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ASSESSING PREMATURE MORTALITY IN SERBIA: INSIGHTS FROM THE MEDIAN AGE OF YEARS OF LIFE LOST

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Abstract: Premature mortality, defined as death occurring before a predetermined chronological age, is a significant public health challenge in Serbia, compounded by an aging population, high rates of non-communicable diseases, and healthcare system challenges. This study introduces a novel indicator, the Median Age of Years of Life Lost (MeAYPLL), to assess the age distribution of premature mortality in Serbia and selected European Union (EU) countries during the pre-pandemic period (2000-2019). The findings reveal that Serbia is among the European countries with the highest rates of premature mortality, similar to other former socialist countries. However, the age distribution of premature deaths varies considerably across countries, influenced by factors such as the cause of death and population age structure. The results show that Serbia, in the period between 2017 and 2019, lost 539,591.3 years of potential life annually with Serbian MeAYPLL being 57.62 years in this period. The study underscores the importance of considering multiple dimensions of premature mortality, including its intensity, age structure, and geographical variations, for designing effective public health interventions. It also highlights the limitations of the MeAYPLL indicator, recommending its use in conjunction with other measures of premature mortality intensity for a comprehensive assessment.

Keywords: YPLL, YLL, deaths, public health, health indicators in Europe

Sažetak: Prevremena smrtnost, definisana kao smrt koja je nastupila pre unapred određenog hronološkog doba, predstavlja značajan izazov za javno zdravlje u Srbiji, poduprt starenjem stanovništva, visokim stopama nezaraznih bolesti i izazovima zdravstvenog sistema. Ova studija uvodi novi indikator, medijalnu starost godina izgubljenog života (MeAYPLL), za procenu starosne distribucije preranog mortaliteta u Srbiji i odabranim zemljama Evropske unije (EU) u periodu pre pandemije (2000-2019). Nalazi otkrivaju da je Srbija među evropskim zemljama sa najvišim stopama prerane smrtnosti, slično kao i u drugim bivšim socijalističkim zemljama. Rezultati studije pokazuju da je Srbija, u periodu između 2017. i 2019. godine (tri godine pre pandemije), gubila 539.591,3 godina potencijalnog života godišnje uz MeAYPLL od 57,62 godine. Međutim, starosna distribucija preranih smrti značajno varira od zemlje do zemlje, pod uticajem faktora kao što su uzrok smrti i starosna struktura stanovništva. Studija naglašava važnost razmatranja više dimenzija preranog mortaliteta, uključujući njegov intenzitet, starosnu strukturu i geografske varijacije, za for-

mulisanje efikasnih intervencija javnog zdravlja. Takođe naglašava ograničenja indikatora MeAYPLL, preporučujući njegovu upotrebu u kombinaciji sa drugim merama intenziteta preranog mortaliteta radi sveobuhvatne procene.

Ključne reči: YPLL, YLL, smrti, javno zdravlje, indikatori zdravlja u Evropi

INTRODUCTION

Premature mortality, a poignant reflection of lives cut short, serves as an important metric in demography and public health, offering insights into the broader implications of societal health, medical intervention efficacy, and overall quality of life. While mortality rates offer a snapshot of a population's health, premature mortality digs deeper, painting a vivid picture of the societal, familial, and economic implications of lives lost before their anticipated time. This concept, though universally understood, finds its roots in an evolving set of indicators and methodologies. In this paper, I underscore the necessity of continual refinement in our approach to gauging the true impact of premature deaths on a society.

Premature mortality broadly refers to deaths that occur earlier than expected based on various criteria. More specifically, it denotes deaths occurring before the expected timeframe based on chronological age. In this paper, I focus on this specific, narrower definition of premature mortality.

Serbia is faced with a significant mortality problem (Galjak, 2014, 2018b), and in particular, with the problem of premature mortality (Galjak, 2022a; Marinkovic, 2021), losing over half a million of potential years of life every year (Galjak, 2022b). This problem is further exacerbated by a combination of factors, including an aging population (Devedžić & Stojilković Gnjatović, 2015; Magdalenic & Galjak, 2016), high rates of non-communicable diseases such as cardiovascular diseases and cancer (Milić et al., 2021), and challenges related to the health care system and public health expenditures (Galjak, 2014, 2018b; Rašević & Galjak, 2022).

Given this context, it is important to have accurate and meaningful indicators to assess the magnitude and distribution of premature mortality in Serbia, to identify vulnerable populations and prioritize public health interventions. The existing indicators, while useful, have limitations that may not fully capture the complexities of the issue. This study aims to address this gap by introducing a novel indicator, the Median Age of Years of Life Lost (MeAYPLL), and applying it to the Serbian context to provide a more nuanced and comprehensive understanding of premature mortality in the country. This will not only help to better understand the current situation but will also provide a valuable tool for policymakers and public health professionals to design and implement more effective interventions to address this pressing issue.

Maximova et al. (2016) state that the "years of life lost" indicator was first introduced to classify causes of death in the USA (Dickinson & Welker, 1948). American statistician Mary Dempsey from the "National Tuberculosis Association" devised this metric (Dempsey, 1947). Its primary objective was to measure the societal burden of tuberculosis in comparison to other causes of death. It aimed to guide the allocation of limited resources, highlighting the need to prioritize public health efforts toward tuberculosis control. Notably, during that era, tuberculosis was largely suppressed, yet it persisted among certain population subgroups (Thacker et al., 2006). Dempsey's use of the indicator hinged on a reference age of 65 years (Dempsey, 1947). As life expectancy rose over time, this reference age was adjusted upward. One significant merit of this indicator is its emphasis on the deaths of the youngest individuals. For instance, the death of a newborn equates to 65 potential years of life lost, while the death of a one-year-old represents 64 years. However, deaths beyond the age of 65 were not accounted for in this metric (Bonneux, 2002). While the indicator has its limitations, it aptly mirrors the societal, familial, and economic burdens arising from premature deaths (Yuen et al., 1997). Historian Robert Lee of the University of Liverpool posits that a more informed understanding of premature death often paved the way for formal state interventions (Lee, 2009).

Since 1996, the starting point of the Web of Science database, up until the end of 2021, a substantial 2,992 papers have incorporated indicators of premature mortality. Among these, 14 of the most cited specifically address the global burden of disease, gauged through the DALY indicator (Fitzmaurice et al., 2015, 2017; Forouzanfar et al., 2015; Lim et al., 2012; Lozano et al., 2012; Murray et al., 2012; Murray & Lopez, 1997; Naghavi et al., 2017; Ng et al., 2014; Roth et al., 2018; Vos et al., 2012, 2016; Wang et al., 2016; Whiteford et al., 2013). Intriguingly, only 15 papers (a mere 0.5% of the total) originate from the realm of demography. This skewed distribution suggests that the discourse around premature mortality is dominantly anchored in public health and medicine rather than demography. While this trend aligns with expectations, an insightful observation by demographer Alyson van Raalte (2021) sheds light on the blurring lines between disciplines. In her review paper, Raalte notes a conspicuous absence of demography-exclusive perspectives in mortality research, underscoring the increasingly porous boundaries among academic disciplines. Ivan Marinković (2021) published a monograph entitled Demographic analysis of the impact of health care and public health on mortality trends in the population of Serbia, which is an extension of the analysis from his doctoral dissertation (Marinković, 2016). In that monograph, the author deals directly with premature mortality.

Undoubtedly, age is the most pivotal aspect of mortality, grounded in the fundamental reality that the process of aging inherently escalates the probability of death, barring early childhood mortality. Consequently, when comparing two societies identical in all respects except population age, the one with an older demographic will invariably record a higher annual death rate. This correlation underscores the reliance of demography and epidemiology on summary indicators like life expectancy or standardized mortality rates, which factor in age distribution. The mortality curve, derived from specific mortality rates, encapsulates the age-dependent mortality model and offers profound insights into a society's mortality landscape.

Typically, demographers categorize age into five-year intervals, with the exception of the first category (0 to 1 year) and the final open-ended category (e.g., 85+). The former is singled out due to the historically elevated mortality rates associated with this age bracket. As life expectancy has risen, the age threshold for the open-ended category has concurrently shifted upwards.

Age is not merely a crucial element in delineating premature mortality but also instrumental in analyzing the age distribution of deaths among individuals below the reference age. Despite identical levels of premature mortality, two regions may exhibit disparate age distributions of premature deaths.

This paper aims to dissect the age distribution of premature mortality, an important yet underexplored dimension that shapes the overall narrative of premature deaths. We will introduce a novel indicator, the Median Age of Years of Life Lost (M_eAYPLL), detail its calculation and subsequently applying it to Serbia and select European Union (EU) countries. This endeavor involves an examination of the implications of M_eAYPLL in the context of Serbia and the EU. By juxtaposing Serbia with selected EU countries, we aim to evaluate how Serbia compares in terms of this indicator, shedding light on the relative severity of premature mortality in Serbia and its standing in the broader European context. Additionally, this study aspires to contribute to the existing body of knowledge by offering a fresh perspective on premature mortality, enriched by the incorporation of the M_eAYPLL indicator.

METHODOLOGY

The analysis in this paper covers Serbia without Kosovo, and 35 other countries mostly members of the European Union (EU). The timeframe for analysis is the immediate pracademic three-year period from 2017 to 2019 when closely examining Serbia, and longer period from 2000 to 2019, when comparing Serbia to the EU countries. The pandemic period was specifically selected for analysis due to the COVID-19 pandemic's drastic alteration of

the mortality landscape in Europe. However, a detailed examination of this period's impact is beyond the scope of this study.

Multiple data sources were utilized for this study. The primary data, which includes mortality details such as sex, age, cause of death, and municipality, were sourced through specialized processing of vital statistics from the Statistical Office of the Republic of Serbia (Republički zavod za statistiku, 2021b). Additionally, the estimated population data, categorized by sex, age, and municipality, were retrieved from the "opendata" portal of the Statistical Office of the Republic of Serbia (Republički zavod za statistiku, 2021a). In instances where domestic statistics were insufficient for calculating complex indicators, raw data from international organizations' databases were employed. The World Health Organization (2023) database served as the most crucial foreign source, supplemented by Eurostat (2023) databases for mortality data of selected European countries.

Standardized rate of years of potential life lost, i.e. the age standardized formula for the rate of life years lost indicator introduced by Dempsey (1947) was calculated as outlined below.

$$YPPLi = \left(\sum_{i=1}^{L} \frac{((L - i) * d_i) * w_i}{P_i} \right) * 100.000$$

L – reference age

d_i – number of people who died that are i years old

P_i – the number of residents that are i years old

w_i – age weight for the standard population

Reference age of 75 years was chosen.

Median age of potential life years lost effectively bifurcates the distribution of lost years of potential life into two equal halves, signifying an age threshold at which the years lost by individuals younger than that age and those older than that age contribute equally to the overall sum of lost years of potential life. In mathematical terms, for one-year age groups, the formula can be articulated as follows:

$$M_e AYPLL = l + \frac{\frac{YPLL}{2} - \mathrm{cf}}{\mathrm{f}}$$

l – the lower limit of the median age

$YPLL$ – the total sum of lost years of potential life

cf – cumulative frequency of years of life lost for years before the median age

f – number of years of life lost for the median age

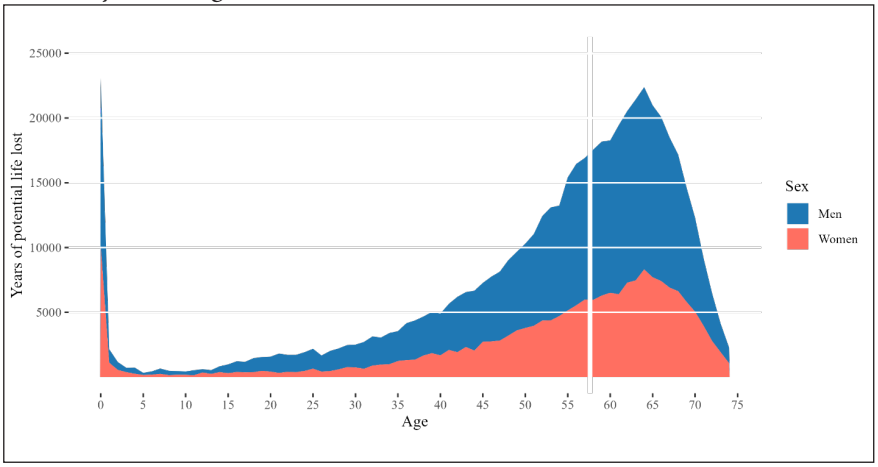
Standard European population was used for standardization.

The entire research is transparent and replicable. In this study, all calculations, data analysis, and visualizations were carried out using the R programming language. The complete code with data is publicly available in the repository: https://osf.io/gx7e3. To replicate the analysis, it is the free, open-source R environment (R Core Team, 2023) is necessary along with the following packages: tidyverse (Wickham et al., 2019), ggrepel (Slowikowski, 2023) and ggthemes (Arnold, 2021) for data manipulation and visualization; openxlsx (Schauberger & Walker, 2023) for data import; and eurostat (Eurostat, 2023) for accessing the Eurostat database.

RESULTS AND DISCUSSION

During the period between 2017-2019 (the pre-pandemic three-year period), Serbia was losing 539,591.3 years of potential life per year[1]. The distribution of premature mortality through the indicator of years of potential life lost is somewhat different compared to the usual mortality curve. The median age of lost years of potential life for the total population was 57.62 years in the same period (for men 57.35 while for women it was slightly higher and amounted to 58.11). This means that an equal number of lost years of life occurred for those under the age of 57.62 and for those older than that age (which is detonated in Figure 1 by the vertical white line).

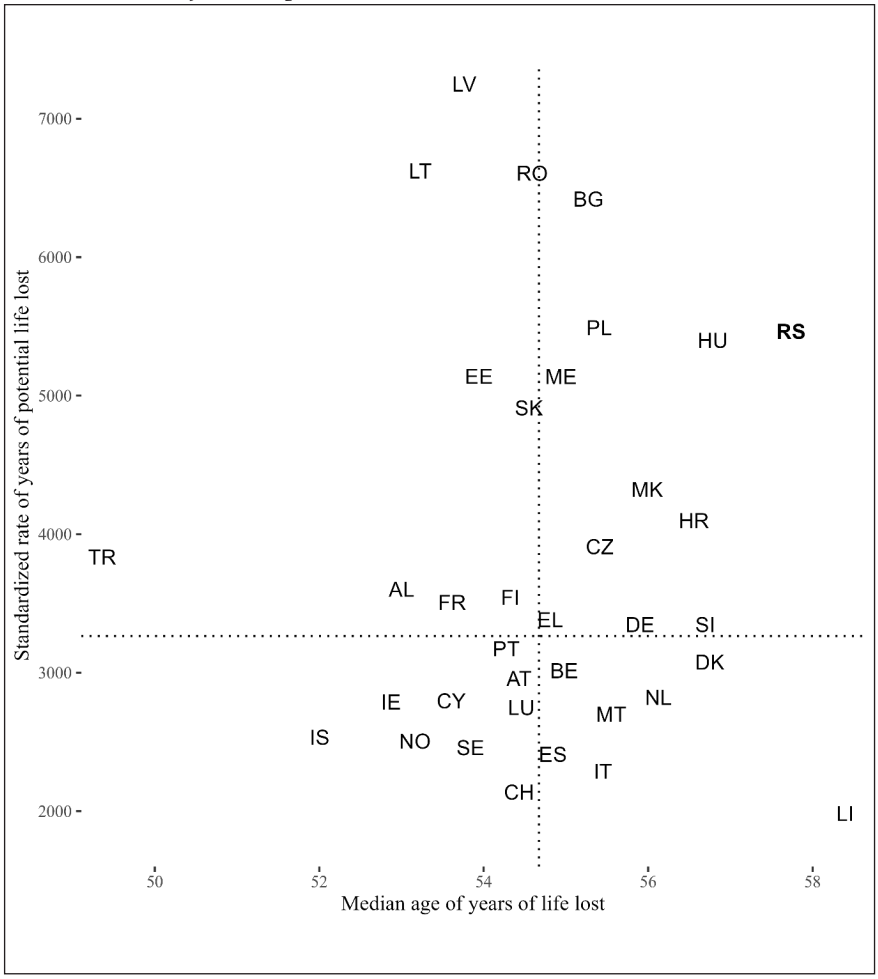
Figure 1. Distribution of lost years of potential life by sex and age (2017-2019 three-year average)



1 Compared to 614.312 in 2020 – the first year of the pandemic (Galjak, 2021).

In order to fully understand the situation of premature mortality in Serbia, it is necessary to put the data from Serbia in a wider context (Figure 2). Europe, when it comes to mortality, includes a set of countries to which Serbia is largely similar (demographically, socioeconomically), and among them are more developed countries that Serbia (with the aim of reducing premature mortality) can look up to (and potentially copy) success.

Figure 2. The ratio of the level of premature mortality and the age of premature mortality in European countries in 2019.



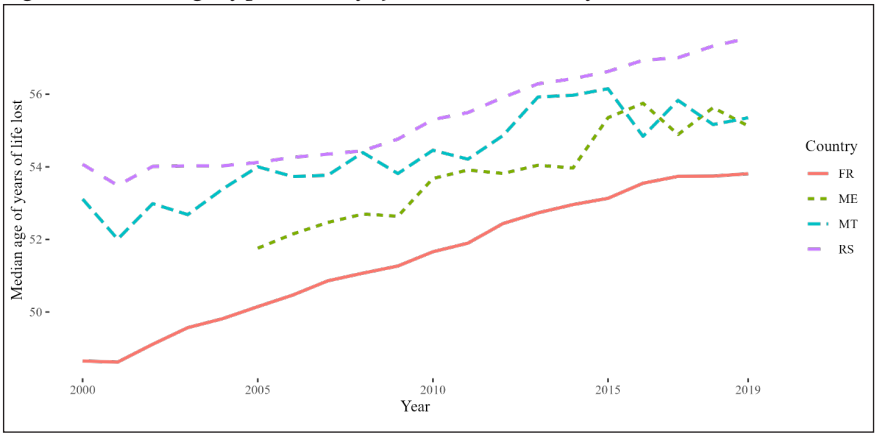
Note: Horizontal and vertical lines represent median values of the indicators.

According to the standardized rate of lost years of potential life (YPLLi), Serbia is among the countries that are at the very top of Europe, together with other former socialist countries. Latvia, Lithuania, Bulgaria and Romania are the countries with the highest rates, while they are followed by three countries with very similar values: Hungary, Poland and Serbia. This result is not surprising considering that mortality conditions are worse in former socialist countries (Meslé, 2004; Vallin & Meslé, 2004; Grigoriev et al., 2014; Galjak, 2018a). There are many factors that influence such a condition, and among them the most important are behavioral factors (smoking and alcohol) as well as the quality of health care. If you don't count Liechtenstein (which is a micro-state, so you shouldn't load too much into extreme values), the best values of this indicator are Switzerland (with almost twice as low premature mortality), Italy and Spain.

Premature mortality encompasses two key dimensions: its intensity and the age at which it occurs. Although countries may exhibit similar levels of premature mortality intensity, the age structure of deaths can vary significantly. For instance, Serbia and Poland have comparable levels of premature mortality intensity, but the age structure of deaths is notably different. In Poland, most lost years of life occur two years earlier than in Serbia, likely due to variations in the causes of death. Countries with a high incidence of deaths from external causes, such as the three former communist Baltic states, tend to have younger ages of premature mortality compared to others. It is crucial to note that the median age of lost years of life is also influenced by a country's population age structure, as exemplified by Turkey. A predominantly young population will consequently manifest in a lower median age of lost years of life.

The median age of years of potential life lost is a novel indicator that has proven useful, but only when combined with other measures of premature mortality intensity. A limitation of this indicator is its sensitivity to extreme values in less populous administrative units (Figure 3). We can see that in the Figure 3 this indicator is not stable for smaller countries like Malta and Montenegro. Specifically, in some countries, the number of deceased individuals under the age of 75 may be exceedingly low, and even lower for specific causes or groups of causes of death. This can result in unexpected values for this indicator in certain countries. Therefore, it is advised to use this indicator in conjunction with the standardized rate of lost years of life when analyzing premature mortality. Future research could refine this indicator by relating it to the median age of individuals younger than the reference age.

Figure 3 Median age of potential life years lost over time for select countries.



Due to the calculation method, the median age of years of potential life lost is influenced by the population structure (i.e., the age structure of the deceased), unlike YPLLi, which is a standardized indicator. This is also obvious in the analysis presented in this paper, as naturally the country with the youngest will have the lowest median age of lost years of life (example of Turkey in Figure 2).

CONCLUSION

The study highlights the importance of considering multiple dimensions of premature mortality, namely its intensity and the age at which it occurs. The age structure of deaths can vary significantly between countries with similar levels of premature mortality intensity, underscoring the need for a multifaceted approach to its analysis. The median age of years of potential life lost, while a valuable indicator, should be used in conjunction with other measures, such as the standardized rate of lost years of life, due to its sensitivity to extreme values in smaller populations. Ultimately, a comprehensive approach that combines multiple indicators and considers demographic, economic, and geographical factors will be essential for a more nuanced understanding of premature mortality and its determinants.

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REFERENCES

Arnold, J. B. (2021). *ggthemes: Extra Themes, Scales and Geoms for "ggplot2."* https://CRAN.R-project.org/package=ggthemes

Bonneux, L. (2002). How to measure the burden of mortality? *Journal of Epidemiology & Community Health*, *56*(2), 128–131. https://doi:10.1136/jech.56.2.128

Dempsey, M. (1947). Decline in tuberculosis; the death rate fails to tell the entire story. *American Review of Tuberculosis*, *56*(2), 157–164. doi:10.1164/art.1947.56.2.157

Devedžić, M., & Stojilković Gnjatović, J. (2015). *Demografski profil starog stanovništva Srbije*. Republički zavod za statistiku.

Dickinson, F., & Welker, E. (1948). What is the leading cause of death? *AMA Bulletin*, *64*, 1–25.

Eurostat. (2023). *Bulk Download Repository—Dataset: Demo_r_mwk3_ts*. Eurostat. http://ec.europa.eu/eurostat/estat-navtree-portlet-prod/BulkDownloadListing

Fitzmaurice, C., Allen, C., Barber, R., Barregard, L., Bhutta, Z., Brenner, H., Dicker, D., Chimed-Orchir, O., Dandona, R., Dandona, L., Fleming, T., Forouzanfar, M., Hancock, J., Hay, R., Hunter-Merrill, R., Huynh, C., Hosgood, H., Johnson, C., Jonas, J., … Global Bourden Disease Cancer Coll. (2017). Global, Regional, and National Cancer Incidence, Mortality, Years of Life Lost, Years Lived With Disability, and Disability-Adjusted Life-years for 32 Cancer Groups, 1990 to 2015 A Systematic Analysis for the Global Burden of Disease Study. *JAMA ONCOLOGY*, *3*(4), 524–548. doi:10.1001/jamaoncol.2016.5688

Fitzmaurice, C., Dicker, D., Pain, A., Hamavid, H., Moradi-Lakeh, M., Maclntyre, M., Allen, C., Hansen, G., Woodbrook, R., Wolfe, C., Hamadeh, R., Moore, A., Werdecker, A., Gessner, B., Te Ao, B., McMahon, B., Karimkhani, C., Yu, C., Cooke, G., … Global Burden Dis. (2015). The Global Burden of Cancer 2013 Global Burden of Disease Cancer Collaboration. *JAMA ONCOLOGY*, 1(4), 505–527. doi:10.1001/jamaoncol.2015.0735

Forouzanfar, M., Alexander, L., Anderson, H., Bachman, V., Biryukov, S., Brauer, M., Burnett, R., Casey, D., Coates, M., Cohen, A., Delwiche, K., Estep, K., Frostad, J., Astha, K., Kyu, H., Moradi-Lakeh, M., Ng, M., Slepak, E., Thomas, B., … GBD 2013 Risk Factors. (2015). Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks in 188 countries, 1990-2013: A systematic analysis for the Global Burden of Disease Study 2013. *LANCET*, 386(10010), 2287–2323. doi:10.1016/S0140-6736(15)00128-2

Galjak, M. (2014). Predupredіv mortalitet u Srbiji i Evropskoj uniji—Komparativna analiza. *Demografija, 11*, 135–146.

Galjak, M. (2018a). East-west demographic divide in the EU: A regional overview. *Stanovnistvo, 56*(2), 1–21. doi:10.2298/STNV181003004G

Galjak, M. (2018b). Fight against the early mortality in Serbia: Finland as an example of good practice. *Zbornik Matice Srpske Za Drustvene Nauke, 167*, 585–595. doi:10.2298/ZMSDN1867585G

Galjak, M. (2022a). Premature Mortality in Serbia – The Effects of Air Pollution and COVID-19 Pandemic. *Kritika: Časopis Za Filozofiju i Teoriju Društva, 3*(2), 253–274. doi:10.5281/zenodo.7369726

Galjak, M. (2022b). *Prevremeni mortalitet u Srbiji*. (Doktorska disertacija). Beograd: Univerzitet u Beogradu – Geografski fakultet. https://nardus.mpn.gov.rs/handle/123456789/21191

Grigoriev, P., Meslé, F., Shkolnikov, V. M., Andreev, E., Fihel, A., Pechholdova, M., & Vallin, J. (2014). The Recent Mortality Decline in Russia: Beginning of the Cardiovascular Revolution? *Population and Development Review, 40*(1), 107–129. doi:10.1111/j.1728-4457.2014.00652.x

Lee, R. (2009). Früher Tod und langes Leben in historischer Perspektive: Der vorzeitige Tod in Europa und seine kulturelle, ökonomische und soziale BedeutungEarly Death and Long Life in History: Establishing the Scale of Premature Death in Europe and its Cultural, Economic and Social Significance. *Historical Social Research, 34*(4). doi:10.12759/HSR.34.2009.4.23-60

Lim, S., Vos, T., Flaxman, A., Danaei, G., Shibuya, K., Adair-Rohani, H., Amann, M., Anderson, H., Andrews, K., Aryee, M., Atkinson, C., Bacchus, L., Bahalim, A., Balakrishnan, K., Balmes, J., Barker-Collo, S., Baxter, A., Bell, M., Blore, J., … Ezzati, M. (2012). A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: A systematic analysis for the Global Burden of Disease Study 2010. *LANCET*, *380*(9859), 2224–2260. doi:10.1016/S0140-6736(12)61766-8

Lozano, R., Naghavi, M., Foreman, K., Lim, S., Shibuya, K., Aboyans, V., Abraham, J., Adair, T., Aggarwal, R., Ahn, S., Alvarado, M., Anderson, H., Anderson, L., Andrews, K., Atkinson, C., Baddour, L., Barker-Collo, S., Bartels, D., Bell, M., … Murray, C. (2012). Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: A systematic analysis for the Global Burden of Disease Study 2010. *LANCET*, *380*(9859), 2095–2128. doi:10.1016/S0140-6736(12)61728-0

Magdalenic, I., & Galjak, M. (2016). Ageing map of the Balkan Peninsula. *Journal of the Geographical Institute Jovan Cvijic, SASA*, *66*(1), 75–89. doi:10.2298/IJGI1601075M

Marinković, I. (2016). *Razlike u smrtnosti stanovništva Srbije po polu*. (Doktorska disertacija). NoviSad: Univerzitet u Novom Sadu, Prirodno-matematički fakultet https://www.cris.uns.

ac.rs/ DownloadFileServlet/Disertacija146771956941352.pdf?controlNumber=(BISIS)101411&fileName=146771956941352.pdf&id=6268

Marinkovic, I. (2021). *Demografska analiza uticaja zdravstvene zastite i javnog zdravlja na trendove smrtnosti stanovnistva Srbije monografije*. Beograd: Institut društvenih nauka. http://idn.org.rs/wpcontent/uploads/2021/02/Demografska_analiza_uticaja_zdravstvene_zastite_i_javnog_zdravlja_na_trendove_smrtnosti_stanovnistva_Srbije.pdf

Maximova, K., Rozen, S., Springett, J., & Stachenko, S. (2016). The use of potential years of life lost for monitoring premature mortality from chronic diseases: Canadian perspectives. *Canadian Journal of Public Health*, *107*(2), e202–e204. doi:10.17269/cjph.107.5261

Meslé, F. (2004). Mortality in Central and Eastern Europe: Long-term trends and recent upturns. *Demographic Research*, *Special 2*, 45–70. doi:10.4054/DemRes.2004.S2.3

Milić, N., Stanisavljević, D., Krstić, M., Jovanović, V., Brcanski, J., Kilibarda, B., Ljubičić, M., Živković-Šulović, M., Borirčić, K., Živanović-Radnić, T., Milanković, J., Ogrizović Bašanac, M., Jordanovski, G., & Bjelobrk, G. (2021). *Istraživanje zdravlja stanovništva Srbije 2019. Godine*. Beograd: OMNIA. https://publikacije.stat.gov.rs/G2021/pdf/G20216003.pdf

Murray, C., & Lopez, A. (1997). Alternative projections of mortality and disability by cause 1990-2020: Global burden of disease study. *LANCET*, *349*(9064), 1498–1504. doi:10.1016/S0140-6736(96)07492-2

Murray, C., Vos, T., Lozano, R., Naghavi, M., Flaxman, A., Michaud, C., Ezzati, M., Shibuya, K., Salomon, J., Abdalla, S., Aboyans, V., Abraham, J., Ackerman, I., Aggarwal, R., Ahn, S., Ali, M., Alvarado, M., Anderson, H., Anderson, L., … Lopez, A. (2012). Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990-2010: A systematic analysis for the Global Burden of Disease Study 2010. *LANCET*, *380*(9859), 2197–2223. doi:10.1016/S0140-6736(12)61689-4

Naghavi, M., Abajobir, A., Abbafati, C., Abbas, K., Abd-Allah, F., Abera, S., Aboyans, V., Adetokunboh, O., Arnlov, J., Afshin, A., Agrawal, A., Kiadaliri, A., Ahmadi, A., Ahmed, M., Aichour, A., Aichour, I., Aichour, M., Aiyar, S., Al-Eyadhy, A., … GBD 2016 Causes Death Collaborato. (2017). Global, regional, and national age-sex specific mortality for 264 causes of death, 1980-2016: A systematic analysis for the Global Burden of Disease Study 2016. *LANCET*, *390*(10100), 1151–1210. doi:10.1016/S0140-6736(17)32152-9

Ng, M., Fleming, T., Robinson, M., Thomson, B., Graetz, N., Margono, C., Mullany, E., Biryukov, S., Abbafati, C., Abera, S., Abraham, J., Abu-Rmeileh, N., Achoki, T., AlBuhairan, F., Alemu, Z., Alfonso, R., Ali, M., Ali, R., Guzman, N., … Gakidou, E. (2014). Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: A systematic analysis

for the Global Burden of Disease Study 2013. *LANCET*, *384*(9945), 766–781. doi:10.1016/S0140-6736(14)60460-8

Rašević, M., & Galjak, M. (2022). Demographic Challenges in Serbia. In E. Manić, V. Nikitović, & P. Djurović (Eds.), *The Geography of Serbia: Nature, People, Economy* (pp. 143–155). Springer International Publishing. doi:10.1007/978-3-030-74701-5_11

Republički zavod za statistiku. (2021a). *Procene stanovništva sredinom godine (prosek).* https://opendata.stat.gov.rs/data/WcfJsonRestService.Service1.svc/dataset/18010403IND03/3/cs

Republički zavod za statistiku. (2021b). *Umrli po polu, starosti, uzroku smrti i opštinama*. Podaci dobijeni posebnom obradom

Roth, G., Abate, D., Abate, K., Abay, S., Abbafati, C., Abbasi, N., Abbastabar, H., Abd-Allah, L., Abdela, J., Abdelalim, A., Abdollahpour, I., Abdulkader, R., Abebe, H., Abebe, M., Abebe, Z., Abejie, A., Abera, S., Abil, O., Abraha, H., … GBD Causes Death Collaborotors. (2018). Global, regional, and national age-sex-specific mortality for 282 causes of death in 195 countries and territories, 1980-2017: A systematic analysis for the Global Burden of Disease Study 2017. *LANCET*, *392*(10159), 1736–1788. doi:10.1016/S0140-6736(18)32203-7

Schauberger, P., & Walker, A. (2023). *openxlsx: Read, Write and Edit xlsx Files*. https://CRAN.R-project.org/package=openxlsx

Slowikowski, K. (2023). *ggrepel: Automatically Position Non-Overlapping Text Labels with "ggplot2."* https://CRAN.R-project.org/package=ggrepel

Thacker, S. B., Stroup, D. F., Carande-Kulis, V., Marks, J. S., Roy, K., & Gerberding, J. L. (2006). Measuring the Public's Health. *Public Health Reports*, *121*(1), 14–22. doi:10.1177/003335490612100107

Vallin, J., & Meslé, F. (2004). Convergences and divergences in mortality: A new approach of health transition. *Demographic Research*, *Special 2*, 11–44. doi:10.4054/DemRes.2004.S2.2

van Raalte, A. A. (2021). What have we learned about mortality patterns over the past 25 years? *Population Studies*, *75*(sup1), 105–132. doi:10.1080/00324728.2021.1967430

Vos, T., Allen, C., Arora, M., Barber, R., Bhutta, Z., Brown, A., Carter, A., Casey, D., Charlson, F., Chen, A., Coggeshall, M., Cornaby, L., Dandona, L., Dicker, D., Dilegge, T., Erskine, H., Ferrari, A., Fitzmaurice, C., Fleming, T., … GBD 2015 Dis Injury Incidence. (2016). Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990-2015: A systematic analysis for the Global Burden of Disease Study 2015. *LANCET*, *388*(10053), 1545–1602. doi:10.1016/s0140-6736(16)31678-6

Vos, T., Flaxman, A., Naghavi, M., Lozano, R., Michaud, C., Ezzati, M., Shibuya, K., Salomon, J., Abdalla, S., Aboyans, V., Abraham, J., Ackerman, I., Aggarwal, R., Ahn, S., Ali, M., Alvarado, M., Anderson, H., Anderson, L., Andrews, K., … Murray, C. (2012). Years lived with disability (YLDs) for 1160 sequelae of 289

diseases and injuries 1990-2010: A systematic analysis for the Global Burden of Disease Study 2010. *LANCET*, *380*(9859), 2163–2196. doi:10.1016/S0140-6736(12)61729-2

Wang, H., Naghavi, M., Allen, C., Barber, R., Bhutta, Z., Carter, A., Casey, D., Charlson, F., Chen, A., Coates, M., Coggeshall, M., Dandona, L., Dicker, D., Erskine, H., Ferrari, A., Fitzmaurice, C., Foreman, K., Forouzanfar, M., Fraser, M., … GBD 015 Mortality and Causes Death. (2016). Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980-2015: A systematic analysis for the Global Burden of Disease Study 2015. *LANCET*, *388*(10053), 1459–1544. doi:10.1016/S0140-6736(16)31012-1

Whiteford, H., Degenhardt, L., Rehm, J., Baxter, A., Ferrari, A., Erskine, H., Charlson, F., Norman, R., Flaxman, A., Johns, N., Burstein, R., Murray, C., & Vos, T. (2013). Global burden of disease attributable to mental and substance use disorders: Findings from the Global Burden of Disease Study 2010. *LANCET*, *382*(9904), 1575–1586. doi:10.1016/S0140-6736(13)61611-6

Wickham, H., Averick, M., Bryan, J., Chang, W., McGowan, L. D., François, R., Grolemund, G., Hayes, A., Henry, L., Hester, J., Kuhn, M., Pedersen, T. L., Miller, E., Bache, S. M., Müller, K., Ooms, J., Robinson, D., Seidel, D. P., Spinu, V., … Yutani, H. (2019). Welcome to the tidyverse. *Journal of Open Source Software*, *4*(43), 1686. doi:10.21105/joss.01686

World Health Organization. (2023). *WHO Mortality Database*. https://www.who.int/data/data-collection-tools/who-mortality-database

Yuen, P., Haybittle, J., & Machin, D. (1997). Geographical variation in the standardized years of potential life lost ratio (SYPLR) in women dying from malignancies of the breast in England and Wales. *British Journal of Cancer*, *75*(7), 1069–1074. doi:10.1038/bjc.1997.182

PROCENA PREVREMENE SMRTNOSTI U SRBIJI: UVIDI IZ MEDIJALNE STAROSTI GODINA IZGUBLJENOG ŽIVOTA

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REZIME

Prevremena smrtnost, definisana kao smrt koja se dogodi pre unapred određenog hronološkog doba, predstavlja značajan izazov za javno zdravlje u Srbiji, koji je dodatno otežan starenjem stanovništva, visokim stopama nezaraznih bolesti i izazovima zdravstvenog sistema. Ova studija uvodi novi indikator, medijalnu starost godina izgubljenog života (MeAIPLL), za procenu starosne distribucije prevremenog mortaliteta u Srbiji i odabranim zemljama Evropske unije u periodu pre pandemije (2000 -2019). Primarni podaci, uključujući detalje o mortalitetu kao što su pol, starost, uzrok smrti dobijeni su specijalnom obradom vitalnih statistika iz Republičkog zavoda za statistiku, dok su dodatni podaci preuzeti iz međunarodnih baza podataka. Rezultati studije pokazuju da je Srbija, u periodu između 2017. i 2019. godine (tri godine pre pandemije), gubila 539.591,3 godina potencijalnog života godišnje. Distribucija prevremenog mortaliteta kroz indikator godina potencijalnog gubljenja života je nešto drugačija u poređenju sa uobičajenom krivom mortaliteta. MeAIPLL za ukupnu populaciju bila je 57.62 godina u istom periodu (za muškarce 57.35 dok je za žene bila nešto viša i iznosila 58.11). To znači da je jednak broj izgubljenih godina života nastao za one mlađe od 57.62 godina i za one starije od te starosti. Nalazi otkrivaju da je Srbija među evropskim zemljama sa najvišim stopama prerane smrtnosti, ali to da je to i stanje i u drugim bivšim socijalističkim zemljama. Međutim, starosna distribucija preranih smrti značajno varira od zemlje do zemlje, pod uticajem faktora kao što su uzroci smrti i još važnije starosna struktura stanovništva. Studija naglašava važnost razmatranja više dimenzija prevremenog mortaliteta, uključujući njegov intenzitet, starosnu strukturu i geografske varijacije, za dizajniranje efikasnih intervencija i javnih politika u vezi sa javnim zdravljem. U radu se takođe naglašavaju ograničenja indikatora MeAIPLL, preporučujući njegovu upotrebu u kombinaciji sa drugim merama intenziteta prevremenog mortaliteta za sveobuhvatnu procenu.

Ključne reči: YPLL, YLL, smrti, javno zdravlje, indikatori zdravlja u Evropi