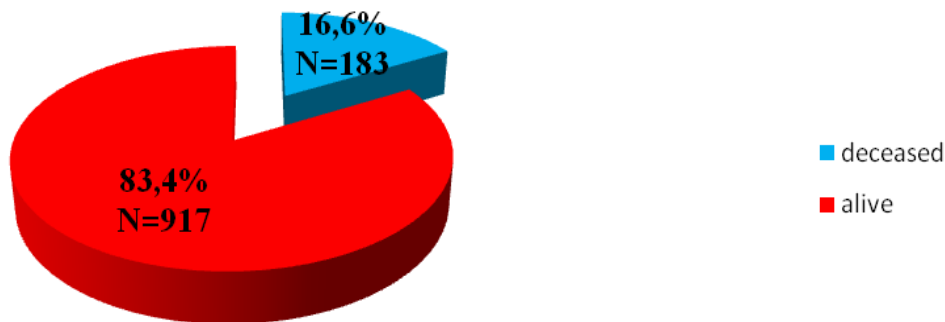


Figure 2. Percentage of deaths between 1980-1989.

The main causes of death for the deceased patients in this period were also cardiac causes (34.4%) followed by stroke (18.0%) as detailed in [Table 2](#).

Cardiac causes of death were more frequent in men (37.2%) than women (31.5%), while stroke was more frequent in women (22.5%) than men (13.8%) but differences were not statistical significant (Table 2). Unlike the previous period, neoplasms were more frequent in women (15.7%) than men (12.8%), while other causes of death were

more frequent in men (33.0%) than women (29.2%) but again the differences were not statistically significant ([Table 2](#)).

Between 1990-1999, out of 996 patients enrolled, 7.0% (n=70) had died by the end of the period of time studied ([Figure 3](#)). 5.0% (n=22) of the men and 10.9% (n=48) of women enrolled in this period died by the end of the study.

The main causes of death in this period were also cardiac (45.7%), followed by stroke (8.6%) as detailed in [Table 3](#).

Table 2. Main causes of death between 1980-1989.

Causes of death	Total number of deaths/Percentage	Men	Women	Significance
Cardiac causes	63 (34.4%)	35 (37.2%)	28 (31.5%)	Ns
Stroke	33 (18.0%)	13 (13.8%)	20 (22.5%)	Ns
Infections	2 (1.1%)	2 (2.1%)	0 (0.0%)	Ns
Neoplasms	26 (14.2%)	12 (12.8%)	14 (15.7%)	Ns
Hypoglycemic coma	0 (0.0%)	0 (0.0%)	0 (0.0%)	Ns
Hyperglycemic coma	2 (1.1%)	1(1.1%)	1 (1.1%)	Ns
Other causes	57 (31.1%)	31 (33.0%)	26 (29.2%)	Ns
TOTAL	183 (100%)	94 (100%)	89 (100%)	

ns=non significant

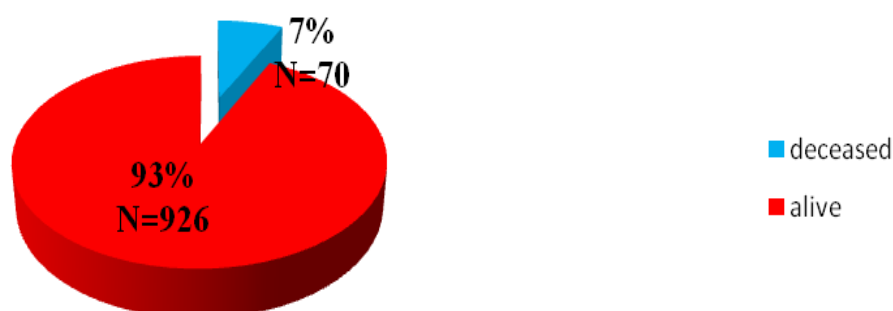


Figure 3. The percentage of deaths between 1990-1999.

Though no significant differences between the sexes have been noticed, there was a trend for increased cardiac cause death in men (59.1%) than in women (39.6%), the same being true for stroke: men (18.2%), women (4.2%). Both neoplasms and other causes of death were more frequent in women than men, but again differences were not statistically significant ([Table 3](#)).

Comparison of the causes of death during the three periods under analysis

Death due to cardiac causes exhibited initially a significant ($p<0.01$) reduction from

the first period analyzed (1970-1979) till the second period (1980-1989), then a significant increase ($p<0.01$) could be observed between the years 1990-1999. The same holds true when performing a differentiated analysis according to sex, as detailed in [Table 4](#).

Unlike the tendency of death by cardiac causes, an initial growth of mortality due to other causes could be observed between the first and the second ($p<0.01$) period, followed by a decrease between 1990-1999 ($p<0.01$). This trend was registered in men, while in women there was a constantly growth, but not

statistically significant (Table 4, Figure 4, Figure 5).

Table 3. Main causes of death between 1990-1999.

Causes of death	Total number of death / Percentage	Men	Women	Significance
Cardiac causes	32 (45.7%)	13 (59.1%)	19 (39.6%)	Ns
Stroke	6 (8.6%)	4 (18.2%)	2 (4.2%)	Ns
Infections	0 (0.0%)	0 (0.0%)	0 (0.0%)	Ns
Neoplasms	15 (21.4%)	4 (18.2%)	11 (22.9%)	Ns
Hypoglycemic coma	0 (0.0%)	0 (0.0%)	0 (0.0%)	Ns
Hyperglycemic coma	0 (0.0%)	0 (0.0%)	0 (0.0%)	Ns
Other causes	17 (24.3%)	1 (4.5%)	16 (33.3%)	Ns
TOTAL	70 (100%)	22 (100%)	48 (100%)	

ns=non significant

Table 4. Comparison of the causes of death for the three periods under analysis.

Causes of deaths	Sex	1970-1979 N=391	1980-1989 N=183	Significance vs 1970-1979	1990-1999 N=70	Significance vs 1980-1989
Cardiac causes	T	196 (50.1%)	63 (34.4%)	p<0.01	32 (45.7%)	p<0.01
	F	109 (50.2%)	28 (31.5%)	p<0.01	19 (39.6%)	p<0.05
	M	87 (50.0%)	35 (37.2%)	p<0.01	13 (59.1%)	p<0.01
Stroke	T	88 (22.5%)	33 (18.0%)	p<0.05	6 (8.6%)	p<0.01
	F	50 (23.0%)	20 (22.5%)	ns	2 (4.2%)	p<0.01
	M	38 (21.8%)	13 (13.8%)	p<0.05	4 (18.2%)	ns
Infections	T	15 (3.8%)	2 (1.1%)	p<0.05	0 (0.0%)	ns
	F	9 (4.1%)	0 (0.0%)	ns	0 (0.0%)	ns
	M	6 (3.4%)	2 (2.1%)	ns	0 (0.0%)	ns
Neoplasms	T	38 (9.7%)	26 (14.2%)	p<0.05	15 (21.4%)	p<0.05
	F	17 (7.8%)	14 (15.7%)	p<0.05	11 (22.9%)	p<0.05
	M	21 (12.1%)	12 (12.8%)	ns	4 (18.2%)	ns
Hypoglycemic coma	T	7 (1.8%)	0 (0.0%)	ns	0 (0.0%)	ns
	F	2(0.9%)	0 (0.0%)	ns	0 (0.0%)	ns
	M	5 (2.9%)	0 (0.0%)	ns	0 (0.0%)	ns
Hyperglycemic coma	T	1 (0.3%)	2 (1.1%)	ns	0 (0.0%)	ns
	F	1 (0.5%)	1 (1.1%)	ns	0 (0.0%)	ns
	M	0(0.0%)	1 (1.1%)	ns	0 (0.0%)	ns
Other causes	T	46 (11.8%)	57 (31.1%)	p<0.01	17 (24.3%)	p<0.05
	F	29 (13.4%)	26 (29.2%)	p<0.01	16 (33.3%)	ns
	M	17 (9.8%)	31 (33.0%)	p<0.01	1 (4.5%)	p<0.01

ns- non significant

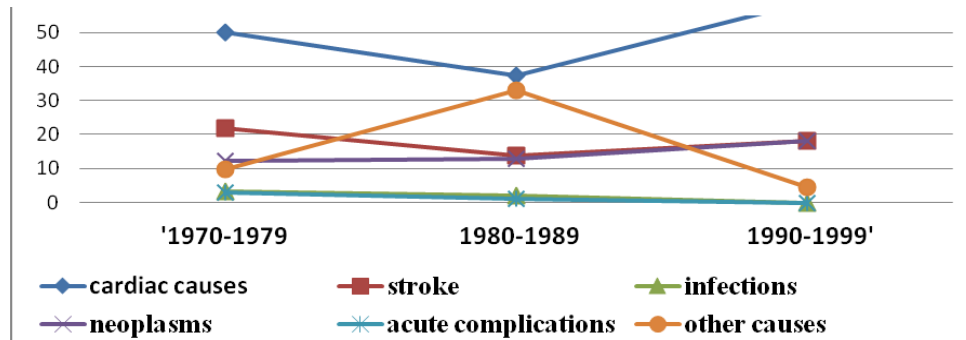


Figure 4. Temporal evolution of the main death causes in women.

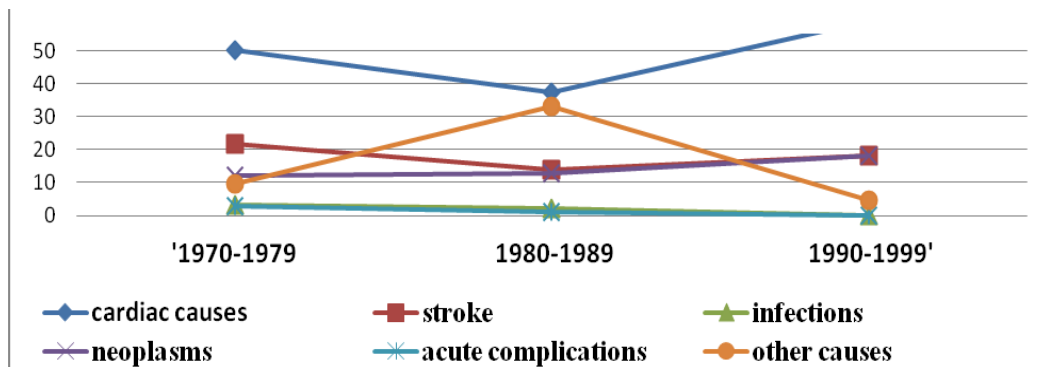


Figure 5. Temporal evolution of the main causes of death in men.

The number of deaths due to stroke had a continuous decrease beginning with 1970-1979 to 1980-1989 ($p < 0.05$) and to 1990-1999 ($p < 0.01$). Between 1970-1979 and 1980-1989 the decrease was statistically insignificant in women, then significantly decreased ($p < 0.01$) between 1990-1999. In men, the decrease was significant between the first two periods ($p < 0.05$), then stroke mortality showed a non-significant rising tendency (Table 4, Figure 4, Figure 5).

A “mirror” image presented the evolution of deaths caused by neoplasms which maintained a rising tendency throughout the 3 analyzed periods ($p < 0.05$). In women the difference was significant while for men, though the evolution was similar, it was statistically irrelevant (Table 4, Figure 4, Figure 5).

Discussions

Our study showed a tendency of decrease for the all cause mortality throughout the three study periods, both in the whole group (24.1%-16.6%-7%) as well as in women (24.2%-14.7%-10.9%) and men (24%-19%-5%). Our results support the findings of numerous studies performed worldwide which have demonstrated a tendency for decreased mortality for subjects with T2DM. Thus, a Scottish study that observed a group of patients newly diagnosed with T2DM between 1993 and 2004 found a decrease of the mortality rate throughout the analyzed period [12]. Similarly, a study performed in Sweden established the same tendency of reduced mortality in diabetics, irrespective of sex [13].

According to the literature data, the main cause of death in T2DM patients is

represented by cardiovascular disease, the reported percentage varying between 42-75% [14,15]. Our data can be included within the limits mentioned above (adding the deaths due to cardiac causes and stroke leads to a percentage of 63.2% deaths). In the Verona study, CV causes of death represented only 41.8% (974 of 2328) of the total number of deaths [16], though cardiac causes and stroke are still on first places. A meta-analysis of four important studies performed in USA and Western Europe [17] confirmed that the main cause of death in T2DM patients is represented by cardiovascular disease (approximately 40% of all deaths).

In our study, irrespective of the evaluated period, mortality due to cardiac causes occupied the first place, irrespective of sex, results that are similar to other literature data. Thus, a Finnish study involving 11.215 diabetic patients (no specifications of type) observed for five years (1981-1985) reported that the first place among the causes of death was hold by cardiovascular disease, without notable differences between sexes [18].

The falling tendency of death due to cardiac causes between the first two periods of our study, both for women (50.2%-31.5%) and for men (50.0%-37.2%) match the data obtained by other international studies. Though the majority of the studies show differences between sexes in regard to mortality due to CV causes, the Framingham Heart Study performed between 1950 and 2005 in the USA showed a decrease of general and CV mortality, irrespective of sex, or presence of DM [19]. A similar evolution was observed in the Nord-Trondelag Health Study (HUNT) performed in Norway that followed-up 2 groups of patients for 9 years [20].

Our data showed that stroke is the second cause of death in T2DM patients while neoplasms represent the third. Unlike our data, in other studies the percentage of deaths due to stroke is lower. Thus, in a study performed in Rochester, Minnesota, between 1945 and 1979, the percentage of death due to stroke was of only 6% [17]. In another study which involved the inhabitants of 11 localities in South Wisconsin, deaths due to stroke represented only 9.5% of the recorded deaths in T2DM patients [17]. However, a WHO report [15] showed that stroke was responsible for 15% of deaths in T2DM patients, a percentage similar with that provided by our study.

In the NHANES-I study there were more deaths due to neoplasms in diabetic men, as opposed to the data obtained in this paper, where a higher number of deaths due to neoplasms were found in women [21]. The growing importance of neoplasms in DM is supported by the findings of a Korean prospective study that followed 1.2 million people with DM for ten years and demonstrated the growing risk of cancer in the presence of high glycemic levels [22].

Conclusions

In accordance with the worldwide trend, cardiac causes are the first cause of death in our group of T2DM patients, irrespective of the decade under study. The second cause of death, stroke, has known a falling evolution. However, a growth in the number of deaths due to neoplasms was recorded. The oncologic pathology reached the second place among the causes of death in T2DM patients in the decade 1990-1999. A favorable aspect was the decrease of deaths due to infections and the

almost disappearance of lethal hypoglycemic accidents.

Our study reflects the image of the evolution of T2DM in our geographic area,

with its socio-economic, cultural and medical care characteristics.

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