The analysis of premature mortality in selected Central and East European countries

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ABSTRACT

Despite mortality improvements across Europe, premature mortality notably persists in Central and East European countries. This study is aimed to assess premature mortality variations across Central and East European countries from 1970 to 2019, employing both classical premature mortality indicators and the more nuanced lifespan disparity indicators. Specifically, the analysis utilised the proportion of deaths up to the age of 65, lifespan disparity, and an age threshold derived from lifespan disparity to explore mortality trends. The findings reveal a stable reduction in premature mortality within Central European and Baltic countries, contrasting with the pronounced fluctuations experienced by East European countries. Remarkably, Czechia, Slovakia, and Estonia demonstrating the most significant progress in mitigating premature deaths. The trajectory of premature mortality in Central and Eastern European nations underscores the influence of socioeconomic crises and distinct alcohol consumption patterns on mortality trends. The study highlights the limitations of employing a static age threshold of 65 years in analysis of premature mortality, which fails to capture the full scope of premature mortality realities, particularly among females. However, the traditional metric of deaths before age 65 provides a broadly understandable measure, the nuanced insights offered by lifespan disparity and its derived age threshold enhance our understanding of premature mortality dynamics. Recognising the strengths and limitations of each indicator is essential for advancing our grasp of premature mortality and for refining the development and execution of targeted public health interventions throughout Europe.

KEYWORDS

premature mortality; lifespan disparity; age threshold; proportion of deaths

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1. Introduction

Over the past five decades, life expectancy at birth has shown a consistent upward trend across all European countries, albeit following different paths and trajectories. Certain countries, particularly those in Western Europe, have achieved remarkable success, witnessing substantial increases in life expectancy. Conversely, East European countries have experienced more modest gains in reducing mortality levels. Furthermore, the mortality process in European countries has undergone significant transformations, evident in changes in overall mortality levels and intensities and in shifting societal attitudes and perspectives towards mortality. Significantly, considerable variation exists in the age structure of mortality among European countries, reflecting diverse societal, cultural, and healthcare contexts. Against this backdrop, premature mortality emerges as a subject of profound interest and concern.

This study aims to assess the variations in premature mortality across selected Central and East European countries – Belarus, Bulgaria, Czechia, Estonia, Hungary, Latvia, Lithuania, Moldova, Poland, Russia, Slovakia and Ukraine – from 1970 to 2019.

One of the central objectives of this study is to employ two distinct methodological frameworks – traditional and alternative – to capture the evolution of premature mortality. The traditional framework implies an indicator based on a pre-defined age to highlight premature deaths. This approach could induce some distortions when the analysis is conducted on a set of countries or for some extended period of time. At the same time, the alternative framework will imply the lifespan disparity indicator. Lifespan disparity is a measure of the variation in age at death among individuals within a population. This metric complements traditional mortality measures by providing insight into the distribution of deaths across different ages, thus reflecting on the equity of health outcomes across a population. Also, the lifespan disparity is particularly sensitive to deaths occurring at younger ages, making it a valuable tool for assessing the impact of policies or interventions aimed at reducing premature mortality.

2. Literature review

In scholarly discourse, premature mortality garners substantial attention, yet a consensus on its precise definition remains elusive (Committee on Population National Research Council 2015; Sørheim et al. 2024). Conceptually, premature mortality encompasses deaths occurring before their anticipated time, posing a challenge in delineating a threshold that distinguishes premature from "late" mortality (Lapostolle et al. 2008). In the field literature could be distinguished various approaches corresponding to different conceptions of premature mortality (Sørheim et al. 2024). One and more common approach used a pre-defined, absolute age threshold. Based on this conception, all deaths which occurred under the pre-defined age threshold are considered premature ones. Various age thresholds, including 65 (Eames et al. 1993; Eurostat 2002; French National Institute for Statistic and Economic Studies 2023), 70 (OECD 2011) and 75 years (Wong et al. 2002) have been proposed, yet a universally accepted mechanism for their determination remains absent. The researcher's scientific interest predominantly influences this selection process (Wise et al. 1988; Mingot et al. 1991).

Another approach, which involves the existence of an age threshold but offers a more dynamic perspective linked to mortality dynamics and temporal fluctuations, is based on lifespan variation. According to this framework, the deaths are categorised as premature when their incidence contributes to an increase in the lifespan disparity (Sørheim et al. 2024). Based on this approach, premature mortality is evaluated through the lifespan disparity indicator, which indicates an average number of years lost. In typical scenarios, this measure of disparity suggests a threshold value ($a^{\dagger}$) for a population. Preventing deaths below this threshold decreases the disparity measure, while preventing deaths above it increases disparity (Zhang and Vaupel 2009; Zhang and Li 2020). Therefore, this disparity point shifts over time in response to changes in a population's longevity.

Despite the methodological issues, premature mortality is subject to intensive investigation and is recognised as a significant concern in Eastern Europe (Németh et al. 2023). The collapse of the Soviet Union significantly influenced the trajectory of premature mortality in countries from region. Following this event, Bobadilla and colleagues conducted a comprehensive analysis, assessing the level of premature mortality and identifying key contributing factors (Bobadilla et al. 1997). They underscored the role of risk behaviours in shaping premature mortality trends. Moreover, the impact of risk behaviours, notably alcohol consumption, was highlighted in Central European countries such as Czechia, Hungary and Poland, compared to other European countries such as France, Sweden and the United Kingdom (Rehm et al. 2007). Another noteworthy aspect of premature mortality in East European countries is the pronounced gender disparity (Murphy 2011), exceeding that observed in Central or West European counterparts (McKee and Shkolnikov 2001). However, Central European countries exhibit an intermediate pattern of premature mortality evolution between East and West European countries (Megyesiova and Lieskovska 2019; Németh et al. 2023).

3. Background

This study delves into the period between 1970 and 2019. This period is characterised by distinctive socioeconomic and political evolution in Eastern and Central Europe. These changes have had far-reaching impacts, notably on the demographic trends within the region, especially on the evolution of mortality.

In the socialist period in the countries from the region, the Semashko centralised model for healthcare was implemented. While effective in some respects, such as in controlling communicable diseases and achieving high vaccination coverage rates, the model's downfall began with the Soviet Union's economic challenges in the 1980s, leading to a decline in healthcare quality (Glushkova et al. 2023). After the dissolution of the Soviet Union and the gaining of independence, the Baltic and Central European countries developed distinct healthcare models compared to East European countries, mainly based on the Semashko model.

It is important to note that the period of pre- and post-dissolution of the Soviet Union brought a high divergence in aspects of the region's socioeconomic development. Most East European countries needed a more extended period to recover after the unstable

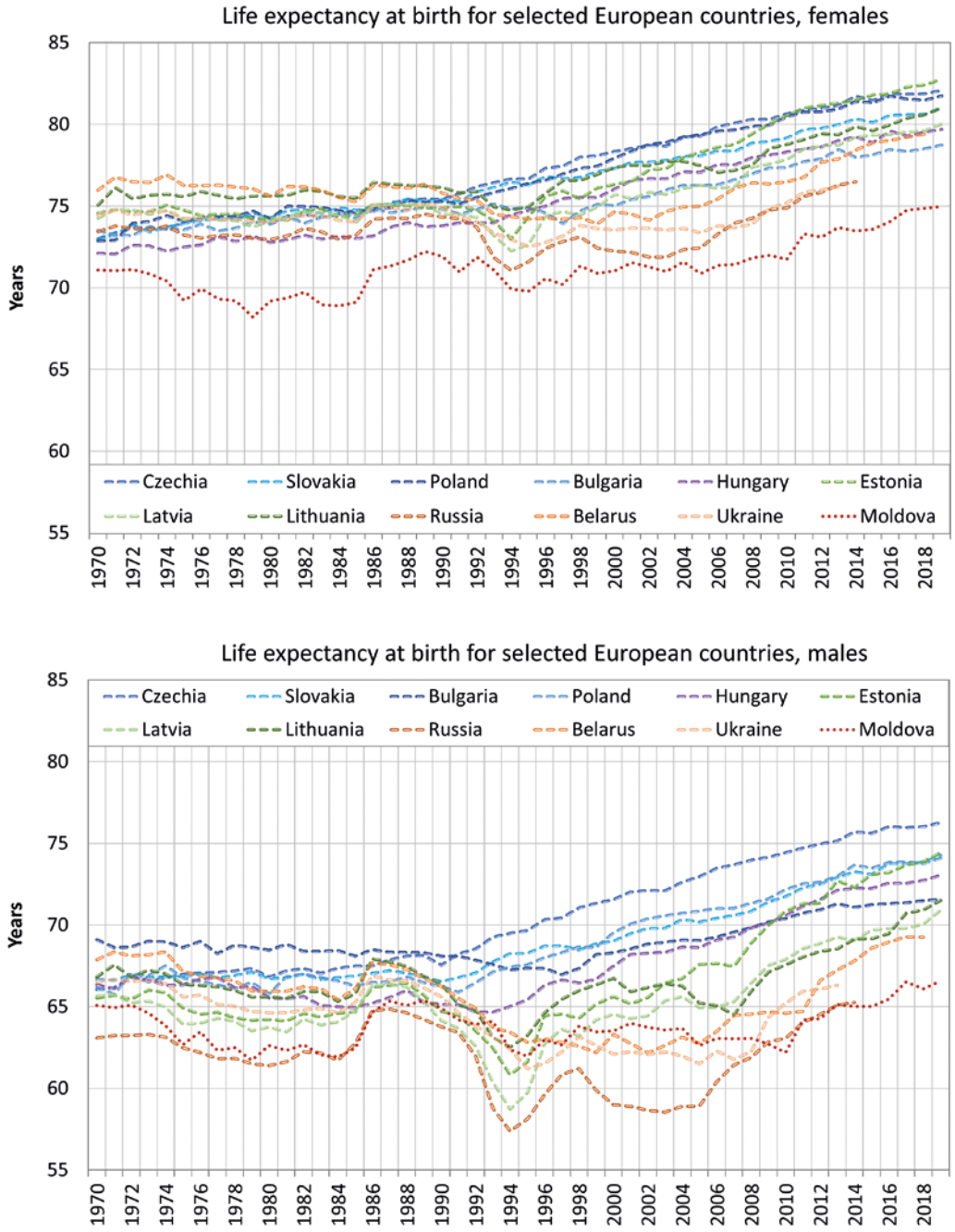

Fig. 1 Life expectancy at birth dynamic in selected European countries, both sexes.
Source: Based on HMD data for all countries except Moldova.

period of the '90s, followed by several regional financial crises. Towards the late 20th century, socioeconomic and political upheavals substantially reduced life expectancy at birth, especially among males, dropping below levels seen between 1965–1970. A resurgence in life expectancy was only evident in the early 21st century, eventually matching the 1970 levels. That highlights the substantial impact that socio-political fluctuations have on public health indicators.

Despite all the changes and transformations observed in the analysed period, overall mortality declines in all analysed countries, with significant variation by region and sex. Central European countries have shown remarkable progress, particularly among females (Fig. 1). Czech females, in particular, exhibited an impressive growth of 9.1 years in life expectancy at birth, while their male counterparts experienced a notable increase of 10.2 years. Similarly, females in Poland, Slovakia, and Hungary demonstrated commendable progress, with respective gains of 8.9, 8.1, and 7.6 years. Although the corresponding male populations were experiencing slightly smaller increments, they still showcased significant improvements at 7.9, 7.6, and 6.7 years. Comparatively, Bulgaria recorded more modest advancements for both genders in Central European countries. Females in Bulgaria experienced an increase of 5.2 years in life expectancy at birth, while males saw a twice smaller growth of 2.5 years. Notably, Baltic countries displayed more favourable indicators when contrasted with their East European counterparts. Estonia witnessed a robust growth in life expectancy at birth, mirroring other Central European countries, with increases of 8.2 years for females and 8.9 years for males. Meanwhile, Latvia and Lithuania demonstrated gains of 5.8 and 6 years in females and 5.3 and 4.7 years in males. Conversely, East European countries exhibited the most minor progress in life expectancy at birth during the abovementioned period. In Moldova, females gained 3.9 years to life expectancy at birth values; in Belarus, 3.4 years for 1970–2018; and in Russia and Ukraine, 3 and 1.8 years for 1970–2014 and 1970–2013, respectively. In males, the gains were much more modest – 1.5, 1.4, 2.2 and –0.2 years.

Even though life expectancy at birth is growing in almost all countries, the age pattern of mortality varies greatly (Meslé 2004). The countries achieving the most significant gains in life expectancy at birth have successfully postponed deaths to the oldest ages and reduced premature mortality – a trend not as prevalent in East European countries.

4. Data and methods

This study focuses on an analysis across selected European countries, specifically East European countries (Belarus, Russia, Ukraine, Moldova), Baltic (Estonia, Latvia, Lithuania), and Central European countries (Bulgaria, Czechia, Hungary, Poland, Slovakia). The research encompasses the period from 1970 to 2019.

The choice of the initial year for analysis, 1970, is dictated by the earliest available data for Moldova, while the terminal year, 2019, marks the last year before the onset of the global pandemic. The exclusion of the pandemic period from this study is deliberate, aiming to scrutinise the trends in premature mortality during a phase of normal mortality evolution devoid of extraordinary circumstances. Furthermore, it is essential to note the variability in the data endpoints for Belarus, Russia, and Ukraine. Specifically, the dataset extends to 2018 for Belarus, 2014 for Russia, and 2013 for Ukraine. Despite the temporal discrepancies in the datasets for these countries, their inclusion in the analytical model is justified by their critical significance in understanding the mortality dynamics in East European contexts. These nations serve as pivotal models for the analysis of East European countries.

Mortality data for all examined countries, except Moldova, were sourced from the Human Mortality Database (HMD). Owing to challenges associated with accurately accounting for migration, data for Moldova were obtained from two distinct sources. The initial dataset, covering the period from 1970 to 2013, incorporates information on the population exposed to risk and the number of deaths by age and sex. This dataset was derived from an alternative source, specifically the retrieved population data published by Olga Penina et al. (2015). From 2014 to 2019, data concerning the exposed population and mortality by age and sex were procured from the National Bureau of Statistics Database (NBS). This latter dataset has been adjusted to exclude long-term migrants and residents living abroad, ensuring its compatibility with the alternative data provided by Penina and colleagues.

For the countries subject to analysis, excluding Moldova, complete life tables were obtained directly from the HMD. For Moldova, the author calculated the complete life table, employing methodologies compatible with the HMD to mitigate any substantial discrepancies. Even data for Moldova supposed the engagement data from diverse sources was very important to include Moldova in this analysis, because this enabled the generation of a more thorough depiction of the situation in the East European region. In the base of the life tables data was computed lifespan disparity. The lifespan disparity ($e^{\dagger}$ – e-dagger) is the average remaining life expectancy when death occurs or life years lost due to death (Shkolnikov et al. 2011). It weights the average remaining life expectancy at age x by the number of life table deaths at age x (Kibele 2012).

The used formula is expressed as follows:

$$e^{\dagger} = \sum_{\alpha=0}^{\omega-1} d_{\alpha} \bar{e}_{\alpha} \quad (1)$$

Where,
ω – is the highest age group;
$\bar{e}_{\alpha}$ – is the average remaining life expectancy at age α;
d_{α}– is the number of life table deaths at age α;
α – age.

The age threshold, which divided "early/premature" by "late" deaths, was highlighted based on lifespan disparity. The age threshold derived from the lifespan disparity indicator represents, in essence, the age at which many deaths and a high remaining life expectancy are observed (Vaupel et al. 2011; Kibele, 2012). According to Zhang and Vaupel (Zhang and Vaupel 2009), this age threshold can be identified based on the following relationship:

$$e^{\dagger} = e(a)(1 - H(a)) \quad (2)$$

Where,
$H(a)$ – cumulative hazard to the age a;
$e(a)$ – life expectancy at age a.

Thus, according to the method presented by Zhang and Vaupel, $a^{\dagger}$ is the age at which the relationship shown in equation 2 is true. To identify this age, the direct interpolation method was applied.

To evaluate premature mortality based on a "traditional" age pre-defined approach, the proportion of deaths occurring before the age of 65 was calculated. This age threshold, 65 years, was selected to avoid underestimating premature mortality in East European countries, where male mortality rates are particularly high. The calculation of the proportion of premature deaths was refined using life table deaths, allowing for an assessment that mitigates the impact of population number and structure variances, thus providing a more precise measure of premature mortality in the region.

5. Main results

The period under analysis can be delineated into two different phases, corresponding to the socioeconomic and political development of countries involved in the analysis. The initial phase encompasses the era up to the dissolution of the USSR, while the subsequent phase commences in 1992, following the dissolution. The proportion of premature deaths, defined here as deaths occurring before the age of 65 years, exhibits divergent trends across the analysed countries (Fig. 2) during these two phases. The first stage, between 1970–1991, is characterised by a higher convergence than the period from 1992. The data variance in males from 1992 to 2019 is 5 times higher than for the previous period, while it was just two times higher for females. Females are characterised by higher convergence in terms of trends of premature mortality compared to males in both periods before and after the dissolution of URSS.

Females exhibit a lower proportion of premature deaths before the age of 65 in comparison to males. During the timeframe spanning 1970 to 1991, gender-based discrepancies in the proportion of premature deaths before the age of 65 varied from 1.5 to 2.2, indicating that the proportion of premature deaths before the age of 65 among males was between 1.5 and 2.2 times greater than that observed in females. The most minimal discrepancies were observed in Moldova, attributable to the relatively higher proportion of premature deaths recorded among females in this region. After the dissolution of the USSR, the gender gap in terms of the proportion of premature mortality before the age of 65 widened further, with the rate among males rising to between 1.9 and 2.5 times the rate seen in females.

Between 1970 and 1991, most countries engaged in this study exhibited remarkably parallel trends regarding the evolution of premature mortality levels (Fig. 2). Initially, in 1970, these countries commenced with notably similar levels of premature mortality, with the exceptions being Bulgaria and Russia for males and Moldova for females. Moldova, in particular, documented the highest proportion of premature deaths up to the age of 65 among females relative to other countries in the analysis. Among males, Bulgaria recorded a lower proportion of premature deaths up to 65 years, whereas Russia reported the highest when compared to all other countries under examination. Starting from 1992, a significant divergence among the countries can be observed, with distinct patterns of premature mortality rate evolution emerging for both females and males. Central European countries followed a steady and practically linear course in reducing the rate of premature deaths, whereas significant fluctuations characterised countries from the East European and Baltic countries. These fluctuations disrupted the overall trend of reduction, highlighting a contrast in the progression of premature mortality rates between the two groups of countries.

The period between 1970 and 1991, in the evolution of the proportion of premature deaths among females, can be characterised more by stagnation and insignificant fluctuations. An exception in this regard is presented by Moldova, where fluctuations were more intense than in other countries, yet the general trend of stagnation in the overall level of premature mortality was still maintained. The highest reduction in this phase, 1970–1991, was registered in Czechia – 3.9 p.p. After 1992, the proportion of premature deaths among females in Central European countries, particularly in the Czechia, Slovakia, and Poland, followed a very steady and linear decreasing trend. The reductions were less significant but similarly characterised by a marked linearity for Bulgaria and Hungary. Countries from the East region and

Baltic zone experienced pronounced fluctuations immediately after the dissolution of the USSR, reaching a peak in 1994–1995. After the mid-90s, the Baltic countries (Estonia, Latvia, and Lithuania) joined the firm trend of reduction observed in the Central European countries. Due to these fluctuations, females from East European countries remained at a relatively high level of premature mortality compared with other countries. The highest reduction in the East European and Baltic countries from 1992 was registered for Estonia – 10.5 p.p.

For males, the situation is quite different. Even from 1970 through 1991, different trajectories could be observed in the evolution of the proportion of premature deaths among males. Hungary represented an intermediate model of evolution. In all countries except Czechia, during this period, an increase in the proportion of premature deaths was noted. A slight decrease of 2.6 percentage points in Czechia was recorded – from 38.5% to 35.9%. In the other countries, the increase varied from 1.1 percentage points in Russia – from 46% to 47.1% – to 9.7 percentage points – from 35.6% to 45.2% in Hungary. One of the noteworthy moments during this period was the reduction in premature mortality between 1986 and 1988 in the East European and Baltic countries.

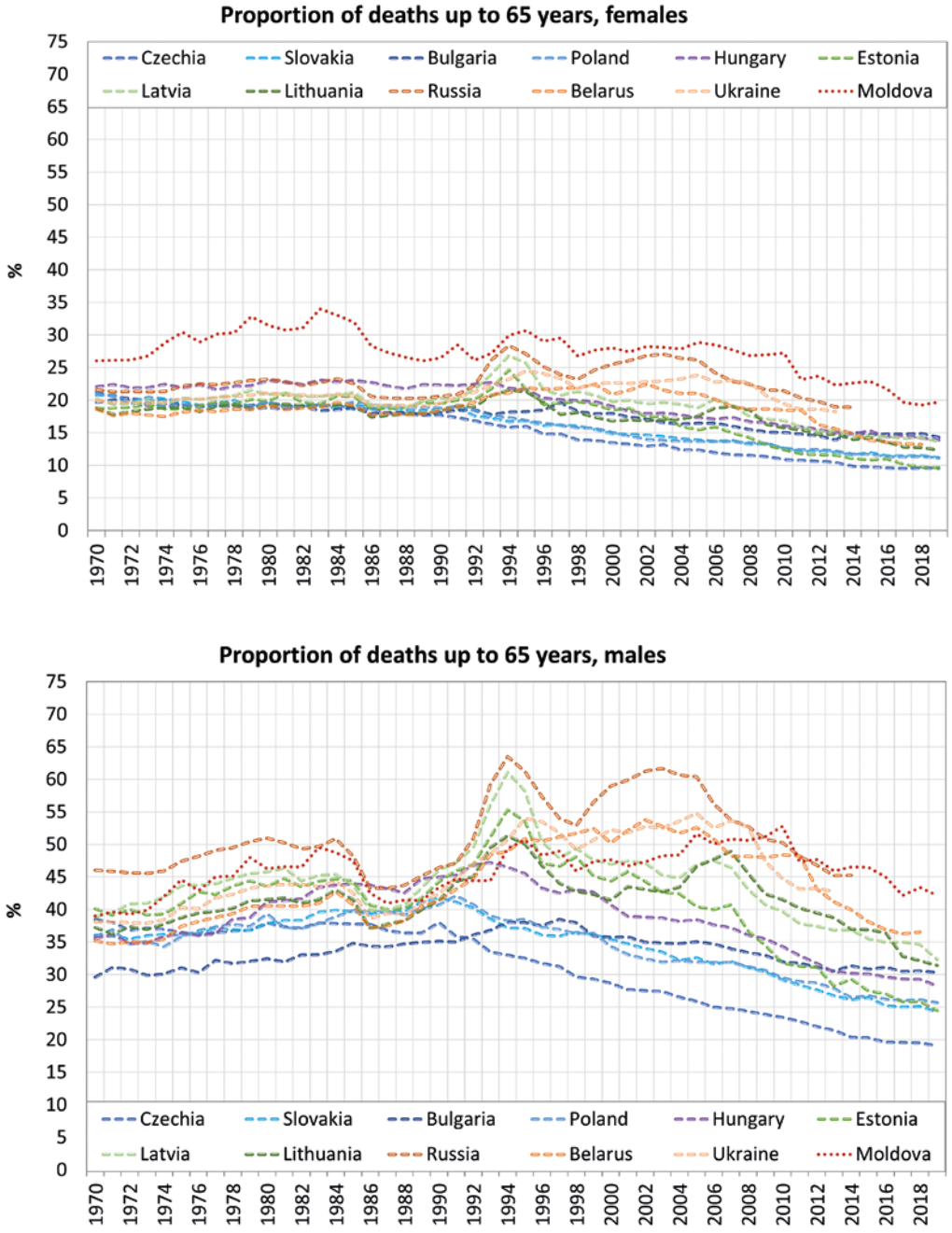

Fig. 2 Proportion of premature deaths up to 65 years in selected European countries, both sexes.
Source: Author calculations based on HMD data for all countries except Moldova.

This reduction, which is very evident among males, represents the effect of the anti-alcohol campaign promoted by Gorbachev. The proportion of premature deaths was reduced by 3 to 5 percentage points in the countries within the bloc. The collapse of the USSR and the subsequent socioeconomic crisis led to a significant increase in premature mortality among males. The dissolution of the USSR resulted in a dramatic and sudden transition to a market economy for the East European and Baltic countries, as well as for the Central European countries. The most affected were the post-socialist countries, especially those in Eastern Europe. In Belarus, Moldova, Russia, and Ukraine, an increase in the proportion of premature deaths was observed over a more extended period; disregarding some fluctuations, this lasted until the beginning of the new millennium. The prolonged increase was determined by perpetuating the trend observed immediately after dissolution. In the years immediately after the collapse of the USSR, males from Belarus noted an increase in the proportion of premature deaths from 44.7% in 1992 to 50.8% in 1995; in Moldovan males, it increased from 44.4% to 50.7% in the same period. In Russia, the proportion of premature deaths among males increased by approximately 13 percentage points in the next two years after the collapse of the USSR; in Ukraine, the rise constituted 7 percentage points in the period 1992–1995. The Baltic countries, despite a considerable increase in the proportion of premature deaths in the years following the collapse – 9 percentage points noted in Estonia from 1992 to 1994 years, 11 percentage points for Latvia and 6 percentage points for Lithuania for the same period; managed to recover at a much faster pace. Among the Central European countries, only Bulgaria and Hungary were observed to have a similar trend but at a significantly lower level than that observed in Baltic countries. At the same time, in Czechia, Slovakia, and Poland, the beginning of a stable period of reduction in the proportion of premature deaths was noted. Cumulatively, for the entry analysed period, 1970–2019, the highest reduction was observed in Czech males – 19.4 p.p. while in the East European countries was observed the worst situation – the proportion of premature deaths at the end of the analysed period was even higher than values from the beginning. The Baltic countries registered an intermediary position between the Central and East European countries. Estonia obtained a reduction in the proportion of premature deaths up to 65 years in males by 15.6 p.p., and Latvia and Lithuania gained more moderate reductions by 6.6 and 5.8 p.p., respectively. The evolution of the proportion of premature mortality up to 65 years is very fragmentary in males from East European countries. The proportion of premature deaths up to 65 years in Ukrainian males in 2013 was approximately 5 p.p. higher than in 1970, while in Russian males, just 0.8 p.p. lower. This is mainly determined by the deterioration of the mortality structure that expanded in the early and mid-1990s.

Throughout the analysis period, a consistent trend toward diminishing disparities in lifespan was noted across all examined countries and both sexes (Fig. 3). However, this trend exhibited a more uniform progression in Central European countries, particularly in Czechia and Slovakia, contrasting with a more segmented pattern observed within the East European and Baltic countries. Notably, the divergence in lifespan disparity's evolution across historical epochs – namely the socialist and post-socialist periods – was predominantly evident within the East European and Baltic countries, where Central European countries displayed a relative insensitivity to the socio-political shifts of that era.

In 1970, the disparity in lost life years among females ranged from 14.1 years in Moldova to 11.3 years in Czechia. Moldova presents a distinct and notably specific scenario compared to the mortality structure and patterns observed in other countries included in this study. The lowest level of lifespan disparity and a linear trend toward reduction were notably observed in Czechia and Slovakia. Females from East European and Baltic countries recorded reductions towards the late '80s, aligning with a previously identified gradual decline modestly accentuated by the anti-alcohol campaign. The subsequent crisis following the USSR's dissolution profoundly impacted the trend of lifespan disparity in post-Soviet states. A marked increase in lost life years was observed in Russia, Estonia, and Latvia during 1994–1995. The Baltic countries rapidly ameliorated this surge, achieving significantly lower values by 2019, with Estonia particularly noteworthy. Russia's experience, however, was characterised more by a stagnation in lifespan disparity until a consistent, albeit modest, reduction trend emerged post-2005. The most substantial decreases were seen in Moldova and Belarus, where lifespan disparity values decreased by 28.4% and 23.6%, respectively. These significant reductions were mainly attributable to the exceedingly high initial values recorded at the study's onset. Despite lesser reductions – 17.5% and 15.6% – Czechia and Estonia reported the lowest disparity values at the study's end, mainly due to the lower initial values observed in 1970. Ukraine and Russia experienced the most minor reduction, at 9.5% and 8.7%, respectively. However, it is critical to acknowledge that both countries had already demonstrated a clear downward trend, which likely would have persisted.

Regarding males, a less pronounced reduction in lifespan disparity was observed compared to females. Notably, Estonia and Latvia presented exceptions where the decline was more significant in males than in females, with Estonia witnessing a 16.2% reduction in males compared to 15.6% in females. While not substantial, these discrepancies indicate a divergent trend from other countries under analysis.

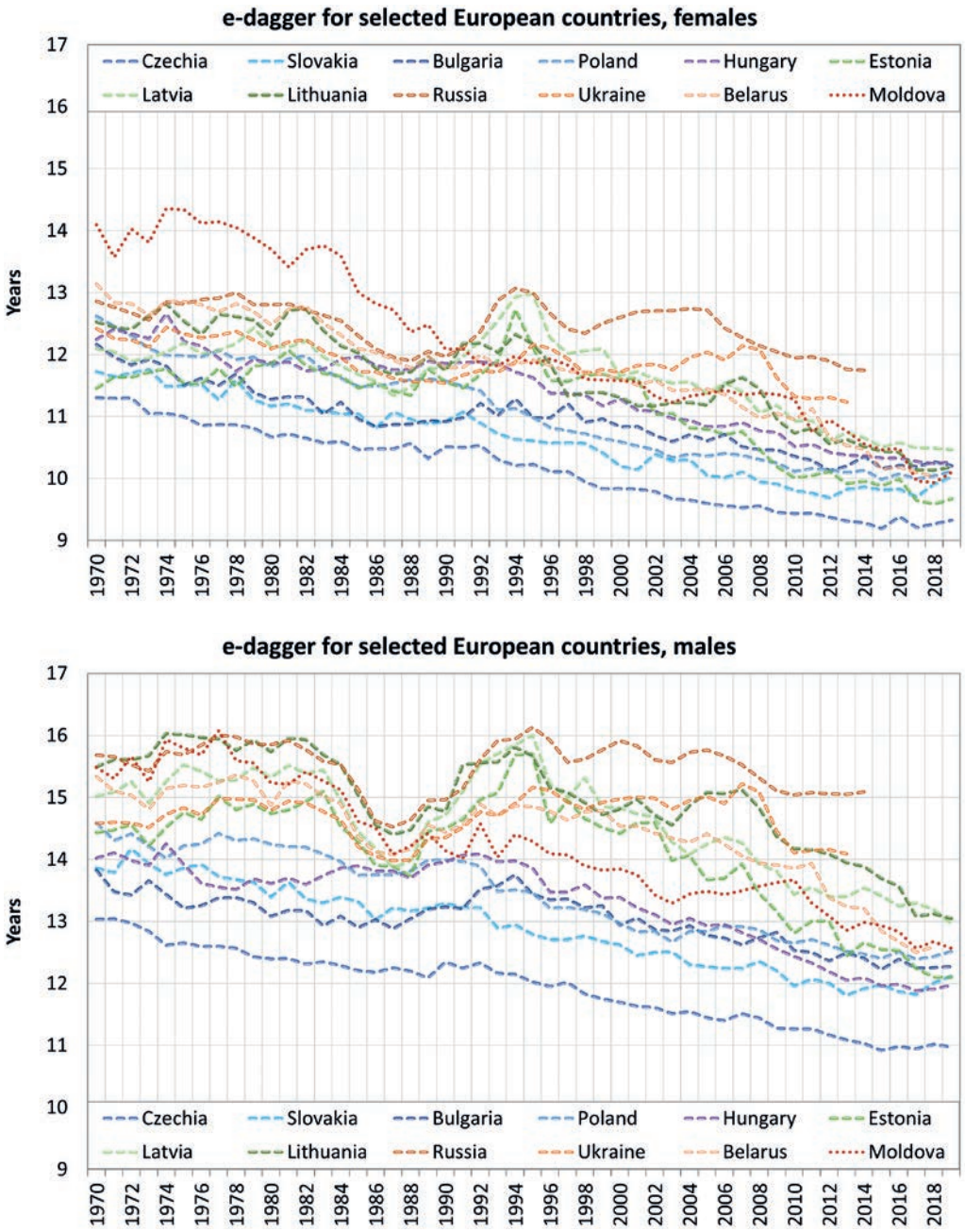

Fig. 3 Lifespan disparity in selected European countries, both sexes.
Source: Author calculations based on HMD data for all countries except Moldova.

Czechia and Slovakia represent distinctive models in the evolution of lifespan disparity among males, exhibiting a steadfast and stable reduction pathway. Czechia, in particular, reported the lowest life years lost towards the study's end. East European and Baltic countires, having been more exposed to the tumultuous events in the former USSR, noted a significant reduction in lost years due to lifespan disparities in the late '80s – attributed to the anti-alcohol campaign – and a profound deterioration in the mid-90s, following the USSR's dissolution and the ensuing socioeconomic crisis. It is paramount to highlight that the deterioration was significantly more severe for Russia and the Baltic States.

Males in Moldova and Belarus saw a more considerable reduction in lifespan disparity throughout the study period, 18.8% and 17.9%, respectively. Estonia, Czechia, and Lithuania also successfully reduced lifespan disparity among males, with reductions approximating 16%. The remaining Central European and Baltic countries obtained reductions between 11 and 15%, with Russia and Ukraine showing minimal progress, at 3.8% and 3.4%, respectively.

Utilising lifespan disparity as a foundational metric, an age threshold delineating premature mortality from deaths occurring at more advanced ages was established. Patterns in age threshold ($a^{\dagger}$) evolution reveal distinct trajectories for males and

females within the analysed European countries (Fig. 4). Among females, a pronounced convergence was observable until the early 1990s, succeeded by a phase of emerging and intensifying divergences. In contrast, male populations consistently diverged across countries from 1970 to 2019. This divergence became particularly pronounced in the early 1990s and the mid-first decade of the 21st century.

For males, divergences showed a clear upward trend from the onset of the period under review, peaking in 2005, followed by a subsequent decline phase. The gap in age thresholds among males widened from 7.3 years in 1970 to 22.2 years in 2005 before narrowing to 9.3 years by 2019. Russia exhibited the lowest age thresholds throughout this period, a distinction that shifted to Belarus and Latvia by 2019. Moldova and Bulgaria displayed the highest thresholds until 1993, after which Czechia consistently showed the highest values for the next 26 years.

In East European countries and Hungary, the male age threshold exhibited significant volatility, contrasting with the more stable trends observed in Czechia, Slovakia, Poland, and Bulgaria. Notably, the latter group experienced a slight decrease in the early 1990s, followed by an increasing trend. Despite

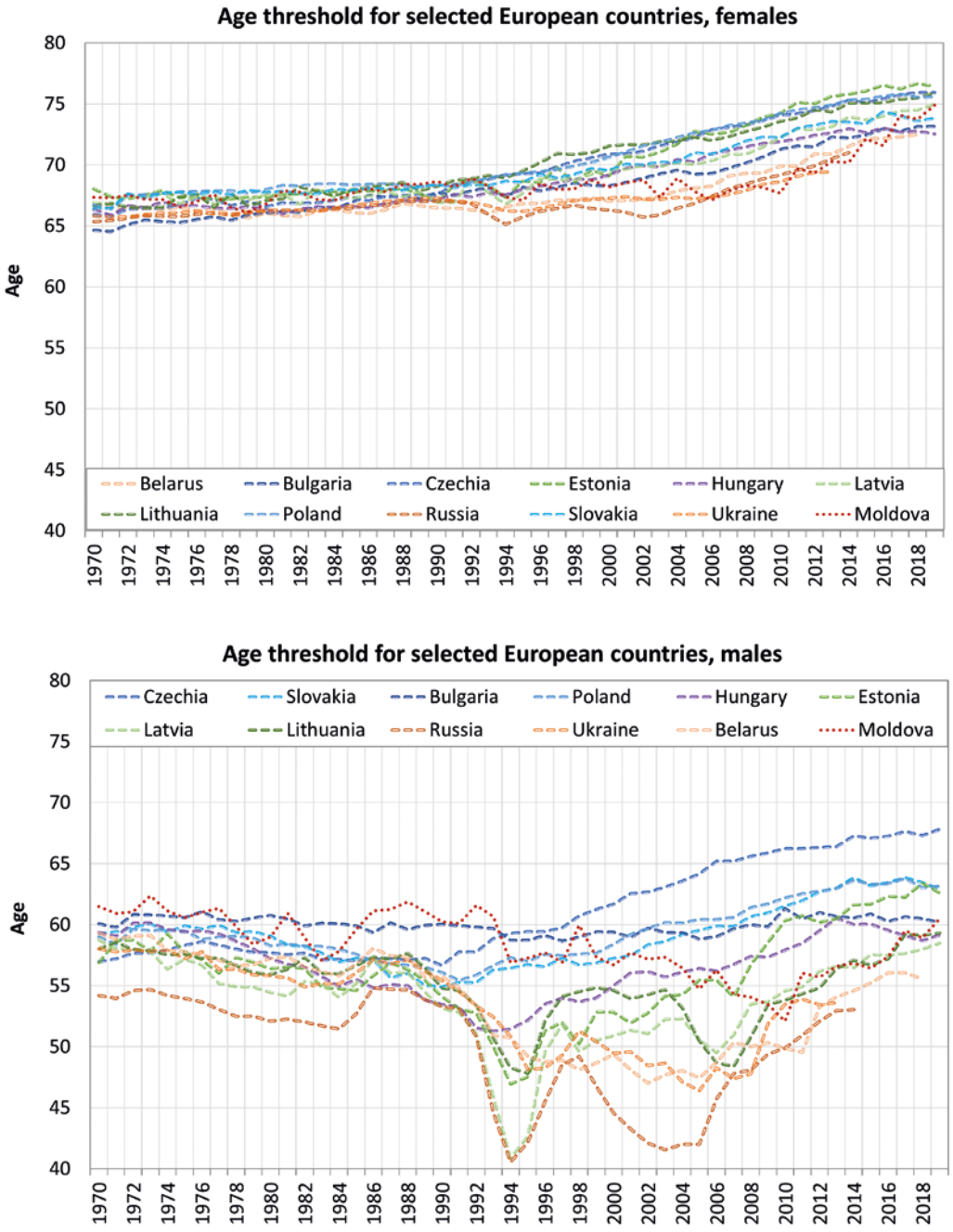

Fig. 4 Age threshold based on lifespan disparity in selected European countries, both sexes.
Source: Author calculations based on HMD data for all countries except Moldova.

starting with one of the highest thresholds in 1970, Bulgaria's trajectory is marked by stagnation, with the age threshold mainly maintaining similar values throughout the period under examination.

6. Discussion

This discussion draws upon comparative studies within the field to further elucidate the complex interplay between healthcare systems, socioeconomic development, and behavioural factors in shaping premature mortality. For instance, Nolte and McKee (2004) and subsequent analyses (Nolte et al. 2004) offer foundational insights into how the efficacy of healthcare systems critically influences levels of premature mortality. Our findings resonate with these insights, highlighting the nuanced roles of healthcare accessibility and quality in East and Central European countries. Acknowledging that the Semashko model implemented in analysed countries played an essential role in reducing premature mortality by promoting universal access to healthcare services is crucial. However, the gains achievable through these measures eventually reached their limits, necessitating systemic modifications to sustain the positive trend in reducing premature mortality. The importance of system transformations, along with the introduction of innovations, is clearly defined in Czech scholarly research, albeit focusing on increasing life expectancy (Lukášová 2018).

Moreover, by integrating the socioeconomic dimensions explored by different researchers (Kontopantelis et al. 2015; Plümper et al. 2018) and the behavioural dimensions of premature mortality, as explored by Leon et al. (2007) and Mackenbach et al. (2015), this study offers a comprehensive analysis that aligns with broader research trends. It is crucial to highlight that these socioeconomic and behavioural factors constitute the primary distinctions between East European and Baltic countries and their Central European counterparts, with alcohol consumption patterns particularly noteworthy. The impact of alcohol consumption was predominantly evident in the improvements noted as a result of the anti-alcohol campaign promoted by Gorbachev. Indeed, during the anti-alcohol campaign, the level of premature mortality observed in East European and Baltic countries was similar to that observed in Central European countries.

The significant disparities in premature mortality outcomes across different socio-political contexts underscore the multifactorial nature of this issue, reinforcing the need for a multidimensional approach to tackling premature deaths. The observed fluctuations in premature mortality, especially during the socioeconomic upheavals after the dissolution of the Soviet Union, provide a case study of the critical importance of resilient and adaptable healthcare systems in mitigating the adverse effects of such transitions on population health.

7. Conclusion

This study thoroughly examines premature mortality trends across European nations, leveraging both traditional and alternative indicators to shed light on the intricate dynamics of early mortality. Traditional indicators, such as the proportion of premature deaths before age 65, benefit from a direct calculation method and straightforward interpretation, facilitating widespread comprehension and application in public health evaluations. However, introducing lifespan disparity as an alternative indicator offers a more nuanced perspective on mortality patterns. By aligning closely with age-specific mortality trends, lifespan disparity adds significant analytical depth and introduces complexity in its calculation and interpretation.

The research underscores the utility of the age threshold derived from lifespan disparity, particularly when juxtaposed with static and absolute age thresholds. This comparison highlights the shifts in general mortality trends and the shortcomings of applying a uniform age threshold over time. Moreover, the derived age threshold from lifespan disparity possesses practical relevance for formulating targeted health strategies and policies. Identifying age groups where reductions in mortality would most effectively diminish lifespan disparity provides critical insights for interventions aimed at curtailing premature mortality. Using lifespan disparity and its associated age threshold allows us to devise nuanced and effective public health strategies tailored to the unique mortality challenges of diverse populations.

Nonetheless, these indicators are not devoid of limitations. The traditional method, while user-friendly, risks simplifying the complexities of premature mortality and might miss significant variations in mortality patterns across different demographics and temporal scales. Conversely, despite offering rich insights, the complexity inherent in the lifespan disparity indicator demands substantial data and analytical expertise, which could hinder its immediate utility in some contexts.

The empirical analysis reveals a consistent trend towards reducing premature mortality across all studied countries, albeit at disparate rates. Central European and Baltic countries display more consistent trends in reducing premature mortality, in contrast to the significant fluctuations observed in East European countries. Notably, Czechia, Slovakia, and Estonia are identified as frontrunners in advancing efforts to reduce premature mortality, evidencing the effectiveness of their public health policies and healthcare systems.

Additionally, the study points to persistent disparities between males and females in premature mortality level, with males disproportionately affected compared to females. This trend remained relatively unchanged throughout the study period, indicating a persistent challenge beyond healthcare access and improvements.

The analysis further critiques the adequacy of the conventional 65-year age threshold in accurately reflecting the nuances of premature mortality, particularly among females, in the examined countries. This observation advocates for a dynamic and context-sensitive approach to defining and assessing premature mortality, capable of accurately capturing mortality pattern shifts and the efficacy of mortality-reduction interventions.

Highlighting the divergent paths of premature mortality reduction in Central European versus East European and Baltic countries the study illustrates the intricate influence of socioeconomic development, healthcare system efficiency, and behavioural factors on health outcomes. The turbulent experience of the East European and Baltic countries emphasises the significant impact of socio-political changes on public health, necessitating ongoing research and targeted interventions.

In conclusion, this research charts the trajectory of premature mortality over a crucial period of European history and establishes a foundation for subsequent research. It advocates for an in-depth understanding of the drivers behind premature mortality and the creation of focused, evidence-based interventions. The findings stress the importance of dynamic, adaptable public health policies capable of effectively addressing the evolving challenges of premature mortality, thus fostering healthier and more resilient societies across Europe. Additionally, the study highlights the imperative of choosing mortality indicators congruent with public health research's specific aims and limitations. While the traditional metric of deaths before age 65 provides a broadly understandable measure, the nuanced insights offered by lifespan disparity and its derived age threshold enhance our understanding of premature mortality dynamics. Recognising the strengths and limitations of each indicator is essential for advancing our grasp of premature mortality and refining the development and execution of targeted public health interventions throughout Europe.

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