

The Use of Joinpoint Regression Analysis in the Mortality Study of Developmental Age Population in the Podlaskie Voivodeship, 2003–2012

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Abstract. The youngest population in society is recognized as that at the healthiest stage of life but is burdened by the occurrence of premature death that should be avoidable. There is a need to use adequate statistical methods in assessing the health status of the population of developmental age. The aim of the study was to analyze trends of mortality in children and adolescents by age and gender in the Podlaskie Voivodeship in the years 2003–2012 by joinpoint regression and to identify the causes of mortality. The mortality rate was analysed according to gender and the age groups: 0, 1–4, 5–9, 10–14 and 15–19 years in the Podlaskie Voivodeship. The data were obtained from the Central Statistical Office for the period 2003–2012. Differences in mortality levels between age and gender subgroups were obtained by the Wilcoxon signed-rank test. Joinpoint regression was used to analyze the trends in mortality. The nomenclature of ICD-10 was used to assess the causes of mortality of children and adolescents. In the Podlaskie Voivodeship in the years 2003–2012 in the 0–19-year-old age group, the highest proportion of deaths (42.4%) occurred during the first year of life. There were differences in mortality rates between boys ($8.0/10^4$) and girls ($3.1/10^4$) in the 15–19-year-old age group ($p < 0.01$), and also between the 1–14-year-old and 15–19-year-old age groups ($p < 0.01$), both among boys ($2.1/10^4$ vs. $8.0/10^4$) and girls ($1.5/10^4$ vs. $3.1/10^4$). Monotonous trends were shown regarding total mortality rates in infants. There was a drop in the mortality rate of infant girls ($AAPC = 5.3\%$, $p < 0.05$) and boys ($AAPC = 4.7\%$, $p < 0.05$). Changes in the direction of the total mortality rate trend were visible in the population of boys aged 1–14 years, in which, between 2003 and 2010, a significant reduction in mortality ($AAPC = 9.5\%$) was observed, while in the years 2010–2012 the trend was not significant. No statistical evidence was found that mortality changed among girls in the 1–14-year-old and 15–19-year-old age groups. Deaths in infancy were due to perinatal conditions and congenital malformations. The main causes of mortality in the 1–19-year-old age group were external causes, mainly traffic accidents and intentional self-harm. Joinpoint regression indicated a uniform decrease of mortality in the years 2003–2012 except

for boys from 1–14 years old, for whom the decreasing trend was for the years 2003–2010 with subsequent stabilization. The main problems are still infant deaths due to perinatal conditions, traffic accidents and intentional self-harm in boys in the 15–19-year-old age group.

Introduction

The systematic assessment of the health needs of children and adolescents are necessary to determine what the changes occurring in the health of this population are. Changes in the infant mortality rate that have occurred in Poland are the result of the improved socio-economic conditions after the change of the political system (Zatoński et al., 2006). During the years between 1990 and 2011, the infant mortality rate has significantly decreased from 15.95 to 4.73/1000 live births. Despite this improvement, the infant mortality rate in Poland is higher compared to the highly developed Nordic countries such as Finland (2.37) and Norway (2.32) (WHO, 2014). The OECD report also shows an unfavorable picture of the health of children and youth in Poland. A high mortality rate occurred in the population of boys aged 0–19 (73/100.000), while in Luxembourg and Iceland, these values were twice lower (respectively 34 and 38) (OECD, 2009).

Differences in the mortality rates of children and adolescents are visible among countries, as well as in the population at the local level (Lozano et al., 2012; Wojtyniak et al., 2012). Health inequalities can be studied according to gender, age, socio-economic status or ethnic group (CSDH, 2008). The International Statistical Classification of Diseases and Related Health Problems (ICD-10) helps comparisons to be made between epidemiological data describing the differences in health status within a given population (WHO, 2010). A thorough assessment of health status is the foundation of preventive measures and benefits from interventions in social and health policy (Zieliński, 2010).

These measures are particularly important in the case of the youngest population, whose health status has a significant impact on the long-term effects on the development of social capital and economic development (World Bank, 2007). The concentration of this type of action is crucial to the success of many public health programs. Although the age from 0 to 19 years is considered to be the healthiest stage of life, there is still a significant risk of avoidable premature death (Patton et al., 2009; Sawyer et al., 2012). Therefore, there is a need for the use of adequate statistical methods in assessing the health status of children and adolescents, taking into account the rate of change, as well as the causes of mortality according to the in-

ternational nomenclature, which justifies the aim of the present study. In particular, interpretation of methods that allow for the possibility of trend change, like joinpoint regression, is required. The aim of the study was to identify the causes and analyze trends of mortality in children and adolescents by age and gender in the Podlaskie Voivodeship in the years 2003–2012 using joinpoint regression.

Material and Methods

The study analyzed the epidemiological situation regarding mortality rates in children aged 0, 1–4, 5–9, 10–14 and 15–19 years old, according to gender, in the Podlaskie Voivodeship from 2003–2012. The information used for the study was obtained from the Central Statistical Office.

The number and the percentage of deaths for each disease entity was presented according to age and gender. Then, the causes of partial mortality rates, according to the nomenclature of ICD-10, were calculated (WHO, 2010). The analysis included the following disease entities: infectious and parasitic diseases (A00-B99), neoplasms (C00-C97, D00-D48), diseases of the blood and blood-forming organs (D50-D89), endocrine disorders (E00-E88.9) diseases of the nervous system (G00-G98), diseases of the circulatory system (I00-I99), diseases of the respiratory system (J00-J99), diseases of the digestive/alimentary system (K00-K92), diseases of the bone – joint system (M00-M99), diseases of the genitourinary system (N00-N98.9), perinatal conditions (P00-P96), congenital malformations (Q00-Q99), symptoms, signs and abnormal clinical and laboratory findings (R00-R99) and external causes (V01-Y89), including transport accidents (V01-V99), accidental drowning and submersion (W65-W74), intentional self-harm (X60-X84).

The infant mortality rate expressed the total number of deaths in the first year of life attributable per 1,000 live births, while overall mortality rates in different age groups of 1–19 years were expressed by the number of deaths in the age group in relation to the number of people in the population of a given age group per 10,000. Due to the similar mortality rates in the 1–4, 5–9 and 10–14-year-old age groups, which were confirmed by Mazur et al. (2010) the mortality rate for these age groups was calculated together in the age group 1–14 years. Disparities between the level of overall mortality, particular age subgroups and the population of boys and girls at a particular age from 2003–2012 were evaluated. Comparisons were made using the non-parametric Wilcoxon test for related samples. The calculations were performed with IBM® SPSS® Statistics 20.0.

Changes in mortality rates over time were examined by estimating the average annual percentage change (AAPC), using Kim's method (Kim et al., 2000) according to the equation:

$$AAPC = (e^{b_1} - 1) \times 100\%,$$

where b_1 is the parameter estimate in the regression model formulated as

$$\log(MI) = b_0 + b_1y + \varepsilon,$$

where MI (mortality index) is a suitable mortality index: Infant mortality rate per 1000 live births or total mortality per 10.000 population, and y is a calendar year.

Analyses were carried out using Joinpoint Regression Program 4.0.4 – 2013, which allows for modeling a discontinuous relationship, where a previously described model is fitted in time intervals, while the number of these intervals and their location is automatically determined by used software.

The average annual percentage changes for particular mortality rates were described with the 95% confidence interval. Statistical hypotheses were verified at the significance level $\alpha = 0.05$.

Results

In the years 2003–2012 in the 0–19-year-old age group in the Podlaskie Voivodeship, there were 1,426 deaths that mostly occurred among boys (61.9%, 882 deaths) rather than girls (38.1%, 544 deaths). Taking age groups into consideration, the highest percentage of deaths occurred during the first year of life in girls – 49.5% (269 deaths) and boys – 38.0% (335 deaths). The burden of mortality in the age group of 1–14 years was relatively lower compared to infants and the 15–19-year-old age group. In the population of children from 1–14 years, the percentage of deaths among girls was 26.1% (142 deaths) vs. boys 22.0% (194 deaths). In the 15–19-year-old age group, there was a significantly higher proportion of deaths among boys – 40.0% (353 deaths) than girls – 24.4% (133 deaths).

In the years 2003–2012, the median value of the total infant mortality rate and the ratio of total deaths in the age range of 1–14 years were higher among boys than girls, and did not differ significantly ($p = 0.139$). However, in the 15–19-year-old age group, the overall mortality rates were significantly higher among boys than girls. Also, in the 15–19-year-old age group, the burden of overall mortality was higher than in the younger 1–14-year-old age group, in both sexes. The highest median value of the total mortality

Table 1. Median of the overall mortality rate among children and adolescents by age and sex in the Podlaskie Voivodeship in the years 2003–2012

Age group in years	boys	girls	<i>p</i> ***
0*	5.5	5.2	0.139
1–14**	2.1	1.5	0.139
15–19**	8.0	3.1	0.005

Gender	1–14 years	15–19 years	<i>p</i> ***
boys**	2.1	8.0	0.005
girls**	1.5	3.1	0.007

* rate per 1,000 live births; ** rate per 10,000 population; *** Wilcoxon signed-rank test

Table 2. Trends in overall mortality rates in the age range of 0–19 years, by age and gender in the Podlaskie Voivodeship from 2003–2012

	years	<i>AAPC</i> (95% <i>CI</i>)
Infant mortality rate		
boys	2003–2012	-4.7* (-7.9, -1.4)
girls	2003–2012	-5.3* (-10.3, -0.1)
All-cause mortality rate in the age group of 1–14 years		
boys	2003–2010	-9.5* (-16.2, -1.2)
	2010–2012	10.4 (-40.4, 104.4)
girls	2003–2012	-4.9 (-13.2, 4.1)
All-cause mortality rate in the age group of 15–19 years		
boys	2003–2012	-0.5 (-4.8, 4.1)
girls	2003–2012	-6.5 (-15.5, 3.4)

AAPC – average annual percentage change; *CI* – confidence interval, **p* < 0.05

rate was found in the 15–19-year-old age group in the population of boys (8.0/10.000) (Table 1).

Trends in mortality rate changes within the 0–19-year-old age group in the Podlaskie Voivodeship are shown in Table 2. Joinpoint analysis showed a homogeneous decreasing infant mortality rate total in 2003–2012. There was a significant infant mortality rate decrease in the total population of girls (*AAPC* = 5.3%) and boys (*AAPC* = 4.7%). Changes in the direction of overall mortality trend were observed in boys at the age of 1–14 years. In the years 2003–2010, a significant decrease was observed in the mortality

rate of boys in the 1–14-year-old age group ($AAPC = 9.5\%$), but in the years 2010–2012 the trend was not significant. There is no evidence for significant changes in mortality rate among girls in the age group of 1–14 years and in the age group of 15–19 years in both sexes.

About half of infant deaths in the groups of boys and girls (56.5% and 53.1%) were due to perinatal conditions. The second most common cause of infant mortality in boys (31.0%) and girls (29.4%) was congenital malformations. In third place among the causes of mortality were respiratory diseases in boys (6.0%) and girls (4.1%). Subsequently, the causes of mortality were infectious and parasitic diseases, symptoms, signs and abnormal clinical and laboratory findings, external causes, and neoplasms. The main causes of mortality in the 1–14 and 15–19-year-old age groups were external causes, such as traffic accidents, intentional self-harm, immersion and drowning, and events of undetermined intent. The percentages of mortality due to external causes among boys in the 1–14 and 15–19-year-old age groups were 47.9% and 75.6% and were higher in both age groups compared to girls (respectively 35.2% and 65.4%). Neoplasms were another cause of death that occurred more frequently in the age group of 1–14 years compared to the age group of 15–19 years. Mortality rate due to neoplasms was higher in the group of girls aged 1–14 and 15–19 (20.4% and 10.5%) compared to males (respectively 14.9% and 6.8%). A high mortality rate due to congenital malformations was observed in boys and girls in the 1–14-year-old age group (11.9% and 15.5%) (Table 3).

Mortality rates in children and adolescents by cause, age and sex are shown in Table 4.

In 2012, among the causes of infant mortality, deaths due to perinatal conditions per 1,000 live births were higher in girls compared to boys (2.63 vs. 2.22). Mortality due to congenital malformations was a greater burden among boys compared to girls (1.37 vs. 0.75).

In the 1–14-year-old age group, the highest mortality rates over a population of 10,000 were recorded for overall external causes in boys (0.95), which consisted mainly of traffic accidents (0.47), intentional self-harm (0.12) and accidental drowning and submersion (0.12). The death rate due to traffic accidents in girls (0.12) constitutes a lesser burden than the mortality rate from neoplasms (0.37) and respiratory diseases (0.25). Of the external causes of death in the 15–19 year-old age group, a significantly higher mortality rate was reported due to traffic accidents for boys than for girls (3.38 vs. 0.28). A similar situation was observed in the case of intentional self-harm (respectively 2.08 vs. 0.28). Important health burdens for boys between the ages of 15 and 19 were also deaths from neoplasms and

Table 3. The causes of mortality in the age group of 0–19 years, by sex and age in the Podlaskie Voivodeship from 2003–2012

Causes of mortality in boys by age	0 years		1–14 years		15–19 years	
	n	%	n	%	n	%
infectious and parasitic diseases	10	3.0	1	0.5	1	0.3
neoplasms	6	1.8	29	14.9	24	6.8
diseases of the blood and blood-forming organs	1	0.3	1	0.5	1	0.3
endocrine disorders	1	0.3	2	1.0	3	0.8
diseases of the nervous system	4	1.2	18	9.3	18	5.1
diseases of the circulatory system	2	0.6	5	2.6	17	4.8
diseases of the respiratory system	20	6.0	17	8.8	11	3.1
diseases of the digestive/alimentary system	1	0.3	0	0.0	2	0.6
diseases of the bone – joint system	0	0.0	0	0.0	1	0.3
diseases of the genitourinary system	0	0.0	0	0.0	0	0.0
perinatal conditions	178	53.1	2	1.0	0	0.0
congenital malformations	104	31.0	23	11.9	3	0.8
symptoms, signs and abnormal clinical and laboratory findings	5	1.5	3	1.5	5	1.4
external causes	3	0.9	93	47.9	267	75.6
total	335	100.0	194	100.0	353	100.0

Causes of mortality in girls by age	0 years		1–14 years		15–19 years	
	n	%	n	%	n	%
infectious and parasitic diseases	4	1.5	6	4.2	2	1.5
neoplasms	3	1.1	29	20.4	14	10.5
diseases of the blood and blood-forming organs	0	0.0	1	0.7	0	0.0
endocrine disorders	3	1.1	1	0.7	2	1.5
diseases of the nervous system	1	0.4	11	7.7	4	3.0
diseases of the circulatory system	2	0.7	3	2.1	9	6.8
diseases of the respiratory system	11	4.1	12	8.5	3	2.3
diseases of the digestive/alimentary system	1	0.4	5	3.5	3	2.3
diseases of the bone – joint system	0	0.0	0	0.0	0	0.0
diseases of the genitourinary system	0	0.0	1	0.7	2	1.5
perinatal conditions	152	56.5	0	0.0	0	0.0
congenital malformations	79	29.4	22	15.5	5	3.8
symptoms, signs and abnormal clinical and laboratory findings	6	2.2	1	0.7	2	1.5
external causes	7	2.6	50	35.2	87	65.4
total	269	100.0	142	100.0	133	100.0

diseases of the nervous system (0.52). A high rate of mortality was found for symptoms, signs and abnormal clinical and laboratory findings (0.56) among girls.

Table 4. Mortality rates in the age group of 0–19 years, grouped according to sex and causes in the year 2012 in the Podlaskie Voivodeship

Causes of mortality by gender and age groups	boys			girls		
	0 year*	1–14 years**	15–19 years**	0 year*	1–14 years**	15–19 years**
neoplasms	–	0.59	0.52	–	0.37	–
diseases of the nervous system	0.34	0.12	0.52	–	–	–
diseases of the circulatory system	–	0.12	–	–	0.12	0.28
diseases of the respiratory system	0.17	0.24	–	–	0.25	–
perinatal conditions	2.22	–	–	2.63	–	–
congenital malformations	1.37	0.24	–	0.75	–	–
symptoms, signs and abnormal clinical and laboratory findings	0.17	0.12	0.26	0.19	–	0.56
external causes including	–	0.95	5.98	0.38	0.12	0.56
transport accidents	–	0.47	3.38	–	0.12	0.28
intentional self-harm	–	0.12	2.08	–	–	0.28
accidental drowning and submersion	–	0.12	0.26	–	–	–
others	–	0.24	0.26	0.38	–	–

* rate per 1,000 live births; ** rate per 10,000 population

In 2012, in the examined group from the Podlaskie Voivodeship, there were no deaths due to infectious and parasitic diseases, diseases of the blood and hematopoietic organs, endocrine disorders, and diseases of the digestive system, bone-joint system and genito-urinary system.

Discussion

The presented analysis of mortality rate in the age group of 0–19 years in the Podlaskie Voivodeship provided us with new data about current trends in all-cause mortality and cause-specific mortality and differences in age and gender. Our study assessed the direction and pace of changes in mortality rate with the use of joinpoint regression, which showed significant uniform decreasing trends in the mortality rates of infants of both sexes. So far, trends in mortality rates of infants have not been studied using joinpoint regression in Poland. However, the overall systematic decrease in the level of infant mortality in Poland and other countries confirms our data (OECD, 2013; Wojtyniak et al., 2012). According to estimates of the National Institute of Public Health-NIH, it is possible for the infant mortality rate in Poland to match the average level for the EU around 2015, given the current rate of decline, and the existing differences

in neonatal mortality may be reduced with effective medical care (Wojtyniak et al., 2012).

Our study reveals that in the structure of causes of mortality in the 0–19-year-old population, a substantial majority of deaths (42.4%) occurred during the first year of life, which has also been confirmed by other researchers (Viner et al., 2011). The main causes of infant death in the Podlaskie Voivodeship, as in the whole country (Szymborski, 2012), were diseases in the perinatal period, which develop during the mother's pregnancy and during the first 6 days of neonatal life, and complications due to shortened duration of pregnancy. These causes are related to the general health of women of childbearing age, low socio-economic status as well as health behaviors during pregnancy such as diet, smoking and alcohol consumption, and shortages of health care (Gaudineau, 2013; Kramer, 2003). Congenital malformations as another cause of infant death are associated with low birth weight and prematurity, having similar socio-economic and environmental conditions (Varela et al., 2009). The results, therefore, indicate the need for further improvement of infants' health in the Podlaskie Voivodeship, which is possible through the actions of social policy, health education for women of childbearing potential, and better access to health care during the prenatal period.

The joinpoint regression method allowed different dynamics of the overall mortality rate among boys in the age group of 1–14 years to be identified. During 2003–2010 a significant reduction in mortality rate was found, whereas after 2010 the changes were insignificant. Our results, as well as those published in national studies (Szymborski, 2012), indicate that the main causes of death in the 1–19-year-old age group were external causes, such as traffic accidents and intentional self-harm. A significant burden was related to traffic accidents, which in the older age group of 15–19 years accounted 46% and 20% of all deaths in this age for boys and girls, respectively.

It should be emphasized that in 2012, in the Podlaskie Voivodeship, the mortality rate from traffic accidents was significantly higher than the national average for boys in the 1–14-year-old age group ($0.47/10^4$ vs. $0.22/10^4$) and the group of 15–19-year-olds ($3.38/10^4$ vs. $1.80/10^4$). The unfavorable position of the Podlaskie Voivodeship compared to the whole country confirms the report of the National Institute of Public Health-NIH (Wojtyniak et al., 2012). In the case of traffic accidents, our research shows a considerable increase in the gender mortality rate between the 1–14 and 15–19-year-old age groups. This result is confirmed by other studies, where it has been found that higher levels of mortality among adolescents com-

pared to younger children is associated with an epidemiological transition, which is caused by global changes in the social, economic and political environment, involving a shift in mortality from infectious diseases to non-communicable causes, mainly traffic accidents. (Viner et al., 2011; World Bank, 2007). In most societies, including those in the Podlaskie Voivodeship, road accident victims are young males, which may be associated with risky behavior on the road and legal access to alcohol (Patton et al., 2012; Stepniewski et al., 2007). Mortality as a result of road accidents is related to lack of experience as a driver after receiving a license, as well as the desire to impress peers and bravado. Although deaths from road traffic accidents account for more than half of male deaths in the second decade of life, the level of mortality in many countries, including Poland, is still falling (Kułaga et al., 2009; World Bank, 2007). Factors that have contributed to this reduction are: an increased minimum age to purchase alcohol and the improvement of road safety (Patton et al., 2012). Intensification of actions aimed at primary prevention may have an effect in reducing the number of deaths due to accidents, while focusing only on treatment and skipping prevention, will bring increased rates of accidental disability (Szymborski, 2012).

Intentional self-harm is the leading cause of death after traffic accidents among adolescents aged 15–19 years, both in the Podlaskie Voivodeship and across the country (Kułaga et al., 2009). In 2012, in the Podlaskie Voivodeship, mortality due to intentional self-harm within the age range of 15–19 years was higher than the national average among boys ($2.08/10^4$ vs. $1.50/10^4$). The occurrence of mental health problems in adolescents aged 15–19 years may be associated with entering adulthood and lack of self-acceptance, which in turn can lead to depression and psychoactive substance abuse. Family pathologies and difficulties in finding a (first) job may also have a significant impact (Polewka et al., 2004). Analyses show that there is a need for preventive actions related to education in terms of coping with stress targeted to young men to be taken in the Podlaskie Voivodeship. It should be noted that both deaths due to traffic accidents as well as intentional self-harm among young people were more frequent in the European Union countries with low levels of wealth, mainly in Lithuania, Latvia and Estonia (Mazur et al., 2010; UNICEF, 2009). The Podlaskie Voivodeship, located in close proximity to these countries, also has such features, which shows the geographical similarity of risky health behaviors among adolescents. Regardless of the region of residence, a majority of deaths due to external causes should be avoided. Our research shows that during the last 10 years the population of boys was heavily laden by mortality due to exter-

nal causes. These causes accounted for 48% of all deaths in the age group of 1–14 years and 76% of all deaths in the age group of 15–19 years. In girls, the proportion of deaths due to external causes was 35% and 65%. These data indicate the need for investment in the youngest generation with particular regard to the population of boys, which requires improving the living conditions of families and that improvements also be made to conditions in the school environment and the coordination of activities within the framework of social and health policy.

Neoplasms were an important cause of mortality in the age group of 1–19 years in the Podlaskie Voivodeship. In Poland, currently, despite the progress in the diagnosis and treatment of neoplasms in children, cures are achieved in only 70–80% of cases. One of the reasons for therapeutic failures in the treatment of neoplasms in children is diagnosis in the advanced clinical stages, as well as delayed first contact with a medical oncologist, which causes the results of treatment in Poland to be worse compared to other European countries (Balcerska, 2009). It is therefore necessary to increase the awareness of parents and guardians about the importance of early arrival to the doctor and follow-up visits. The role of primary care physicians in the diagnosis of distressing symptoms should also be emphasized and activities, including targeting symptomatic examinations should be made available. There is a need to coordinate cooperation from prevention to diagnosis and treatment in order to improve the situation in the early diagnosis of cancer in the pediatric population.

Our results also indicate that in the Podlaskie Voivodeship there were health inequalities in relation to gender and age. A significantly higher mortality rate revealed between boys and girls in the age group of 15–19 years can be explained due to differences in biological and socio-cultural realities, which strongly affect protective or risky behavior. Boys are more likely to engage in risky health behaviors (recklessness on the road, a dangerous sport, fights). Differences in health behaviors between the sexes are also demonstrated by the different ways tobacco or alcohol, which pose a threat to mortality, are consumed (Johnson et al., 2009; Ostrowska, 2012). Inequalities with respect to age groups can be explained by the same factors that influence gender differences (Sawyer et al., 2012). The existence of differences in the relation to sex and age are the reasons why the health potential of the pediatric population in the Podlaskie Voivodeship is not fully exploited. It is manifested by a shorter life expectancy, higher risk of capital loss of health or limited efficiency. Experiences of the EU countries, however, show that the reduction of these factors is possible through the implementation of intervention programs targeting groups vulnerable to

poorer health (European Commission, 2010). The selection of appropriate measures aimed at reducing inequalities in health in children and adolescents in the Podlaskie Voivodeship is possible through systematic research and analysis using adequate statistical methods.

Conclusions

The presented analysis of the epidemiological situation in the Podlaskie Voivodeship showed significant differences between the overall mortality rate between boys and girls from the ages of 15–19 and between the age groups of 1–14 and 15–19 years in both sexes. Joinpoint regression analysis indicated a generally uniform improvement of the situation in the sense of decreasing mortality in the years 2003–2012. However, for the 1–14-year-old boy group there was significant change to the trend, as decrease of mortality was observed only in the years 2003–2010 with subsequent inhibition of this trend.

The main causes of infant mortality were perinatal conditions and congenital malformations, while in the age group above the first year of life, mortality was dominated by external causes. Important problems were transport accidents and intentional self-harm, particularly among boys aged 15–19, in which group the mortality rate exceeded the average nationwide level. This suggests the possibility of improving the health of children and adolescents in the Podlaskie Voivodeship through actions within social and health policy.

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