Mortality of Lithuanian Population Over 2 Decades of Independence: Critical Points and Contribution of Major Causes of Death

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Key Words: *mortality; Lithuania; socioeconomic transition.*

Summary. *The aim of the study was to analyze trends in overall mortality and mortality from major causes of death, detect differences in cut points, and estimate the contribution of the major causes of death to the changes in overall mortality throughout 2 decades of independence in Lithuania (1991–2000 and 2001–2010).*

Material and Methods. Overall mortality and mortality from cardiovascular diseases, cancer, and external causes were analyzed for the periods of 1991–2000 and 2001–2010. Joinpoint analysis was used to identify the best-fitting points wherever a statistically significant change in mortality occurred, and analysis of components was applied for the assessment of the contribution of major causes of death.

Results. The 1991–1994 period was identified as the most negative in terms of increasing mortality from all major causes of death, while the 2007–2010 period was most favorable, when the most significant decline in overall mortality was observed (4.84% per year for males and 4.41% per year for females). External causes contributed most to the growing overall mortality in 1991–1994 both for males and females (37.20% and 25.29%, respectively). Since 2007, all major causes contributed positively to the declining overall mortality of the Lithuanian population. The most significant contribution was made by cardiovascular diseases and external causes.

Conclusions. Despite the considerable transformations of socioeconomic situation and economic crisis, it is likely that Lithuania is entering into the stage of positive health development. For assuring this trend in the future, investments in sustainable health and social developments are inevitable.

Introduction

Over the last 2 decades after regaining independence, Lithuania entered a new era with many opportunities for radical improvements; nevertheless, the population of the country has been exposed to the new and unfamiliar social environment, and consequently, experienced tremendous stress (1, 2). The first decade of independence was the period of major socioeconomic changes, and it was expected that society would gradually enter a more stable stage of development. However, the second decade was marked by an economic crisis and continuing reforms in health system and related areas. Mortality is one of the major indicators reflecting the changes in health outcomes. Several studies carried out in Lithuania have analyzed trends in mortality from major causes (3–7). Most studies modeled mortality rates within a specific time or age group; they provided average annual changes assuming that rates increase or decrease at a constant rate over time, and some identified the calendar years in which changes occurred. However, no analysis has been done to compare 2 decades of independence in the country and identify the contribution of major causes to the changes in overall mortality.

The aim of this study was to analyze trends in overall mortality and mortality from major causes of death, detect differences in cut points, and estimate the contribution of the major causes of death to the changes in overall mortality throughout 2 decades of independence in Lithuania (1991–2000 and 2001–2010).

Material and Methods

The Lithuanian population declined from 3.7 million in 1991 to 3.2 million in 2010. The analysis for this study covered the entire country. Information gathered on deaths from 1991 to 2010 was obtained from death certificates, held by the Lithuanian Department of Statistics. The following established cases of major causes of death were included in the analysis: cardiovascular diseases (CVD) (codes 390–459 according to the International Classification of Diseases [ICD-9] for 1991–1997, and codes 100–199 according to the ICD-10 since 1998), cancer (codes 140–209 according to the ICD-9 and C00-C97 according to the ICD-10 since 1998), and external causes of death (codes E800-E999 accord-

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ing to the ICD-9 and V01-Y98 according to the ICD-10). Mortality rates were age-standardized, using the European standard, as recommended by the World Health Organization. Overall mortality and mortality from major causes (CVD, cancer, and external causes) were assessed separately for males and females.

The joinpoint regression model was applied to describe data on trend changes. The joinpoint regression is a Windows-based statistical software program that enables a user to test the statistical significance of an apparent change in a trend (8). In this analysis, the best fitting points where the rate changes significantly (increase or decrease) were chosen (9). The analysis starts with a minimum number of cut points and tests whether one or more cut points are statistically significant, and whether or not they can be added to the model. In the final model, each cut point (if any) indicates a statistically significant change in a trend; the annual percent of change for each of those trends is computed. For joinpoint analysis, the overall significance level was set at P=0.05. Significant changes included changes in the direction or rate of the trend. The entire study period was divided into 2 decades (1991–2000 and 2001–2010). The permutation test – testing the number of cut points 0 against 1 – was applied in this case, because the 10-year periods did not allow obtaining statistically significant results for more cut points. The coefficients of regression, multiplied by 100, were presented as average annual changes (AAC), which were considered to be statistically significant at the P<0.05 level. This methodology assisted in identifying the occurrence of changes in the major causes of death during distinct periods.

The contribution of the major causes of death to the changes in overall mortality was estimated by the analysis of components, described by Joung and colleagues (10).

Results

The analysis of trends in overall mortality demonstrated the varying transformation during last 2 decades. Because of a considerable variation in mortality rates throughout 1991–2010, the average annual changes in overall mortality were not statistically significant for males (0.45%; P>0.05), while for females, mortality was declining by 1.00% annually (P<0.05).

Based on joinpoint analysis, the year 1994 can be assumed to be the change point of overall mortality rates in the first decade under investigation both for males and females (P<0.05), when an increasing trend reversed to the declining one. During the 2001–2010 period, the cut point occurred in 2007, when overall mortality rates started to decline again after the period of growing mortality (P<0.05) (Figs. 1 and 2).

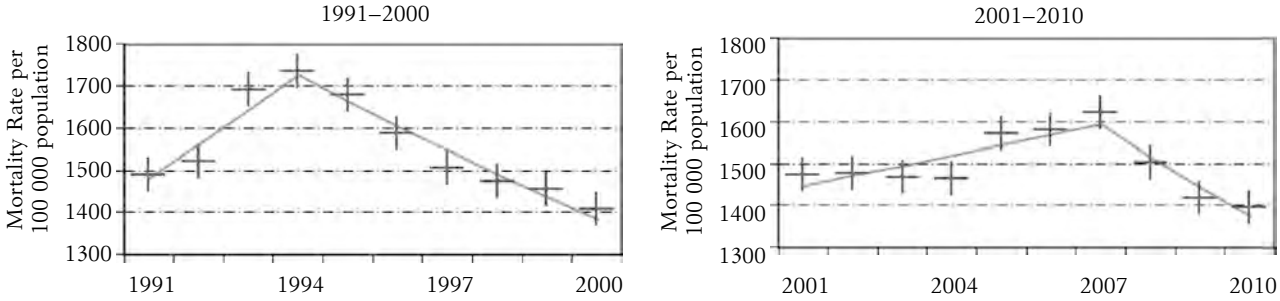

Fig. 1. Trends in overall mortality among Lithuanian males in 1991–2000 and 2001–2010

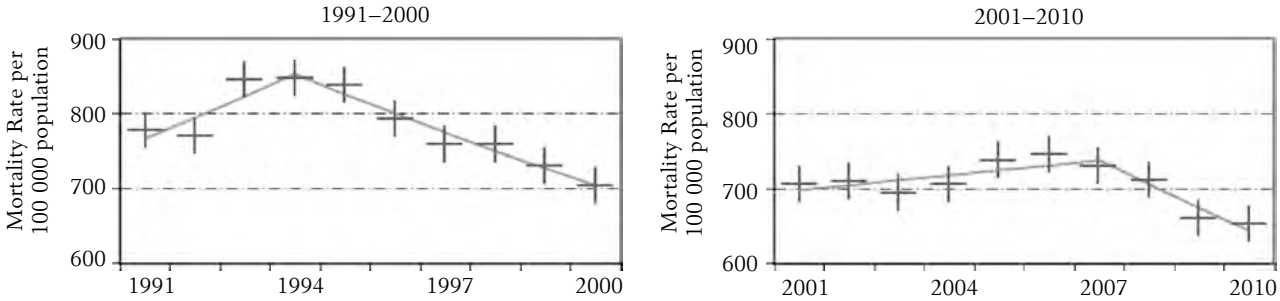

Fig. 2. Trends in overall mortality among Lithuanian females in 1991–2000 and 2001–2010

The most negative trend in overall mortality was observed in 1991–1994 for both males and females, when mortality was growing by 5.25% for males ($P<0.05$) and by 3.56% for females ($P>0.05$), while the 2007–2010 period was the most favorable in terms of overall mortality, when the most significant decline was observed (4.84% per year for males and 4.41% per year for females; $P<0.05$) (Table 1).

CVD, the most important cause of death in Lithuania, accounted for 47.0% of deaths for males and 65.6% for females in the mortality structure for 2010. The importance of CVD did not change considerably over the entire period under investigation. Cancer was the second leading cause, reaching 21.2% for males and 17.2% for females in 2010, showing a nonsignificant increase for males and females since 1991. Mortality from external causes accounted for 14.5% and 4.5%, respectively, in the mortality structure in 2010, demonstrating a decline in the proportion in comparison with 1991 (19.0% for males and 5.7% for females).

Trends in mortality from major causes were not uniform throughout the 1991–2010 period. Mortality from CVD declined statistically significantly both for males and females. During the first decade under investigation, mortality due to CVD among males declined significantly by 1.54% (Table 1). The cut point was registered in 1993 among males: a considerable increase was observed until 1993 (6.70% annually), followed by a steady and significant decrease of 2.94% during 1993–2000. In the meantime, a statistically significantly decreasing trend in female mortality from CVD was registered throughout 1995–2000. During the second decade, the cut point in CVD mortality occurred in 2007 among males and 2006 among females, when the increasing trend reversed to the declining one by 4.08% annually for males ($P>0.05$) and 3.40% for females ($P<0.05$).

For cancer, the overall trend (1991–2010) for males was slightly growing, while a significant decline was observed among females. As can be seen from Table 1, the most favorable period for females was the 2001–2010 period when an average annual decline by 0.81% was registered ($P<0.05$). The latest positive cut point was the year 2007 for males, when the growing trend reversed to the declining one, and 2008 for females, when the tendency to decline in cancer mortality became even more obvious (3.02% per year, $P>0.05$).

Mortality due to external causes declined statistically significantly throughout the entire period under investigation; however, the changes were most fluctuating in comparison with the other major causes of death. The 1991–1994 period was the most unfavorable in terms of mortality due to external causes, when the mortality rates were growing by 11.28% annually for males and 10.25% for females ($P<0.05$). In 1994–2000, a considerable average annual decline was observed. The second decade under investigation was more favorable with a statistically significant cut point in 2007 for males and 2006 for females, when mortality from external causes exhibited a statistically significant decline by 8.62% annually among males and 8.60% among females (Table 1).

The contribution of the major causes of death to the changes in overall mortality over 2 decades is presented in Table 2. It is obvious that external causes contributed most to the growing overall mortality during 1991–1994 both for males and females (37.20% and 25.29%, respectively). When overall mortality started to decrease (1994–2000), declining mortality from CVD was the main contributor to the positive change for males and females. The 2001–2007 period was controversial in terms of the contribution of major causes of death to overall mortality: a major negative influence was made by growing mortality from CVD,

Table 1. Average Annual Changes (AAC) and Joinpoint Analysis of Mortality in 1991–2000 and 2001–2010

Cause of Death	1991–2000					2001–2010				
	AAC 1991–2000	Trend 1		Trend 2		AAC 2001–2010	Trend 1		Trend 2	
		Years	AAC	Years	AAC		Years	AAC	Years	AAC
Overall mortality										
Males	–1.21	1991–1994	5.25*	1994–2000	–3.61*	–0.22	2001–2007	1.62*	2007–2010	–4.84*
Females	–1.32*	1991–1994	3.56	1994–2000	–3.15*	–5.90	2001–2007	0.93	2007–2010	–4.41*
Cardiovascular diseases										
Males	–1.54*	1991–1993	6.70*	1993–2000	–2.94*	–0.24	2001–2007	1.29	2007–2010	–4.08
Females	–1.20	1991–1995	2.00	1995–2000	–3.49*	–0.81	2001–2006	1.15	2006–2010	–3.40*
Cancer										
Males	0.25	1991–1993	2.56	1993–2000	–0.16	0.16	2001–2007	0.63	2007–2010	–1.04
Females	–0.05	1991–1993	1.95	1993–2000	–0.41	–0.81*	2001–2008	–0.41	2008–2010	–3.02
External causes										
Males	–0.60	1991–1994	11.28*	1994–2000	–4.85*	–3.04*	2001–2007	–0.79	2007–2010	–8.62*
Females	–0.15	1991–1994	10.25*	1994–2000	–3.90*	–3.04*	2001–2006	1.28	2006–2010	–8.60*

Values are percentage. *$P<0.05$.

Table 2. Contribution of the Major Causes of Death to the Changes in Overall Mortality in 1991–2000 and 2001–2010

Cause of Death	1991–2000		2001–2010	
	Trend 1 (1991–1994)	Trend 2 (1994–2000)	Trend 1 (2001–2007)	Trend 2 (2007–2010)
Cardiovascular diseases				
Males	28.89	44.49	38.12	34.44
Females	24.47	52.14	9.48	47.05
Cancer				
Males	5.90	–0.24	9.14	6.81
Females	6.51	2.20	–28.60	6.34
External causes				
Males	37.20	26.67	–13.42	25.14
Females	25.29	10.00	–11.92	16.26

Values are percentage.

while positive changes in cancer mortality slowed down the increase in overall mortality of females by 28.60%. The same was truth about external causes, which were also slowing down the overall mortality growth. Therefore, mortality from CVD could be considered as being the major challenge in terms of growing mortality in 2001–2007. Throughout the 2007–2010 period, all major causes contributed positively to the declining overall mortality of the Lithuanian population. The most significant contribution to the decline in overall mortality was made by CVD (34.44% for males and 47.05% for females) and external causes (25.14% and 16.26%, respectively).

Discussion

The social, cultural, and psychological climate characteristic of the transition period in the country and the development of health care services are important considerations for interpreting the results of this study. Major social and economic changes that occurred in 1990–1994 exacerbated social and health problems, which were inherited from the Soviet time. The lack of understanding of modern public health and, consequently, primary prevention programs before and at the beginning of the transition period most probably had some contribution to high and increasing mortality. High alcohol consumption inherited from the Soviet regime could also be considered as an important factor for the increasing mortality, particularly from external causes, during the postcommunist transition (11). The beginning of socioeconomic changes in Lithuania experienced certain specific factors, which had the potential of increasing the risk of mortality from external causes (a sudden increase in motor vehicles and consequent traffic, uncontrolled accessibility to drugs, etc.). New legislation was developed, such as speed limits, helmet requirements, and control of substance abuse and crimes, but the implementation of proper enforcement took more time. Suicide was registered as a major external cause of death for the Lithuanian population, with a considerable increase observed at the beginning of the transition period (by 6.28% annually among males in 1990–1994 and by 22.25% annually among females in 1990–1992, $P<0.05$) (5). Usually, young and middle-aged people lose their lives due to external causes. These are members of the generation, who face a tremendous societal development and the consequent social and economic instability. Therefore, it is not surprising that external causes were the major contributors for considerably increasing mortality during the initial period of socioeconomic and political changes in the country. Similar observations were reported in Poland, where death rates in the category of injuries rose most markedly (nearly by 25% among middle-aged males) in 1988–1991, while the negative health period also lasted about the first 4 years of the socioeconomic transition (12). Increasing social stress and consequent deterioration in lifestyles had negative effects to mortality from CVD, which also increased significantly (11). In the meantime, policy implementation systems established by the previous regime were distrusted resulting in some delays before being replaced with new ones, which could successfully manage the changing environment.

A substantial decline in mortality from major causes reflected the stabilization of the social and political situation since 1994, which was the beginning of overall decline in mortality. This was primarily due to a significant and steady decrease in CVD mortality. Moreover, leveling mortality due to external causes contributed to this favorable trend. In our previous studies, we reported that a decline in traffic accidents contributed most to the positive trends in external causes mortality (5).

Another positive period in terms of declining mortality started in 2006–2007. Again, mortality from CVD and external causes exhibited the most considerable decline and made the major contribution to the positive trend in overall mortality. This period coincided with most of the positive changes that appeared in the State's Alcohol Policy in 2007–

2008 (13). The implementation of strict alcohol control measures and active traffic control policy resulted in a significant decline of mortality from external causes. Our recent studies suggested that age-standardized mortality rates from alcohol-related injuries and years of potential life lost especially due to alcohol-related traffic accidents declined considerably among the 15- to 64-year-old Lithuanian population during 2006–2009 (14).

Significant improvements in mortality from CVD might be associated with positive changes in lifestyles, implementation of preventive measures, and achievements in medical technologies. According to the Finbalt Health Monitor Study, daily smoking decreased significantly among males in Lithuania in 1998–2008, with no significant changes among females. Passive smoking markedly declined in both genders over the same period. These changes could be related to the effective national tobacco control policy (15). The same study reported improvements in food habits toward healthier choices in Lithuania. Mean total cholesterol levels in blood significantly dropped for both males and females throughout the 1992–2008 period (16). The national CVD prevention measures were started in 2006; thus, further positive changes in mortality can also be expected. A shift from a health care system based on inpatient services toward the system including preventive strategies combined with being opened to new medical achievements undoubtedly has played an important role.

The stabilization in the growth of cancer mortality in the recent years might have multiple reasons. Part of the explanation may be the emphasis on preventive measures and early diagnosis. Four cancer-screening programs have been launched in Lithuania: cervical cancer (2004), prostate cancer (active since 2006), breast cancer (2006), and colon cancer (2009). Another important issue is the implementation of new effective methodologies and technologies in cancer treatment. The impact of early detection and adoption of therapeutic advancements on cancer mortality is well recorded in Central and Eastern Europe (17). Nevertheless, the long lag times for most cancer determinants should be taken into account while interpreting trends in cancer mortality.

Improvements in the health of the Lithuanian population coincided paradoxically with the economic crisis. This finding deserves particular attention; however, just limited causal insights could be obtained from the surveys based on routine statistical data. There are an increasing number of studies that analyze the response of health care systems to the economic crisis. Unfortunately, Lithuania occurred in the list of European countries with the evidence of cuts in health budgets at this point (18). When the budgets were cut, the focus has been on salaries of health workers. The process of restructuring the hospital sector through closures and mergers, and a shift toward outpatient care were more strictly enforced. These changes had no negative effect on mortality rates. Based on the experience from previous economic crises and recent mortality trends, some researchers suggest that the rates of suicides have a tendency to increase and traffic accidents to decline because of austerity (19, 20). However, we think that the decline in mortality from traffic accidents in Lithuania was mainly a result of successful alcohol control and traffic policy. At the meantime, mortality due to suicide showed a non-significant tendency to increase among males and remained stable among females. Meanwhile, an increasing number of years of potential life lost due to alcohol-related suicide were observed. This might be affected by increased psychological distress and alcohol abuse among depressed persons, which did not reflect the reduced alcohol availability (14). The countries with the well-developed systems of social protection are able to maintain long-term declines in suicides despite economic fluctuations (21). So far, Lithuania appears to be a country with gradually developing social and health care systems, which still lack the implementation of sustainable strategies. Therefore, in spite of positive changes in mortality during the recent years, evidence-based, population-wide public health actions likewise deserve attention. A major priority is to persuade all different sectors at national and community levels to commit to contribution to health of the population.

Conclusions

This study disclosed the cut points in overall mortality and mortality for the major causes of death over 2 decades of independence in Lithuania. The most critical point for overall mortality occurred in 1994, when an increasing trend reversed to a decreasing one, mainly due to the changes in mortality from cardiovascular diseases and external causes. Another positive cut point was observed in 2006–2007, when after the negative period, mortality started to decline again. The major contribution to both positive and negative changes in overall mortality was made by cardiovascular diseases and external causes. Despite the economic crisis, it is likely that Lithuania is entering into the stage of positive health development. For assuring this trend in the future, investments in sustainable health and social developments are inevitable.

Statement of Conflict of Interest

The authors state no conflict of interest.

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