

FACTORS THAT HAVE IMPACT ON NATURAL POPULATION CHANGE IN REPUBLIC OF NORTH MACEDONIA

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Abstract

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The planning of public health programmes is directly related with the demographic characteristics and the population change has longterm impact on the health, health care and community interventions. The objective of this paper is to analyze the factors influencing the trend of population change in the Republic of North Macedonia. Material and methods: Data from the National Statistical Office and World Health Organization have been used. Literature review was conducted applying public health approach and descriptive method. Results: The natural population change in North Macedonia has negative trend in the last 10 years, the birth rate has declined, while the mortality is increasing. The biological factors and fertility rate have significantly influenced the birth rate, while the burden of chronic noncommunicable diseases, road injuries, violence and COVID-19 are lead causes of mortality. Numerous factors indirectly affect the negative trend of population change such as the high rate of unemployment, poverty, socioeconomic and political context, migration and availability and quality of health care. Conclusion: A detailed analysis of the factors affecting the natural population change and an appropriate national response with the aim of reducing the negative trends is needed.

JAVNO ZDRAVLJE

ФАКТОРИ КОИ ВЛИЈААТ НА ПРИРОДНОТО ДВИЖЕЊЕ НА НАСЕЛЕНИЕТО ВО РЕПУБЛИКА СЕВЕРНА МАКЕДОНИЈА

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Извадок

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Печатарски права: ©2023. Моника Стојчевска, Александра Стаменова, Фимка Тоџија. Оваа статија е со отворен пристап дистрибуирана под условите на нелокализирана лиценца, која овозможува неограничена употреба, дистрибуција и репродукција на било кој медиум, доколку се цитираат оригиналниот(ите) автор(и) и изворот.

Конкурентски интереси: Авторот изјавува дека нема конкурентски интереси.

Планирањето на јавноздравствените програми е директно поврзано со демографските карактеристики природното движење на населението и има долгорочно влијание врз здравјето, здравствената заштита и интервенциите во заедницата. Целта на овој труд е да се анализираат факторите кои влијаат на трендот на природното движење на населението во Република Северна Македонија. Материјал и методи: Користени се податоци од databазата на Државниот завод за статистика и Светската здравствена организација, кои се статистички обработени и прикажани табеларно и графички. Извршен е преглед на литература, а применет е јавноздравствен пристап и метод на дескриптивна анализа. Резултати: Природното движење на населението во Македонија покажува негативен тренд во последните десет години, односно се намалува наталитетот додека морталитетот е во позитивна насока, со зголемен број на починати лица. Биолошките фактори и стапката на фертилитет значајно влијаат на намалување на наталитетот, а од друга страна оптовареноста со хроничните незаразни болести, сообраќајните несреќи, насилството и Ковид-19 се главните причини за зголемената смртност. Бројни индиректни фактори влијаат на негативниот тренд на природното движење на населението, како што се високата стапка на сиромаштија и невработеност, социоекономскиот и политички контекст, миграциите и пристапот и квалитетот на здравствена заштита. Заклучок: Потребна е детална анализа на факторите кои влијаат на природното движење на населението и соодветен национален одговор со цел намалување на негативниот тренд.

Introduction

The natural population change in the Republic of North Macedonia (hereinafter referred to as Macedonia) stands as one of the most important components on which the dynamics and the population number depend.

The natural population change is a biological movement that pertains to reproduction, or better, the sustainability of the human race. It depends on the number of births, i.e. birth rate, and the number of deaths, or the mortality rate, and the natural increase is a result of their mutual relationship, i.e. the difference between the two.¹

The birth rate represents the ratio between the number of live births and the average population number in the middle of the year for which the calculation is made, calculated per 1000 inhabitants¹.

The mortality rate represents the ratio of the number of people who died during the entire year (calendar year) and the average population number in the middle of the year, calculated per 1000 inhabitants, which means the rate shows how many people died on average per 1000 inhabitants

The natality depends on numerous factors such as biological, socio-economic, cultural and psychological.² At the global level, three types of birth rate can be distinguished: low birth rate up to 15‰ annual rate, medium from 16 to 25‰ and high above 25‰.² The birth rate in Macedonia exhibits a gradually decreasing trend over the years. The number of live births in 1994 stood at 31 421 children, while in 2021 it stood 18 790 children.

Mortality is influenced by numerous factors such as the age structure of the population, socioeconomic conditions, environmental conditions, level of health care and health services, the standard of living, whether or not there is warfare, disasters and others.² The mortality rate in Macedonia has been increasing constantly, in particular during the Covid-19 pandemic, when the mortality rate in 2020 was 12.4 deaths per 1000 inhabitants, or the total number of deaths was 25,755.1 In 2021 in Macedonia the mortality rate is 15.5 deaths per 1000 inhabitants or the number of deaths is 28 516 people.¹ The global mortality rate in 2020 stood at 8 dead people, and in 2021 it stood at 8.4 per 1000 inhabitants³

The natural increase in Macedonia stood at 15,772 in 1994, though it has been declining since 2019. In 2019, the natural increase stood at -601, in 2020, as a result of Covid-19, it stood at -6,724, and in 2021, the natural increase showed a negative trend of -9,868. Unlike recent years, the natural increase in 2010, which is only ten years ago, was +5 183.1.¹

The purpose of this paper is to analyze the natural change in the population in Macedonia and to summarize the factors that contribute to the negative trend of the natural increase observed in recent years.

Materials and methods

Data on birth rate, mortality rate and natural increase in Macedonia from the MaxStat database of the State Statistics Office of the Republic of North Macedonia, the World Health Organization (WHO) Health for All databases and the European Health

Information Gateway were used, as well as the database and publications of the Institute for Health Metrics and Evaluation in Washington (Institute for Health Metrics and Evaluation-IHME).

A literature review was performed, and a public health approach and descriptive analysis method were applied. The data are statistically processed and presented in tables and charts.

Results

Natality

The natality in Macedonia exhibits a decreasing trend over the course of the last decade. The number of live births in 2010 was 24,296, and in 2020, it was 19,031 live births. According to the data of the State Statistics Office in 2021, 18,790 children were born in Macedonia, of which

18,648 were live births and 142 were stillborn. The number of live births is 2.0% lower compared to the year before.¹

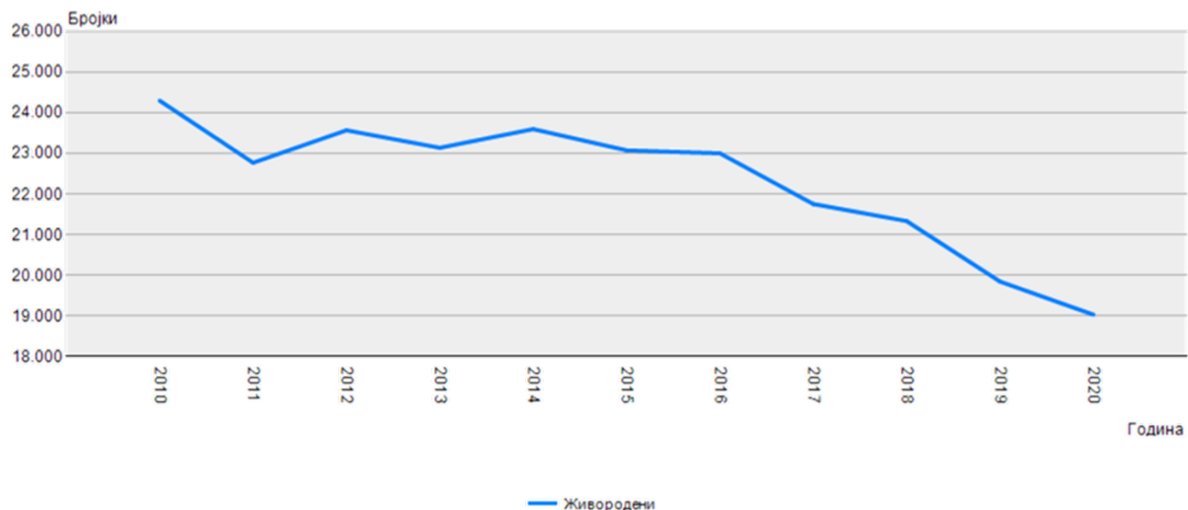
Looking at regions, the largest number of live births in 2021 were in the Skopje region, 7256, followed by the Polog region with 2762 live births. The lowest percentage of live births, 1173, was in the eastern region. In the Skopje region, the highest number of live births were in the municipality of Chair, 873, and the lowest in the municipality of Shuto Orizari, with 380 live births. For example, in 2005, the situation was different with a total of 22482 live births, of which 7282 were in the Skopje region, 3602 in the Polog region, 2213 in the southwest, and 1619 in the eastern region.¹

The birth rate in Macedonia in 2021 was the highest in the Skopje region, and the lowest in the eastern region (table 1)¹

Table 1: Birth rate, mortality rate and natural increase in Macedonia in 2021, by region

2021	Birth rate	Mortality rate	Natural increase
Macedonia	10.2	15.5	-5.4
Vardar region	9.1	17.0	-8.0
Eastern region	7.8	17.9	-10.1
Southwestern region	9.4	14.8	-5.4
Southeastern region	8.6	16.7	-8.1
Pelagonian region	8.3	17.2	-8.9
Polog region	11.0	14.2	-3.2
Northeastern region	9.9	16.0	-6.1
Skopje region	12.0	14.4	-2.4

Source: State Statistics Office of the Republic of North Macedonia, 2022.¹

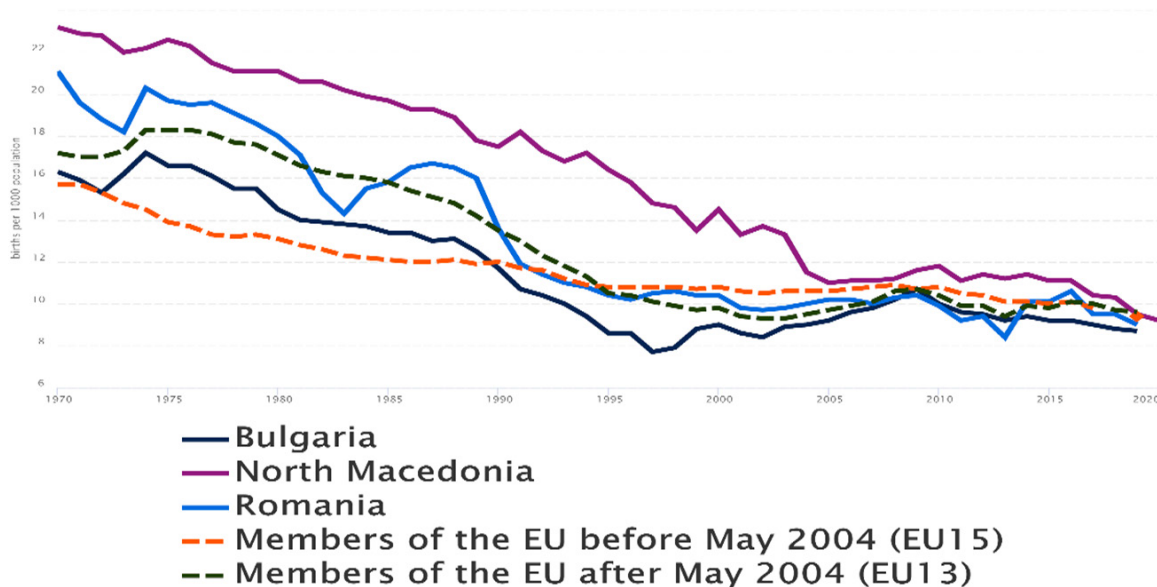


Source: State Statistics Office of the Republic of North Macedonia, 2022¹

Graph1: Number of live births (total number) in Macedonia in the period 2010 to 2020.

We can see on graph 1 the natality linear movement in Macedonia in the period between 2010 to 2020 according to the data from the State

Statistics Office. The trend line is in a slight decline, with the declining trend line more noticeable since 2018.¹



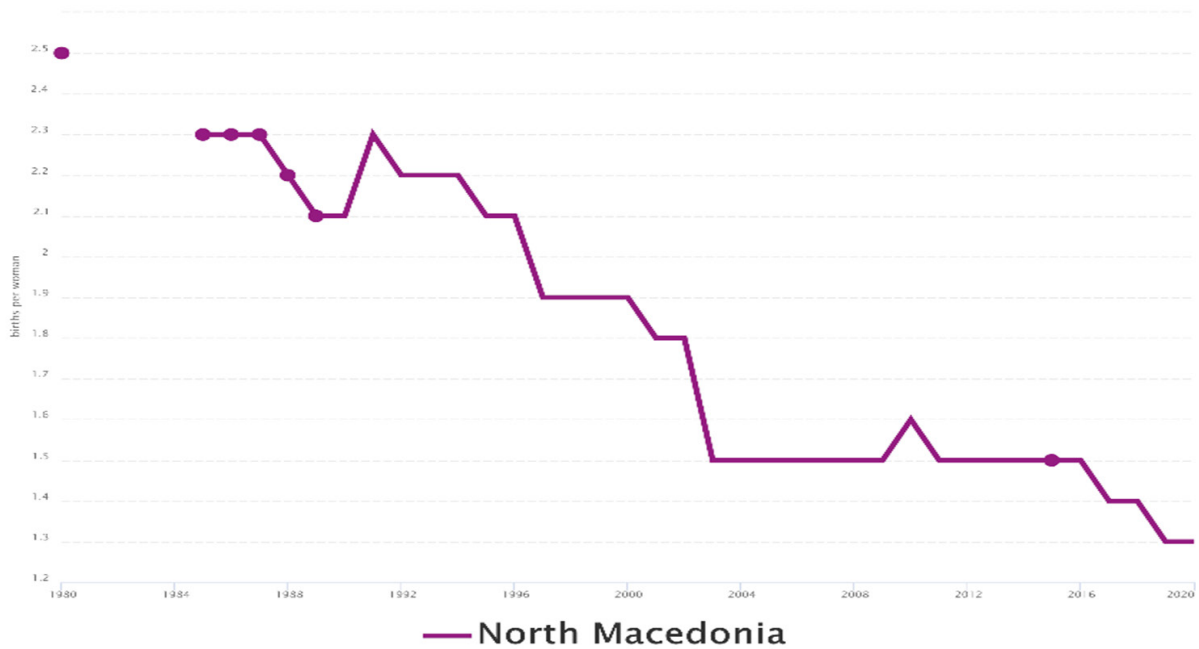
Source: European health information gateway, 2022⁴

Graph 2: Birth rate, births per 1000 inhabitants in Macedonia, Bulgaria, Romania and the average of the member states of the European Union for the period between 1970 to 2020.

The rate of live births per 1000 inhabitants in Macedonia for 2020 stood at 9.2 and is in along the same lines as the member states of the European Union, where the rate stands

at 9.6 (graph 2).⁴

-The fertility rate in Macedonia exhibits a constant negative trend and in 2020 it stood at 1.3 births per woman. (graph 3)⁴



Source: European health information gateway, 2022⁴

Graph 3: Graph 3 Fertility rate among women in Macedonia in the period between 1984 to 2020.

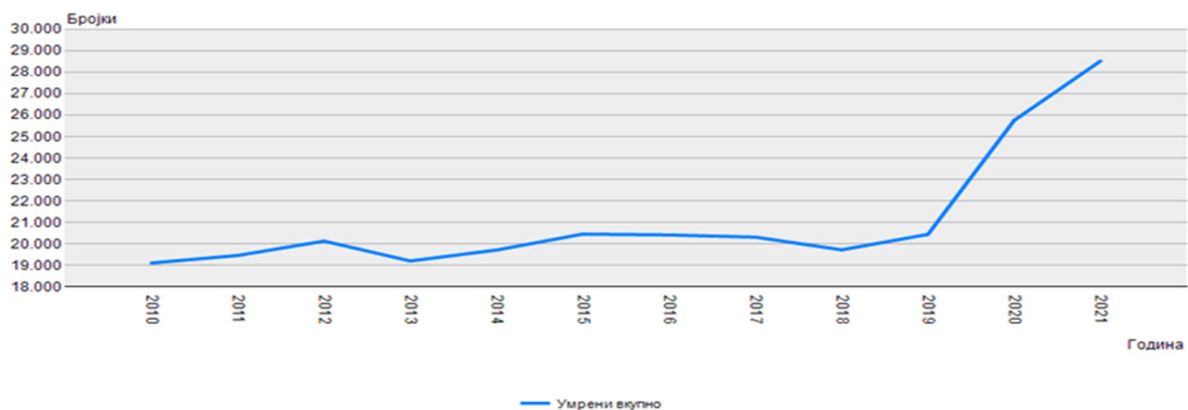
Mortality

In Macedonia, the mortality trend has been increasing in the last decade, reaching the highest point in 2020 due to the Covid-19 pandemic, when this number increased significantly. The number of deceased persons in 2010 was 19,113, and in 2020 that number reached 25 755 deceased persons. In 2021, the number of deceased persons was 10.7% higher than the year before and amounted to 28516 deceased persons. The average age of deceased men was

71.6 while the average age of deceased women was 75.2 years. The highest number of deaths was in the Skopje region with 8715 deaths, while the lowest was in the Vardar region with 2 365 deaths.¹

The mortality rate by region in Macedonia in 2021 stood the highest in the Eastern region, with the lowest in the Polog region (table number 1).¹

The trend between 2010 to 2019 shows a slight increase, while from 2019 onwards, the trend shows a sharp increase (graph 4).¹

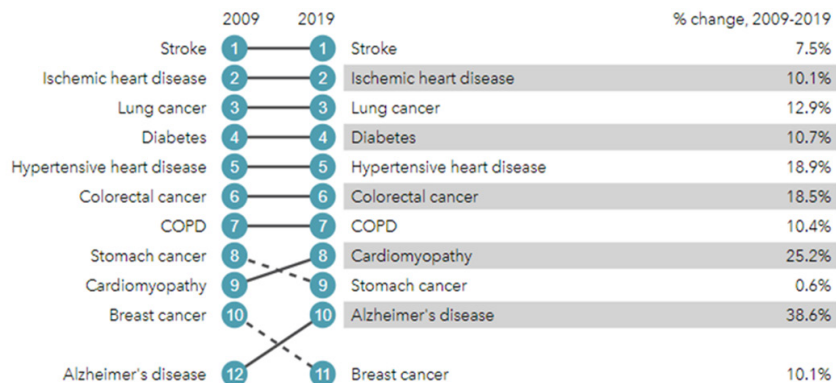


Source: State Statistics Office of the Republic of North Macedonia, 2022¹

Graph 4: Number of deaths in Macedonia in the period between 2010 to 2021

The leading causes of death in Macedonia in 2019 were stroke, ischemic heart disease and lung cancer, with their share remaining unchanged compared to 2009, showing a wors-

ening trend. Diabetes and hypertensive heart disease were the next leading causes of death. Alzheimer's disease and breast cancer (graph 5) stood last as the causes of death)⁵

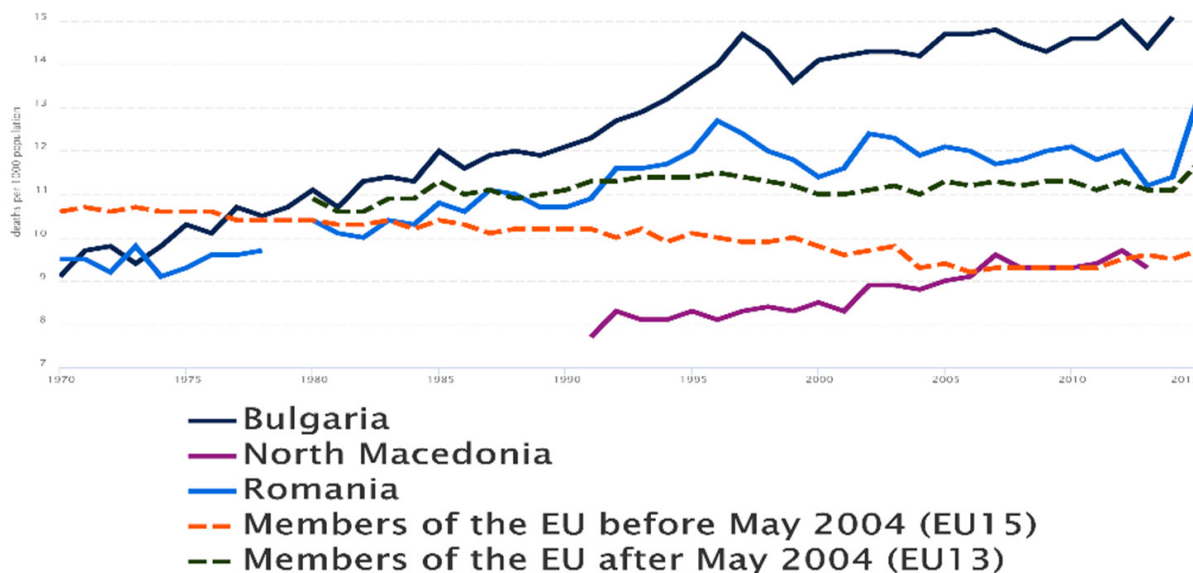


Source: IHME, 2019⁵

Graph 5: 10 leading causes of death in Macedonia in 2009 and in 2019

The death rate per 1000 inhabitants in Macedonia in 2015 was 9.3, compared to the members of the Euro-

pean Union where it was 11.7, and Bulgaria with 15.1 deaths per 1000 inhabitants (graph 6).⁴



Source: European health information gateway,2022⁴

Graph 6: Mortality rate, deaths per 1000 inhabitants in Macedonia, Bulgaria, Romania and the average of the member states of the European Union, for the period between 1970 to 2015

Natural increase

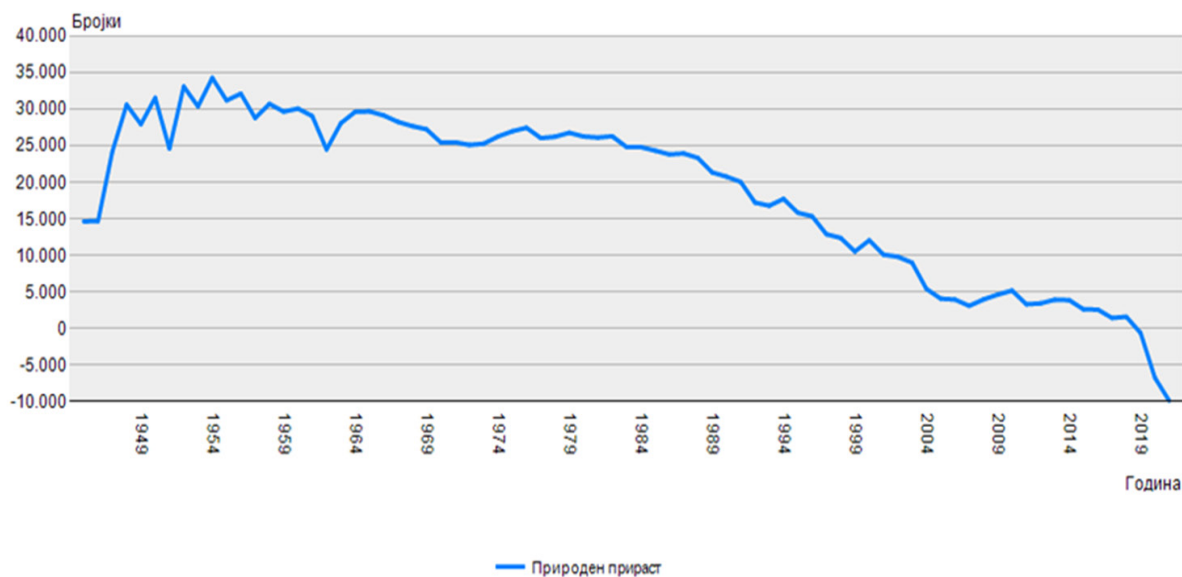
The natural increase in Macedonia shows a negative trend. In 1949,

the natural increase reached 27 917, while in 2021 it stood at -9 868. According to the data from the State Statistics Office in the second half of

2022, the natural increase was negative, amounting to -381, which shows the number of people by which the number of live births is lower than the number of deceased people (graph 6).¹

The number of live births in the second quarter of 2022 compared to

the same period of the previous year decreased by 6.5% and amounted to 4379 live births. The number of deceased persons in the first half of 2022 dropped by 33.4% compared to the same period of 2021, amounting to 4 760 deceased persons, of which 22 were infants.¹



Source: State Statistics Office of the Republic of North Macedonia, 2022¹

Graph 7: Trend of natural increase in Macedonia in the period 1949 to 2021

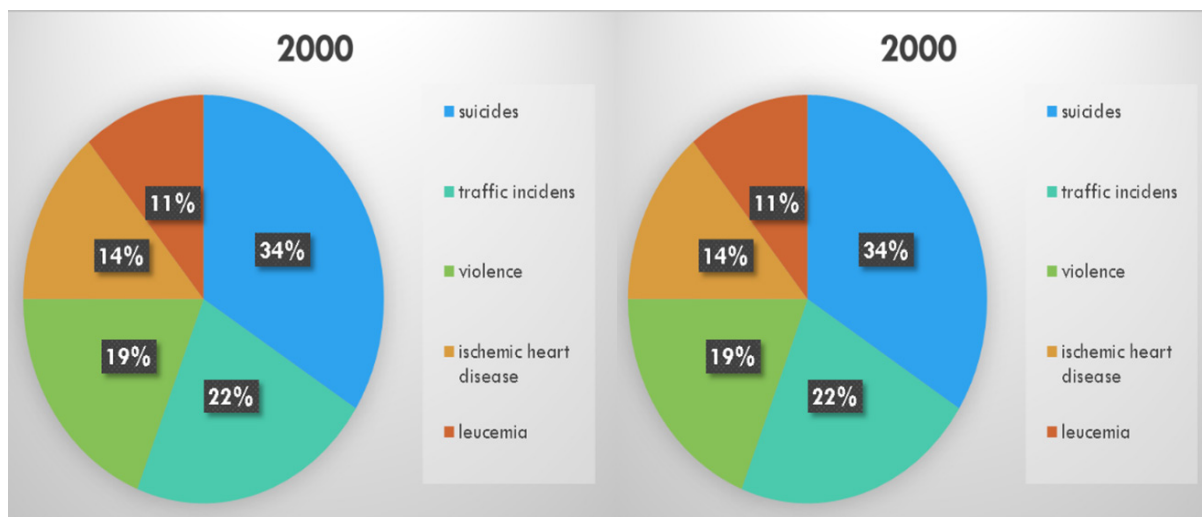
The rate of natural increase in Macedonia in 2021 is the highest in the Skopje region, and the lowest in the eastern region (table 1).¹

Leading causes of death in Macedonia in the period between 2000 to 2020

Among young people aged 15 to 24 in Macedonia, traffic accidents and suicides were the leading cause of death with a share of the total mortality of 4.8% and 3.2% in 2000 and 2020 respectively.

Among the population aged 25-34 the leading cause of death was suicide in 2000, while in 2020, Covid-19 took the lead (chart 8).⁶ In the age group from 35 to 54 the dominant cause of death in 2000 was ischemic heart disease with 42% of the total number of deaths, and in 2020 the dominant cause of death was Covid-19 with 51%.⁶

Similarly, in the age group from 55 to 74 years, Covid-19 was the leading cause of death in 2020 with a share of 15%, followed by cerebrovascular diseases with 14.1% of deaths and diabetes mellitus with 1.91%, while in 2000, the main causes were cerebrovascular diseases.⁶

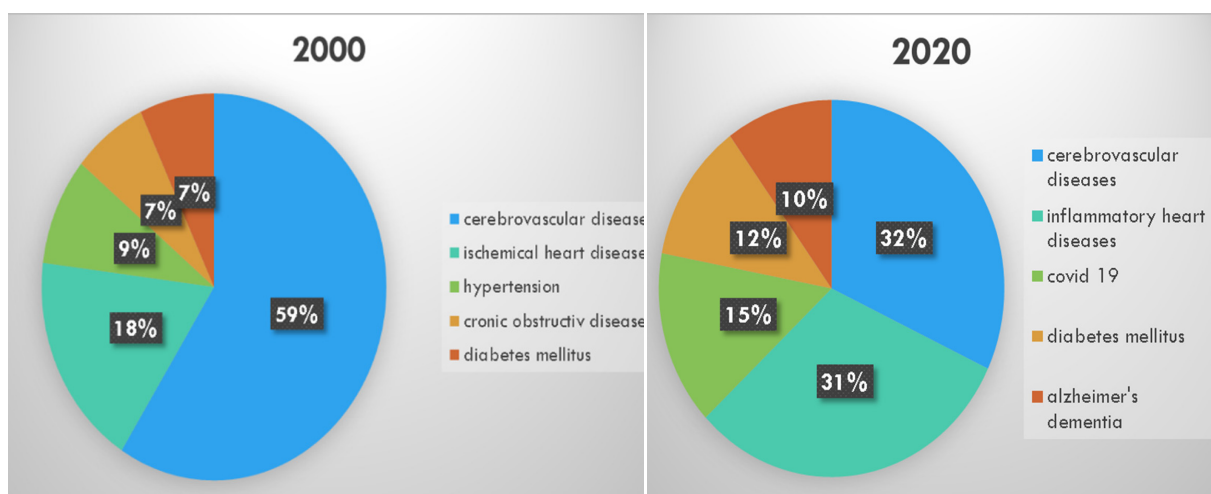


Source: World Health Organisation, 2022⁶

Graph 8: Causes of death in the age group 25 to 34 years, in the period between 2000 to 2020 in Macedonia

The most common causes of death among the age group over 75 in 2000 are cerebrovascular diseases with 59%, and in 2020, apart from

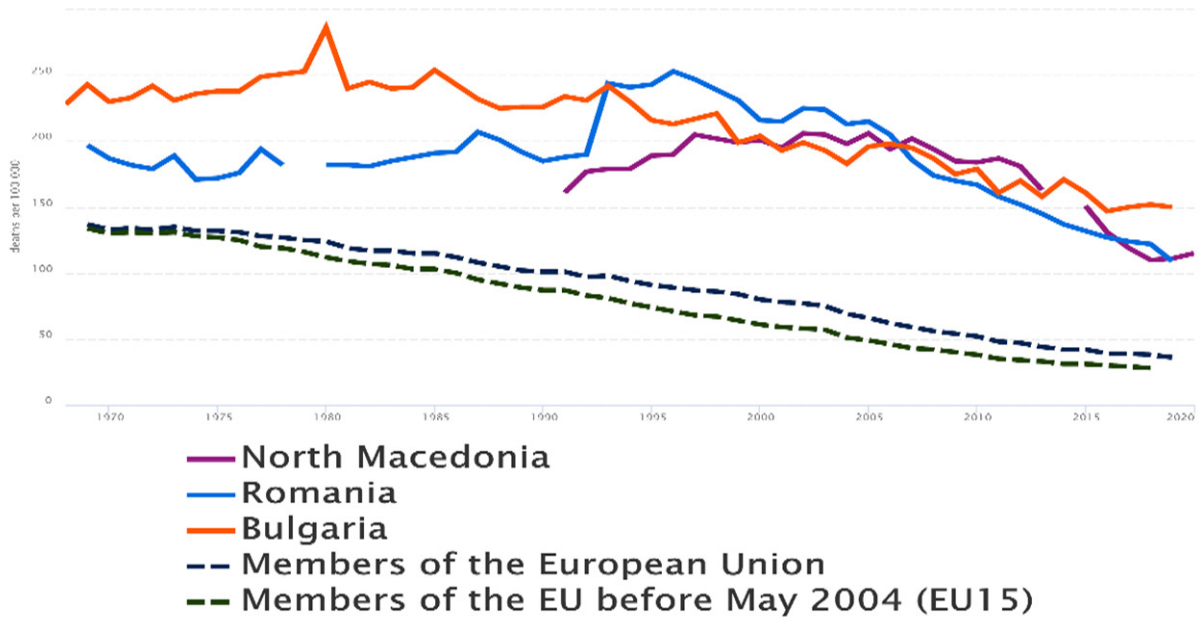
cerebrovascular diseases, Covid -19 is also among the main causes of death, with a share of 31% of the total mortality (Graph 9).⁶



Source: World Health Organisation, 2022⁶

Graph 9: Causes of death in the age group over 75, between 2000 to 2020 in Macedonia

The death rate from cerebrovascular diseases per 100,000 inhabitants in Macedonia was 17.7 in 2020, which is much higher compared to the members of the European Union where the death rate is 13.3 (graph 10).⁴



Source: European health information gateway , 2022⁴

Graph 10: Trend of death rate per 100,000 inhabitants from cerebrovascular diseases in Macedonia, Bulgaria, Romania and the average of the member countries of the European Union in the period from 1970 to 2020

Discussion

Direct factors

The natality has been declining from 24 296 live births in 2010 to 19031 in 2020. Both globally, as well as in Macedonia, with the modernization of society and an increasing number of women in employment, unlike in the past, the number of children a woman gives birth to during her life is also decreasing. In 1950 the average number of children per woman was 5, while in 2020 the average was 2.5 children per woman. This is impacted by education, the economic development of the state, modernization and urbanization of society, the emancipation of women⁷, as well as political freedom, which plays a role in the perceptions of the population regarding fertility.⁸

At the global level, according to the WHO, the top 10 causes of death have been selected, where the first place is taken by ischemic heart dis-

ease, second place is stroke, the third is chronic obstructive pulmonary disease, the 4th place is lower respiratory tract infections, the 5th place is neonatal conditions, 6 cancer of the trachea, bronchi and lungs, Alzheimer’s disease is at the 7th place, followed by diarrheal diseases, and the last two places are taken by diabetes mellitus and kidney diseases.⁹

In developed countries, 55% of deaths or 55.4 million people died from the three most common groups of diseases, namely cardiovascular diseases (ischemic heart disease, stroke), respiratory diseases, chronic obstructive pulmonary disease, lower respiratory tract infections and neonatal conditions (asphyxia, birth trauma, neonatal sepsis and infections and complications at childbirth). Unlike developed countries, in countries with medium and low economic development, the first three causes of death are infectious diseases such as malaria, tuberculosis and HIV in-

fection.^{6,9} Diseases primarily of the cardiovascular and respiratory system, but also other infectious and non-infectious diseases have a major impact globally on high mortality in both developed and developing countries.⁶

Mortality rates among infants and children have significantly decreased both globally as well as in Macedonia, while the mortality rate among the elderly population is increasing. If we take into account the extended life span and the aging trend of the population, it is clear why the leading causes of mortality are chronic non-communicable diseases, and hence it can be seen that the age structure is a significant factor affecting mortality.¹⁰

The most important determinant of mortality is health care, as according to the literature, low quality of health services is the main driver of premature mortality from chronic non-communicable diseases and about 8.6 million deaths can be prevented by improving access and quality of healthcare.¹¹

A detailed assessment of the national diseases and risk factors burden along the lines of strengthening health care and in particular, prevention, is the key to reducing the mortality of the population.

Indirect factors

Indirect factors also play a major role in the natural change in the population. The impact of social determinants on health can come from various aspects of life and environment, a consequence of some decisions made, government activities, or wars that can significantly change the de-

mographic map of a country. Natural disasters (earthquakes, droughts, ice rinks, avalanches, floods, etc.) affect the natural population change.

The territory of Macedonia has such a geographical position that it is suitable for natural disasters, which can be directly or indirectly influenced by man. Throughout history, the most famous natural disasters on the territory of Macedonia are: the earthquake in Skopje in 1963 with 1100 victims and over 4000 injured, the earthquake in Valandovo in 1931 with 15-200 victims and hundreds of injured, the avalanche-landslide along the Radika river valley in 1956 with 52 casualties, torrential flood in Skopje 2016 with 23 casualties, landslide in Kavadarci in 1956 with 11 casualties, lightning strike in Berovo in 1996 with 9 casualties and around 50 injured, earthquake in Debar in 1967 with 6 casualties, torrential flood in Shipkovicica in 2015 with 5 casualties, heat wave in July and August 2007, when dozens of people died either directly or indirectly as a result of it.¹²

Socioeconomic factors and political context

Wars, epidemics, crises, food production, technical breakdowns, accidents, health conditions, social conditions, poverty and hunger, material status, culture, ethics, ideological and psychological heritage, religious influences, territorial threats, and population policy affect the natural population change in Macedonia.

The poverty rate in Macedonia in 2020 was 23%, compared to 2019 when it was 17%, as a result of the Covid 19 crisis.¹³

The unemployment rate in Macedonia was 16.7% in 2020, and the number of unemployed was 159,623 people. The unemployment rate in 2019 was 17.3%.⁴

The main obstacles and problems in the provision of healthcare services in Macedonia are: poor availability of outpatient clinics and health facilities, women from rural areas do not have access to a gynecologist, a poor network of local health services, lack of appropriate valid health documentation for a large number of citizens and others.¹⁴⁻¹⁶

Biological or human factors

Physiological readiness, age, the desire to reproduce, infertility, hereditary traits, lactation and other biological factors influence the natural increase of the population.¹⁷

Government policies in some countries have a significant impact on population growth, such as the example of China where the government has banned the birth of a third child. Another significant factor is the emancipation of women, their position in society, education and the growing desire for a greater position in the working environment, which can lead to delayed birth.¹⁷

Urbanization on the other hand leads to an increase in the birth rate and a decrease in the death rate. People have better access to timely use of medical facilities in urban areas, which can reduce neonatal and infant mortality.^{17,18}

Education is an important factor in population growth. Education is important for reducing the mortality rate, by educating people about the

prevention of communicable and non-communicable diseases. An example is some diseases that in the past have killed millions of lives, but today they have been eradicated by properly educating people on how to protect and treat themselves. Spreading the literacy of mothers to protect themselves and their children has a particular impact, which reduces mortality and morbidity among pregnant women, nursing mothers, newborns and children.¹⁸

Among the important factors affecting mortality are the programs and activities undertaken in low and medium growth countries, such as support from developed countries for the delivery and availability of medicines, food and basic necessities of life for people, presentation of various immunization programs and campaigns, preservation of the environment, reduction of air pollution, tobacco control programs, presentation of the dangers of drugs and psychotropic substances.¹⁷

Through the improvement of economic growth, better education of the population, increase in per capita income, and improved health conditions, the life expectancy rate can be increased in both developed and developing countries. According to WHO, the average global life expectancy today is 73.4 years, while in 2000 it was 66.8 years.

Politics has an impact on the natural increase. Various political disputes and quarrels lead to wars and conflicts and thus population migration and increased mortality. The economic conditions in the countries further motivate people to move to countries with better conditions for a higher salary, the possibility of ad-

vancement, better health conditions, and better conditions for starting a business and its development.¹⁷

Conclusion

The study of the natural population change in Macedonia is an important topic in public health in order to plan health care and respond to the needs of the population. In Macedonia, there is a continuous downward trend in natality and an upward trend in mortality, which results in a negative natural increase. The most dominant factor that has influenced this situation in recent years has been the Covid-19 pandemic as a direct factor to an increase in mortality, but also as an indirect factor, by highlighting inequalities and poverty. This trend is expected to continue due to the aging of the population and the burden of chronic non-communicable diseases, injuries and violence as public health priorities that are not adequately addressed.

Hence the need for a detailed analysis of the factors that influence this negative trend of the natural population change, especially the indirect factors, as well as an appropriate national response.

References

1. State Statistics Office of the Republic of North Macedonia. MakStat database, 2022 Available at: http://makstat.stat.gov.mk/PX-Web/pxweb/mk/MakStat/MakStat__Naselenie__Vitalna/125_VitStat_Mk_PrDviz_mk.px/?rxid=23ade496-1a94-4844-88f3-9152370caac9 (Accessed 06.09.2022)
2. Dimitrov N. Demographics. Goce Delchev University, 2012; 32-54
3. World Bank. Death rate crude (per 1000 people) World development indicators. The World Bank groups, 2022. Available at: <https://data.worldbank.org/indicator/SP.DYN.CDRT.IN> (Accessed 13.01.2023)
4. European health information gateway, Indicator explorer. WHO Regional Office for Europe. Database European health for all explorer 2021. Available at: <https://gateway.euro.who.int/en/hfa-explorer/> (Accessed: 10.09.2022)
5. The Institute for Health Metrics and Evaluation (IHME). Country profiles. University of Washington, 2021. Available at: <https://www.healthdata.org/results/country-profiles> (Accessed: 10.09.2022)
6. World Health Organization. Mortality database, 2022. Available at: <https://platform.who.int/mortality> (Accessed: 07.09.2022)
7. Skakkebaek NE, Lindahl-Jacobsen R, Levine H. et al. Environmental factors in declining human fertility. *Nat Rev Endocrinol* 2022; 18: 139-157 (2022). <https://doi.org/10.1038/s41574-021-00598-8>
8. Wang Q, Sun X. The role of socio-political and economic factors in fertility decline: A Cross-country analysis. *World Development* 2016; 87:360-370 DOI: <https://doi.org/10.1016/j.worlddev.2016.07.004>
9. WHO Global Health Observa-

- tory, 2022. Available at: <https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates>(Accessed: 01.09.2022)
10. Perrott SG, Holland FD. Population Trends and Problems of Public Health. *Milbank Q*, 2005; 83(4):569-608. DOI: 10.1111/j.1468-0009.2005.00393.x
 11. Kruk EM, Gage DA, Joseph TN, Danaei G, Garcia-Saiso S, Salomon AJ. Mortality due to low-quality health systems in the universal health coverage era: a systematic analysis of amenable deaths in 137 countries. *Lancet*, 2018; 392(10160):2203-2212. Doi:10.1016/S0140-6736(18)31668-4
 12. The biggest natural disasters in Macedonia. Available at: https://www.fakulteti.mk/news/16-09-30/najgolemite_prirodni_nepogodi_vo_makedonija_vo_poslednite_100_godini (Accessed: 13.09.2022)
 13. Macedonian platform against poverty. Report on poverty in North Macedonia, 2020. Available at: https://www.eapn.eu/wp-content/uploads/2021/02/EAPN-Poverty-Watch-2020_%D0%9C%D0%9A-4946.pdf (Accessed: 01.11.2022)
 14. Gudeva ND, Tozija F. Social determinants of equity in access to healthcare for tuberculosis patients in Republic of Macedonia-result from a case-control study. *Int Health Police Manag* 2014; 3(4) :199 -205
 15. Tozija F. Social Determinants of Self-reported Health Among Population in Republic of Macedonia - Results from a Case-control Study. *Mater Sociomed*. 2014 ; 26(4): 264-267
 16. Mitevaska L, Stanculescu MS, Stikova E. Performance of the public health care sector in the Republic of Macedonia. *South Eastern European Journal of Public Health (SEEJPH)*, 2016; 6. DOI: <https://doi.org/10.4119/seejph-1832>
 17. Wagle K. Public health notes. Population growth and components of population growth, 2021. Available at: <https://www.publichealthnotes.com/population-growth-and-components-of-population-growth/> (Accessed: 06.09.2022)
 18. Wenner J. Geology Department Population growth and resource depletion, University of Wisconsin-Oshkosh, 2020. Available at: <https://serc.carleton.edu/quantskills/methods/quantlit/popgrowth.html>(Accessed:10.09.2022)