YEARS OF POTENTIAL LIFE LOST AMONG THE POPULATION: IS YPLL ANALYSIS A HELPFUL TOOL?

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Abstract: Mortality is one of the key determinants of the demographic development of the Republic of Srpska (RS). In the last 20 years, there has been an increase in the mortality rate, especially in the older population. Years of potential life lost (YPLL) were used in this study as a measure of the premature mortality of the population of the RS. The reference age limit is set at 70 years of age, therefore, premature mortality refers to all deaths in the age range from 0 to 69 years. The time frame includes a period of 20 years (1998–2018). The subject of the research is the YPLL analysis of the population of the RS, with a special emphasis on the causes of death. The study aims to determine the differences in YPLL according to gender and cause of death, as well as to indicate the factors influencing differential premature mortality. The results of the research indicate a decrease in YPLL by about 40%. Higher YPLL rates were registered in males. Differentiation according to the cause of death showed low values of YPLL in non-communicable diseases, while high rates were recorded in violent deaths. The decrease in the YPLL rate is a consequence of the reduction of infant mortality and violent deaths, while high values in males are a consequence of the influence of risk factors. Reducing these factors can have a significant impact on reducing YPLL rates among the population of the RS.

Keywords: premature mortality; years of potential life lost; the Republic of Srpska

1. Introduction

The Republic of Srpska (RS) is one of the two constituent and constitutional entities in Bosnia and Herzegovina (BiH). The total area of the country is 24,641 km² (Republic of Srpska Institute of Statistics, 2019a), which represents about 48.2% of the territory of BiH. The main characteristic of the geospace of the state is the elongation of its territory and the great indentation of its borders. According to the population estimate for 2018, there are 1,147,902 inhabitants (Republic of Srpska Institute of Statistics, 2019b).

In the RS, as in the rest of Europe, there is a biological model of mortality related to the age of the population. One of the reasons for the increasing mortality rates in RS is the growth of the older population. This process is especially pronounced in less developed areas and municipalities along the inter-entity line. The process of emigration of fertile and working-age population in larger cities, regional centers, and the countries of the European Union (EU) is

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present in these areas. It leads to a surplus population in the oldest age groups, which directly affects the increase in the overall mortality rate. Mortality trends in the RS indicate an increasing proportion of elderly deaths and a decrease in the mortality rate of the younger population, especially infants. These processes have caused a significant increase in the life expectancy of the country's population over the last two decades.

In the period 1996–2018, the absolute number of deaths in the country increased from 10,931 to 14,763, which was an increase in mortality by 3,832 inhabitants or 35.1%. The highest mortality was registered in 2015, when 15,059 deaths were recorded. Along with the increase in total mortality, the crude mortality rate in the RS shows a tendency of successive growth. Compared to the average of the EU (EU-28), in which the mortality rate in 2018 was at the level of 10.3‰ (Eurostat, 2022), the mortality rate of the population in the RS was higher. According to the data of the Republic Bureau of Statistics for 2018, the crude mortality rate of the population of RS was 12.9‰ (Republic of Srpska Institute of Statistics, 2019b).

Years of potential life lost (YPLL) is a widely used measure of the distribution of premature mortality. This concept includes an estimate of the average time a person would have lived if they had not died prematurely (Gardner & Sanborn, 1990). Given that longer life expectancy in women and higher male mortality in the middle-aged population, YPLL is usually higher in men (Šemerl & Šesok, 2002; Wong et al., 2006). Also, most premature deaths can be attributed to the impact of socioeconomic inequalities (Lewer et al., 2020).

Depending on the needs and goals of the research, several approaches are calculated to estimate the YPLL. Some authors (Arcà et al., 1988; McDonnell et al., 1998) set the upper age limit at 65 years of age, while others (Athens et al., 2013; Mansfield et al., 1999) take the age limit as 75 years. The Organization for Economic Co-operation and Development (2022) and Eurostat (2021) sets the upper age limit at 70.

By setting a lower age limit for mortality, violent causes of death and cancers gain more weight compared to cardiovascular diseases (Marinković, 2012). In this study, the reference age limit was set at 70 years of age, therefore, premature mortality refers to all deaths in the age range from 0 to 69 years.

The subject of the research is the YPLL analysis of the population of the RS, with a special emphasis on the causes of death. The aim of the study is to determine the differences in YPLL according to gender and cause of death, as well as to indicate the factors influencing differential premature mortality.

This study was conducted based on available statistical data. Most of the research include the time interval from 1998 to 2018, JPL analysis by cause of death includes the period 2006–2018, while YPLL rates include the period from 2012 to 2018. YPLL, average years of life lost, and YPLL rate are calculated on the basis of data from the Republic of Srpska Institute of Statistics (2007, 2009, 2014, 2019a) and the Public Health Institute of the Republic of Srpska (2020).

2. Premature mortality among population of the RS

2.1. Years of potential life lost

In 2018, the population of the RS potentially lost 48,358 years of life due to premature mortality. Compared to 1998, there was a decrease in the potential lost years of 39.1%. The reduction of premature mortality was a consequence of prolonging life expectancy, increasing mortality in old age, and declining mortality in the contingent of young and mature

population. This is supported by the fact that in the period 1998–2018, a decrease in absolute mortality was recorded in all five-year cohorts up to the age of 69.

The analysis of mortality difference by gender indicates a higher mortality of men up to 70 years of age. According to the data for 2018, YPLL for men were 2.2 times higher than for the female population. In the last two decades, there has been a trend of decreasing premature mortality in both genders. In the period 1998–2018, a decrease in YPLL was registered for men from 53,138 to 33,235, while in the same period, a decrease from 26,215 to 15,123 potentially lost years was recorded for women (Figure 1).
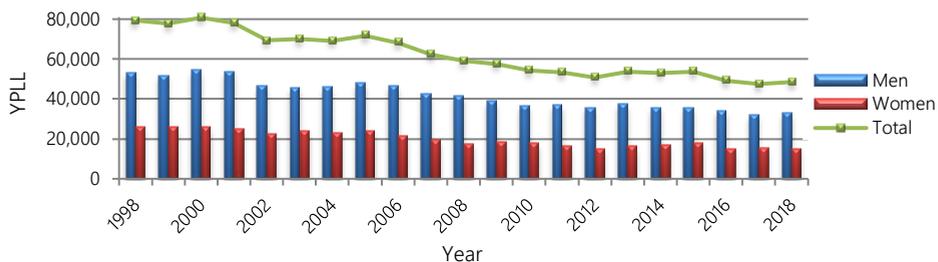

Figure 1. Years of potential life lost in the RS according to gender (1998–2018).

2.2. Average years of life lost

Average years of life lost are an analytical indicator that represents the average loss in years for each deceased person in a certain age contingent (in this case from 0 to 69 years). It is calculated as the quotient of the average lost years of life in the number of deaths up to the upper limit of the age contingent. This indicator suggests a probable shortening of the life expectancy of a certain person, expressed in years.

According to the data for 2018, the average resident of the country lost 10.9 years of life due to premature mortality. The structure by gender in 2018 indicated balanced values for men and women. Men lost an average of 11 years, while each woman lost 10.5 years due to premature mortality. In the period 1998–2018, there was a decrease in premature mortality in both genders. High values of this indicator were registered in the period 1998–2013, when the population of the RS lost an average of 12.6 years of life due to premature mortality. During this period, higher losses of males were recorded in relation to the female population (Figure 2).
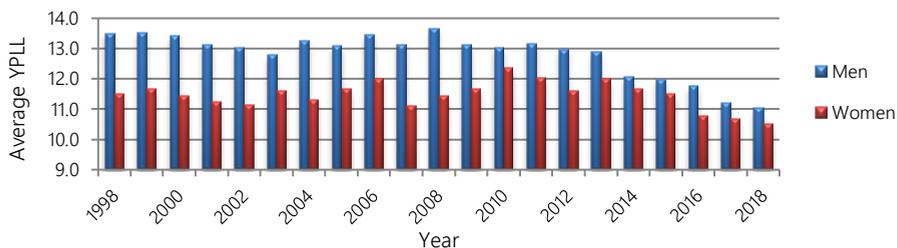

Figure 2. Average years of potential life lost in the RS according to gender (1998–2018).

2.3. YPLL rate

YPLL rate is the quotient of the average lost years of life and the number of inhabitants up to the upper age limit (in this case 0–69). The value of this indicator can be expressed per 1,000 or per 100,000 inhabitants, as will be the case in this analysis. Given that official data related to the age structure of the population of the RS are available from 2012, the analysis of this indicator will refer to the period 2012–2018. In the analyzed period, there is a slight decrease trend in the rate (from 4,909/100,000 to 4,824/100,000). In 2018, a higher YPLL rate was observed for males (6,619/100,000), while on the other hand, the value of this indicator for women was at the level of 3,023/100,000 (Figure 3). Higher rates in males were a consequence of higher mortality from violent causes and mortality associated with risk factors.
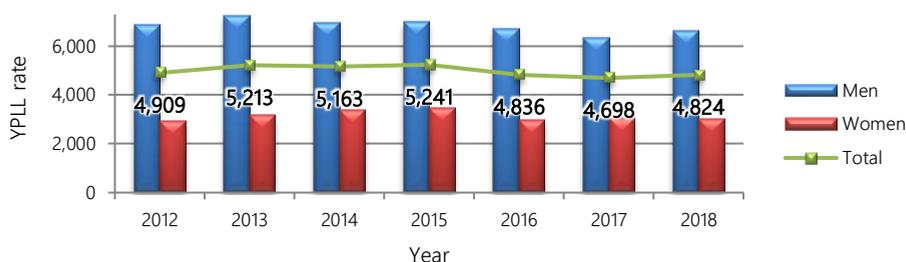

Figure 3. YPLL rate in the RS according to gender (2012–2018).

The highest rates of YPLL in the EU in 2018 were in the countries of Eastern and Southeastern Europe (Eurostat, 2021) referring to the standardized population up to 70 years of age. The highest value of this indicator was registered in Latvia (7,236/100,000), Lithuania (6,547/100,000), Romania (6,401/100,000), and Bulgaria (6,309/100,000) (Figure 4). The high values of this indicator in these countries are a consequence of modern mortality associated with risk factors, especially in the male population.
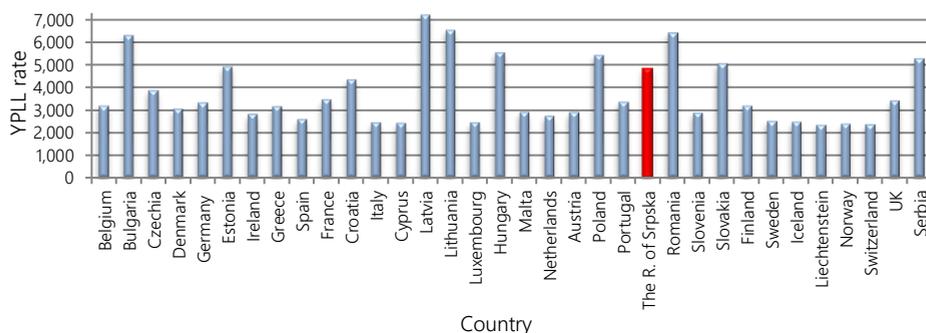

Figure 4. YPLL rate in the RS and the other European countries.
Note. The data in the charts are calculated based on *Causes of death - potential years of life lost by residence*, by Eurostat, 2021 (http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=hlth_cd_apyll&lang=en).

3. Premature mortality in line with the cause of death among the population of the RS

3.1. Years of potential life lost

The differentiation of mortality according to the cause of death indicates a large share of diseases of the circulatory system (I00-I99) in the total mortality of the RS. According to the data for 2018, 6,989 people or 47.3% died from this disease, followed by Neoplasms (C00-D48) with 19.9%, and Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified (R00-R99) which make up 11.2% of the country's mortality (Majić & Marinković, 2021).

The analysis of premature mortality according to the cause of death indicates significant differences in relation to differential mortality according to this criterion. Although almost half of the deaths were related to diseases of the circulatory system (I00-I99), these diseases were responsible for one quarter (25%) of premature mortality in 2018. The absence of a higher share of diseases of the heart and circulatory system was a consequence of higher mortality from this cause in older population. The highest percentage of premature mortality in 2018 was related to Neoplasms (C00-D48). This disease was responsible for 28.4% of potentially lost years of life. The third cause of premature mortality in the RS were symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified (R00-R99), which had a share of 14.3% in 2018. The greatest difference between mortality according to the cause

Figure 5. Distribution of YPLL in the RS according to cause of death, in percent (2018).

of death and premature mortality was observed in injuries, poisoning, and consequences of external causes (S00-T98). According to data for 2018, this cause accounted for only 3.3% of the country's mortality, while in the YPLL structure it was responsible for 13.6% of deaths (Figure 5). The high share of this cause in premature mortality was a consequence of violent deaths, in mature and younger mature population in which accidents and suicides dominated.
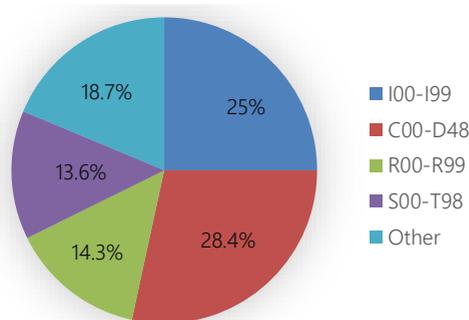
3.2. Average years of life lost

Due to premature mortality of the population up to the age of 70, the life expectancy in the RS was shortened by 10.9 years in 2018. The largest shortening of life expectancy was recorded in other causes of death, which were responsible for reducing life expectancy by 21.1 years. It is important to note that this cause of death accounted for a small percentage of total mortality. In 2018, other causes of death accounted for 2% of the mortality of the population under the age of 70 and 1.2% of the total mortality in the RS. The high values of the average years of life lost were a consequence of the mortality of the youngest age cohort (0–4), and especially the mortality of children up to one year of age. High average years of life lost was associated with certain conditions originating in perinatal period (P00-P96) that mostly reflected neonatal mortality.

Injuries, poisoning, and consequences of external causes (S00-T98) in 2018 were responsible for shortening of life expectancy by 20.8 years. Over 90% of deaths from this cause were related to violent deaths. In the structure of violent deaths, murders had the greatest impact on shortening of life expectancy, due to which life expectancy was shortened by 29 years in 2018. As a result of accidents, the life expectancy of the observed age contingent was shortened by 24.4 years, while suicides affected the shortening of life expectancy by 16.8 years.

High values of average years of life lost were registered for the diseases of the nervous system and sense organs (G00-H95), due to which life expectancy was shortened by 14.5 years, symptoms signs and abnormal clinical and laboratory findings, not elsewhere classified (R00-R99) that affected the reduction of life expectancy for 12.3 years, as well as infectious and infectious and parasitic diseases (A00-B99) due to which life expectancy was shortened by 10.9 years.

Although over three quarters deaths in the RS were related to chronic non-communicable diseases, these causes of death had the least impact on shortening the life expectancy of the population under 70 years. Diseases of the circulatory system (I00-I99) affected the shortening of life expectancy by 9.2 years, while mortality caused by neoplasms (C00-D48) affected the shortening of life expectancy in the RS by 9.5 years in 2018.
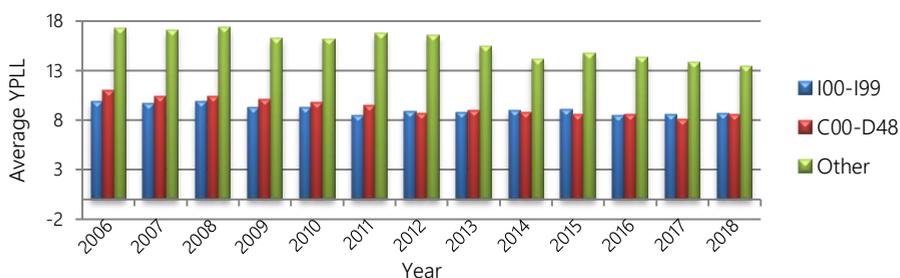

Figure 6. Average years of life lost in the RS according to cause of death (2006–2018).

The analysis of premature mortality in the period 2006–2018 suggested a decrease in the average years of life lost. Diseases of the circulatory system (I00-I99) remained at the same level, while a greater reduction was registered in neoplasms (from 11.3 to 9.5 years). The largest reduction in average lost years was registered for other causes. In 2006, mortality from these diseases affected the shortening of life by 17.3 years, while in 2018 this cause had the effect of shortening life expectancy by 13.4 years (Figure 6). This increase in life expectancy was primarily a consequence of the reduction in infants and the youngest population mortality. In addition to reducing infant mortality, the overall reduction in average years of life lost had a major impact on reducing violent mortality, improving health conditions, screening and early detection of malignancies, and advances in cardiac surgery.

3.3. YPLL rate

YPLL rate according to the cause of death had a distinctly differential character, given the large differences between some diseases. The highest number of lost years of the population up to the age of 70 in 2018 was recorded in neoplasms (1,369/100,000 inhabitants). Diseases of the circulatory system register a rate of 1208 years lost per 100,000 inhabitants, followed by symptoms signs and abnormal clinical and laboratory findings, not elsewhere classified

(688/100,000), injuries, poisoning, and consequences of external causes (658/100,000), symptoms signs and abnormal clinical and laboratory findings, not elsewhere classified (688/100,000), and diseases of the digestive system (K00-K92), which were responsible for 194 potentially lost years per 100,000 inhabitants in the country.

The impact of the COVID-19 pandemic significantly affected the mortality of the population of the RS. According to the data of the Republic of Srpska Institute of Statistics (2021), 16,582 people died in the RS in 2020, which was 1,819 or 12.3% more than in 2018. However, this increase in total mortality did not significantly affect the premature mortality. According to the data for 2020, YPLL in a country was at the level of 50,580, which was 4.6% more than in 2018. YPLL in men was 35,050 in 2020, while in the female population a minimal increase was registered so that the value of YPLL was at the level of 15,530 years. Compared to 2018, a lower value of average years of life lost was recorded in 2020, when every resident of a state lost 10.4 years due to premature mortality, which was 0.5 years less than in 2018.

The rate of YPLL in 2020 did not show significant deviations compared to 2018. The total rate of YPLL was 5,143—for men it was 7,078, while for females it was at the level of 3,180 deaths per 100,000 inhabitants.

The low impact of the COVID-19 pandemic on premature mortality could be explained by the fact that the majority of deaths were due to the pandemic in the category of the elderly population. A large increase in mortality in 2020 was recorded in the male population over the age of 50, as well as in infants, whose mortality increased twice as much as in 2018.

4. Conclusion

Analysis of premature mortality is one of the basic indicators of mortality, especially among the working-age population. In this context, YPLL is an indispensable measure for the analysis of mortality associated with risk factors and violent deaths.

The results of the research indicate a decrease in YPLL in the RS over the last 20 years. This decrease is a consequence of the reduction of the infant mortality rate, as well as the decrease of the violent deaths. These two determinants had the greatest impact on increasing the life expectancy of the population of the country. In the period 1998–2018, life expectancy at birth increased by 4.6 years (from 72.6 to 77.2 years). The differential rate of YPLL according to gender indicates higher male mortality, which is a consequence of higher mortality caused by violent deaths and mortality associated with risk behavioral factors.

Reducing premature mortality in the RS can be achieved by improving primary prevention. Special attention should be paid to reducing exposure to risk factors such as high blood pressure, high cholesterol, high blood glucose, obesity, physical inactivity, tobacco use, alcohol consummation, and unhealthy diet. Media campaigns and raising awareness about the negative consequences of risk factors can play an important role in reducing premature mortality. One of the key factors in premature mortality is the reduction of violent mortality. Reducing mortality from traffic accidents, work-related injuries, and homicide rate can be achieved through stricter penalties and regulations. Finally, one of the key determinants in reducing the YPLL rate is advances in screening and early detection of malignancies, as well as advances in cardiac surgery.

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