



SEASONALITY IN HUMAN MORTALITY: RESULTS FOR THE CITY OF NOVI SAD (SERBIA)

*Daniela ARSENOVIĆ**

Seasonal variation in mortality has long been recognized and confirmed in diverse studies by demographers, climatologists, medics, sociologists etc. Existing research suggests that most world regions experience increase in mortality during winter period and that countries and regions in temperate climate have higher winter mortality than regions in colder climate. As well, numerous studies have so far demonstrated temperature-related mortality associations with increased risk due to both heat-related and cold-related death. The objective of this paper is to research seasonal variations in mortality due to seasonal changes in average air temperature among urban population of Novi Sad (Serbia). The analysis covered the period between 1953 and 2013 for both total and old population (65 and over) by gender and for all-cause mortality, while causes of death were observed only for the 1998-2013 period. This paper considers only cardiovascular diseases I00-I99 (CVD) according to the International Classification of Diseases (ICD, version 10). Seasonal changes in mortality were observed using the coefficient of seasonal variation in mortality (CSVM) while the data were split into five periods in order to research temporal changes. Results for CSVM indicated that mortality in winter period was higher than mortality in non-winter periods, whilst the analysis of the temperature-related mortality suggests that low temperature caused an increase in mortality over the entire year. Despite the confirmed seasonal changes in mortality and the evidence for temperature-related mortality, this research has recognized a declining trend in population vulnerability over time.

Keywords: *mortality, seasonality changes, Serbia, average air temperature, cardiovascular mortality*

Introduction

Seasonal pattern of mortality has long been recognized and detected. Seasonality of mortality is related with different demographic and social factors, environmental issues etc. During the twentieth century climate changes sparked research about influences of climate on mortality and the most frequent issue was the air pollution and the air temperature related mortality.

* Faculty of Sciences, University of Novi Sad, Novi Sad (Serbia);
email: daniela.arsenovic@dgt.uns.ac.rs

One part of the findings supports the standpoint that extreme events have the biggest impact on population health and seasonal changes in mortality, but contrary to this, there is an opinion that seasonality in mortality is connected with regular changes of weather during the year. Both these are justified considering different approaches due to the fact that extreme weather events are observed in a short period, usually during extreme hot or cold periods, while seasonal changes of weather and their impact on mortality are analysed during longer time series.

Contemporary findings suggest that seasonality in mortality has been associated with the effects of both heat and cold (Pattenden *et al.*, 2003). Usually J-, V-, or U-shaped association has been detected with increased mortality at cold and hot temperatures and minimum mortality occurring at various points, depending on latitude (Analitis *et al.*, 2008). Heat waves during the summer of 2003 were breaking news around the Europe, especially in the most affected countries such as France, Italy, Switzerland and Portugal. France was the most affected European country by the heat wave with the estimated excess mortality of 54%. Across the nine largest French cities, 14,800 excess deaths occurred from 1 to 20 August 2003, an overall 60% increase in mortality compared to the seasonal norm (Le Tertre *et al.*, 2006). Similar results were confirmed in other countries in Europe after 2006, 2007 and 2009 when strong heat waves were registered around European regions (Dousset *et al.*, 2011). Harvesting impact of heat waves were also reported in California (Ostro *et al.*, 2009) and Chicago (Naughton *et al.*, 2002).

Despite the increase in number, as well as in duration and intensity of heat waves, and impact on human mortality, observations on a yearly basis shows that majority of countries have experienced a higher mortality during the winter months. A more complex demographic approach to the problem of seasonality in mortality was given by Roland Rau. He investigated seasonal variation in mortality for the United States and Denmark population during the second half of the twentieth century. Seasonal pattern of mortality was confirmed in both countries with the highest mortality during the winter months (Rau, 2007). A study about seasonality of mortality and role of temperature in Germany (1946-1995) shows “that low temperatures cause an increase in mortality rates and that this effect has become less important during recent decades....” (Lerch, 1998). The similar was found for some other countries in Europe. Healy (2003) investigated excess winter mortality in the regions of the EU-14 for the period 1988-97. Results in this study show higher winter mortality in all EU-14 states. For the EU-14, the winter mortality was 16 percent higher compared to other periods of year, while comparing between countries, Portugal suffers from higher excess winter mortality (28 percent). Davie *et al.*

(2007) explored winter mortality in New Zealand and confirmed significant excess mortality during the winter period (18 percent higher). Marti-Soler *et al.* (2014) analysed overall and cardiovascular mortality for 19 countries with different geographical location. In both hemispheres winter mortality was higher than expected and they found seasonal pattern for overall and cardiovascular mortality, while for mortality due to cancer, the seasonal variation was non-existent in most countries.

The research on this topic in Serbia was conducted in various directions, e.g. following excess winter mortality, specific-cause mortality due to the changes in air temperature or during heatwaves etc. All results presented in Table 1 are related to the beginning of the twenty-first century, because the majority of the data for earlier periods are not as available, while the other reason is related to the growing concern about heatwave impact on population since 2003. Only one study dealt with the population on the state level (Blagojević *et al.*, 2012), while others were focused at the urban population in largest cities in the country. All studies confirmed that the mortality trend, particularly cardiovascular and respiratory mortality, depends on air temperature during the year or the specific season.

In this process, cities are marked as very vulnerable places where extreme hot and cold events lead to increase of daily death (Kinney *et al.*, 2015). Main objectives of this paper are to research changes in seasonal pattern of mortality and its relationship with temperature in urban area of Novi Sad. The research was conducted for the period between 1953 and 2013. Novi Sad is located in the north part of Serbia and it is a second largest city in the country. According to the data by the Statistical Office of the Republic of Serbia, 231,798 inhabitants resided in the urban area of Novi Sad in 2011 (SORS, 2012).

Data and methodology

For the period between 1953 and 1997 the mortality data was collected from civil registers, whilst for the period between 1998 and 2013 the data was obtained from the Statistical Office of the Republic of Serbia. During the observed period (1953-2013) 84,413 deaths were included in analysis. Number of deaths was aggregated on monthly level. Monthly crude death rate (CDR) per 100,000 was calculated with all months standardised to 30 days. The average air temperature (T avg.) was used for the analysis of mortality and climate relationship. Data for temperature was taken from NOAA (National Oceanic and Atmospheric Administration, United States De-

partment of Commerce). Relation between the crude death rate and the average temperature was analysed through linear regression.

Table 1
Review of recent research about temperature-related mortality and seasonality in mortality in Serbia

<i>Source</i>	<i>Area and period</i>	<i>Population indices</i>	<i>Climate indices</i>	<i>Method</i>	<i>Results</i>
Stanišić Stojić <i>et al.</i> , 2016	Belgrade 2009-2014	Mortality in old population, for circulatory and respiratory causes	Air pollution, Temperature	Poisson regression model	Strong seasonal pattern, with mortality peak in winter months (February)
Stanišić Stojić <i>et al.</i> , 2016a.	Belgrade 2009-2014	Cardiovascular, respiratory and cancer mortality	-	Winter/summer ratio, dissimilarity index	Seasonal pattern was confirmed for cardiovascular and respiratory mortality, with peak in February and March
Stanojević <i>et al.</i> , 2014	Belgrade Summer 2007	Cardiovascular, cerebrovascular and respiratory mortality	Air temperature	Poisson regression model	1°C is associated with 4.6 (cardiovascular), 2.2 (cerebrovascular)
Stanojević <i>et al.</i> , 2014a	Belgrade, 2000-2010	All-cause mortality	Warm Spell Duration Index; Apparent temperature	Poisson regression model	With increase of temperature over 90 th , 95 th and 99 th percentiles, number of deaths increases for 15%, 22,4% and 32%.
Blagojević <i>et al.</i> , 2012	Serbia 1992-2007	Roma population Causes of death	-	EWM index	Excess winter mortality 24% higher
Bogdanović <i>et al.</i> , 2013	Belgrade July 2007	All-cause and specific causes All ages and 75 and over	-	Observed and expected number of deaths	167 excess death (all age) 151 excess death (age 75 and over)
Đurđev <i>et al.</i> , 2012	Belgrade, 1888-2008	All-cause mortality, All ages, 65 and over	Air temperature	Multiple Linear Regression and Pearson correlation coefficient	Decrease of temperature is related with increase in mortality. In recent years this trend has started to change
Arsenović <i>et al.</i> , 2011	Belgrade, 1946-2008	All-cause mortality, All ages, 65 and over	Air temperature	Multiple Linear Regression and Pearson correlation coefficient	Increase in mortality is related with colder period of years
Stanković <i>et al.</i> , 2007	Niš 2001-2005	Cardiovascular mortality in age 65 and over	Air pollution	Poisson regression model	Ambient air pollutants concentration and cardiovascular mortality are not related

The analysis covered both total and old population (65 and over) by gender and for all-cause mortality, while causes of death were observed only for the period 1998-2013. In this paper were considered only cardiovascular diseases I00-I99 (CVD) according to the International Classification of Diseases (ICD, version 10).

In order to study temporal changes, the data were split into five periods and the coefficient of seasonal variation in mortality (CSVM) was used to detect seasonal variation in mortality during a year. CSVM was calculated using the formula (1) given by Healy (2003), where the dividend represents the difference between the number of deaths in the winter season (December-March) and the average number of deaths occurring during the two non-winter seasons, and divisor is the average number of deaths in the two non-winter seasons:

$$(1) CSVM = \frac{[M(\text{Dec} + \text{Jan} + \text{Feb} + \text{Mar})] - [M(\text{Apr} + \text{May} + \text{Jun} + \text{Jul}) + M(\text{Aug} + \text{Sep} + \text{Oct} + \text{Nov})]/2}{[M(\text{Apr} + \text{May} + \text{Jun} + \text{Jul}) + M(\text{Aug} + \text{Sep} + \text{Oct} + \text{Nov})]/2}$$

Results

Seasonal variation in all-cause mortality, 1953-2013

Existence of seasonal trends in mortality in Novi Sad was observed using the coefficient of seasonal variation in mortality (CSVM) and results for this coefficient are presented in table 2. The analysis shows a clear seasonal pattern with the highest mortality during winter months. The analysis of the number of deaths in Novi Sad has shown that the winter mortality (December-March) is between 8% and 25% higher (between 8% and 20% for males and between 7% and 28% for females) when compared to the mortality in the preceding (August-November) and the following (April-July) period.

In all five periods, winter mortality was higher when compared to the preceding and the following period of a year. CSVM indicated that winter mortality was 25% higher in the period 1953/54-1963/64, 19% higher in 1964/65-1974/75, 11% in 1975/76-1985/86, 12% in 1986/87-1996/97 and 8% higher in 1997/98-2012/13 when compared to other periods of a year. Similar results were founded in the analysis by gender. During the 1950s, 1960s and early 1970s, females were more sensitive during the winter and CSVM reached higher value when compared to males. But the end of the twentieth and the beginning of the twenty-first century brings a smaller difference in winter mortality by gender. In the fifth observed period (1997/98-2012/13), winter mortality for males was 8% and for females 7% higher than in preceding and following periods.

Table 2
Coefficient of seasonal variation in mortality (CSVM) in Novi Sad, 1953/54-2012/13

Period	CSVM	CSVM (male)	CSVM (female)
1953/54-1963/64	0.25	0.20	0.28
1964/65-1974/75	0.19	0.15	0.23
1975/76-1985/86	0.11	0.06	0.16
1986/87-1996/97	0.12	0.14	0.12
1997/08-2012/13	0.08	0.08	0.07
<i>Source: Author's calculation</i>			

In order to check the results of CSVM, the regression analysis of the temperature-related mortality was conducted using crude death rate and temperature in the five observed periods. The results show that the crude death rate and air temperature are negatively associated, the decrease of average air temperature is followed by the increase of crude death rate. The regression analysis indicated that when the average air temperature started to increase for 1°C, the crude death rate decreased (Table 3). These findings were confirmed in all five periods, and similar results were found for both gender (males and females).

Table 3
Results of regression analysis between crude death rate and air temperature, 1953-2013

Period	Total		Male		Female	
	b	Adjusted R	b	Adjusted R	b	Adjusted R
1953/54-1963/64	0.009	0.869 ***	0.008	0.857 ***	0.009	0.815 ***
1964/65-1974/75	0.007	0.807 ***	0.005	0.569 **	0.008	0.870 ***
1975/76-1985/86	0.003	0.752 ***	0.002	0.441 *	0.004	0.689 ***
1986/87-1996/97	0.004	0.752 ***	0.004	0.418 *	0.005	0.854 ***
1997/08-2012/13	0.003	0.385 **	0.003	0.284 *	0.003	0.470 **
<i>Note: * p<0.05, ** p<0.01, *** p<0.001; Source: author's calculation</i>						

Results obtained for total mortality were also found for mortality of old population (aged 65 and over). CSVM 65+ follows the trend of CSVM in total mortality and gives evidence that winter mortality of old population was 33% higher during the 1950s and early 1960s, 25% higher in the 1960s and early 1970s while in the last observed period (1997/98-2012/13) winter mortality of old population was about 6% higher when compared with preceding and following periods (Table 4). The results for CSVM 65+ by gender confirmed the results for males and females, i.e.

winter mortality for both sexes (males and females) was higher than during other seasons.

Table 4

Coefficient of seasonal variation in mortality (CSVM 65+) for old population in Novi Sad, 1953/54-20012/13

Period	CSVM 65+	CSVM 65+ (male)	CSVM 65+ (female)
1953/54-1963/64	0.33	0.34	0.32
1964/65-1974/75	0.25	0.20	0.29
1975/76-1985/86	0.14	0.06	0.20
1986/87-1996/97	0.17	0.21	0.14
1997/08-2012/13	0.06	0.07	0.05
<i>Source: Author's calculation</i>			

The regression analysis detected a strong correlation between the crude death rate for old population and air temperature. Presented results in Table 5 show that increase in average temperature is followed by decrease in crude death rate.

Table 5

Results of regression analysis between crude death rate of old population (65+) and air temperature, 1953-2013

Period	Total		Male		Female	
	b	Adjusted R	b	Adjusted R	b	Adjusted R
1953/54-1963/64	0.103	0.791 ***	0.126	0.887 ***	0.086	0.676 ***
1964/65-1974/75	0.072	0.791 ***	0.073	0.600 **	0.071	0.846 ***
1975/76-1985/86	0.035	0.631 **	0.023	0.149 n.s.	0.042	0.671 ***
1986/87-1996/97	0.035	0.709 ***	0.036	0.493 **	0.035	0.767 ***
1997/08-2012/13	0.016	0.396 *	0.013	0.079 n.s.	0.016	0.310 *
<i>Note: * p<0.05, ** p<0.01, *** p<0.001; Source: author's calculation</i>						

Seasonal variation in cardiovascular mortality, 1998-2013

Cardiovascular diseases (CVD) are recognized as one of the causes that highly depends on temperature changes. CVD are leading cause of death (around a half in all-cause mortality) in the population of Novi Sad. Therefore, the seasonal variation in CVD mortality was investigated additionally. Table 6 shows the coefficient of seasonal variation in CVD mortality (CSVM-CVD) for the total and old population. Winter CVD mortality is about 7% higher compared to the other season of a year (preceding and following periods). The value of CSVM-CVD is slightly higher for

males than for females. When compared to the other seasons, winter mortality for males is higher by 8% (total population) and 7% (old population), while for female is higher by 6% (total population) and 5% (old population).

Table 6
Coefficient of seasonal variation in CVD mortality (CSVM-CVD) in Novi Sad, 1998/99-2012/13

CSVM	Value
CSVM-CVD	0.07
CSVM-CVD (male)	0.08
CSVM-CVD (female)	0.06
CSVM-CVD 65+	0.07
CSVM-CVD 65+ (male)	0.10
CSVM-CVD 65+ (female)	0.05
<i>Source: Author's calculation</i>	

The results of regression analysis indicated that the crude death rate of CVD and air temperature are negatively associated, namely, an increase in average temperature for 1°C is followed by a decrease of CVD mortality by $b=0.002143$ (adjusted $R=0.42102148$, $p=0.013348$). CVD mortality for males ($b=0.002033$, adjusted $R=0.34648900$, $p=0.025870$) and females ($b=0.002220$, adjusted $R=0.39179748$, $p=0.017440$) has also statistically significant negative correlation with the average air temperature.

The analysis of CVD mortality in old population shows that an increase of the average temperature is also connected with a decrease in mortality ($b=0.015344$, adjusted $R=0.29076398$, $p=0.040831$). The results by gender suggest certain changes in the level of sensitivity to temperature oscillation over the year. Therefore, the regression analysis did not confirm statistically significant correlation between CVD mortality and the average air temperature. This finding was confirmed for both gender in the age 65 and over ($b=0.010549$, adjusted $R=0.22790573$, $p=0.066296$ for male; $b=0.010818$, adjusted $R=0.24032384$, $p=0.060371$ for female).

Discussion and conclusions

The analysis of mortality in urban population of Novi Sad (1953-2013) indicated a clear seasonal pattern with higher mortality during the colder period of the year. However, the results have shown that this pattern (CSVM) has been declining since the middle of the twentieth century and the difference between a cold and warm period is lower. During the 1950s and early 1960s winter mortality was more than three times higher than today. These findings were recognized also for seasonal variation in mor-

tality by gender. Long term seasonal variation of mortality shows that during a year, in most countries, the mortality peaks during the winter months. According to Healy (2003), most countries had experienced from 5% to 30% excess winter mortality. Similar course in winter mortality was confirmed for London (Carson *et al.*, 2006) and for England and Wales (Hajat *et al.*, 2007). Kendrovski (2006) gives evidence for Skopje (Macedonia), for the period 1996-2000, and shows that mortality in the winter period is about 15.9% higher than in the non-winter period. When comparing results in this research with other similar research across Europe it can be concluded that seasonal variation of mortality in Novi Sad follows the seasonal pattern confirmed in most countries of North hemisphere.

The coefficient of seasonal variation in mortality of population aged 65 and over has also experienced decreasing over time, but, still, the winter mortality of old population is higher than in the non-winter period. Epidemiological and demographic transition leads to continuously increasing life expectancy, hence, a majority of counts of deaths occurs in older ages. In Novi Sad, the share of mortality of old population (65 and over) in total mortality was the following: about 50% (1953-1963), 59% (1964-1974), 64% (1975-1985), 67% (1986-1997) and 73% (1998-2013). This implies that seasonal changes in mortality of old population have the consequential role in creation of seasonal pattern of total mortality.

Seasonal variation of mortality is the lowest in countries with cold winters, for example Russia, Scandinavian countries and Canada and is higher in Great Britain, Greece, Portugal and Malta where winters are milder (Rau 2007; Davie *et al.*, 2007; Fowler *et al.*, 2015). Still, there is a debate why some regions, countries and cities experience higher winter mortality. As a contribution to this question, this article has examined temperature-related mortality vulnerability. The results show that increase of average temperature during a year is followed with the decrease of crude death rate. However, declining vulnerability to temperature-related mortality over the years was found. In the last observed period (1998-2013) for mortality in old ages (65+), the regression analysis did not confirm statistically significant trend for males. One of the main causes for this change can be found in the frequency of heat waves, especially during summer. This statement refers particularly to the period after 2000. Strong heat waves were registered in the summers of 2003, 2006, and 2007 and unusually high number of heat-related deaths were reported across Europe. In 2007 (during July), the area of Novi Sad (as well as the whole Serbia) experienced a strong heat wave while the number of deaths was about 35% higher compared to the same month in the preceding years as well as in the years that followed.

However, the recent studies show that European climate in the late twentieth century and early twenty-first century is very likely warmer than of any time during the past 500 years (Luterbacher *et al.*, 2004), whilst climatologists forecast that temperature across Europe will rise over the coming decades and the frequency of periods characterized by extremely high temperature will double. The results of the regional climate model indicate that every second summer until the end of the twenty-first century is going to be marked by the same or higher air temperatures compared to those registered during the summer of 2003 (Luterbacher *et al.*, 2004; Meehl, Tebaldi, 2004; Schar *et al.*, 2004; Knowlton *et al.*, 2007). Such changes of air temperature, particularly the extreme values and appearance (as well as frequency, duration and intensity) of heat waves can significantly alter the balance between mortality in winter and non-winter period. Kalkstein and Greene (1997) deal with the impact of global climate changes on mortality in large cities of the United States. In this research they give projections of excess mortality during winter and summer (“excess mortality” is defined as the difference between the observed and expected number of death). The results were based on three global climate models recommended by the Intergovernmental Climate Changes Committee (ICPP): model of Geophysical Fluid Dynamics Laboratory, NOAA, model of the United Kingdom Meteorological Office and model of the Max Plank Institute for Meteorology. All three models give forecasts for 2020 and 2050. By 2050, the difference between the observed and expected mortality during winter will be slightly reduced, but all three models forecast the increase of mortality during summer months, in certain cases up to 70%.

Regardless the fact that analysis of CVD mortality was limited only to the period from 1998 to 2013, CSVM-CVD reveals a consistent pattern as it was detected for all-cause mortality. Other causes of deaths, e.g. respiratory diseases are also exposed to seasonal changes of air temperature during the year, but due to the small numbers,¹ this cause was not investigated, as well as the other non-CVD² causes. Recent research suggests non-existence of seasonal variation in non-CVD mortality (Arsenović 2014; Marti-Soler *et al.*, 2014) and considering that cardiovascular diseases attributed with 48% (in 1998-2013) to all-cause of deaths, it can be concluded that winter CVD mortality affects excess winter mortality for all-cause mortality.

Trends in CVD mortality were affected by the influenza epidemic during the winter 1999/2000 when the CSVM was about 0.27 (excess number of deaths was about 178, while excess CVD deaths was 90). During January

¹ Share of respiratory diseases in all-cause is about 5%

² All other causes except cardiovascular and respiratory diseases.

and February 2000 population in Novi Sad was hit with strong influenza epidemic and it was one of the three strongest epidemics in the 1997-2007 period. According to the Institute for Public Health of Vojvodina Province, Centre for Disease Control and Prevention, most of the recorded deaths in January and February 1999/2000 were related to the population aged 60 and over with some existing chronic diseases (respiratory or cardiovascular). In the winter of 1999/2000, cardiovascular and respiratory excess mortality contributed with 50% to the total number of excess deaths (Arsenović *et al.*, 2016).

Declining vulnerability to temperature-related mortality and changing level of excess winter mortality since the middle of the twentieth century could not be explained by air temperature only. Some other factors also played an important role in this process. Development of the system for central heating has increased prevention for temperature-related mortality. The central heating in Novi Sad has been improved during the observed period. It was launched in 1961 when 491 apartments were included in the system of heating. Today, about 80 percent of homes have central heating (SORS, 2013). Lifestyle risk behaviours have consistent role in longevity and can alert the years of life lost (YLL). Lifestyle risk factors such as physical inactivity, obesity, unhealthy diet, tobacco smoking, alcohol consumption etc. increase the risk of some chronic diseases and can attribute to higher mortality risk.

Despite the fact that temperature-related mortality has declining vulnerability over time, the risk is still evident due to raising level of urbanization and population ageing. Cities have their own microclimate forming an urban heat island which is by meteorological indicators quite diverse relative to the neighbour area (rural areas) and intensive urbanization has significant role in urban microclimate. Old population is one of the most vulnerable groups and increasing share of this age group will increase the health risk over time. The beginning of the twenty-first century is characterized by the rise of the total population of Novi Sad, but at the same time, the share of old population consistently increases particularly in some districts in the city with the average age achieving between 45 and 48 years. Consequently, this research confirmed that the mortality balance between winter and non-winter periods has changed with decreasing trend of excess winter mortality, but the appearance of extreme weather events could alert mortality risk particularly in non-winter periods. Hence, the results in this study, as well as future research, needs to establish a basis for public policies and public health system in order to provide preventive support (considering that a significant number of excess deaths are avoidable).

Limitations and direction for future research

One of the main limitations in this research is the lack of data for causes of death for the period before 1998. Mortality data for the period 1953-1997 were collected from the civil registration, and according to the state legislations after the World War II a cause of death is not the obligatory information in the process of death registration. The causes of deaths were recorded in the death certificate and according to the legislation concerning individual data, this information is not available. Availability of data about causes of deaths for earlier periods would strengthen the analysis conducted in the period 1998-2013, since the chronic diseases as the leading cause of deaths are increasing.

Data about some socio-demographic characteristics, such as marital status, employment and occupation, living arrangement, as well as urbanization, energy consumption etc., are also important factors in temperature-related mortality process. As those data were not available for the entire period analysed in this paper, the future research should be oriented towards using these variables.

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*Daniela Arsenović **

Sezonalnost mortaliteta: Rezultati za Novi Sad

R e z i m e

Sezonalnost mortaliteta stanovništva prepoznata je i nalazi se u sferi interesovanja naučnika dugi niz godina i predmet je proučavanja u brojnim studijama demografija, klimatologa, lekara, sociologa i drugih istraživača. Dosadašnja istraživanja ukazuju na to da je u većini regiona smrtnost stanovništva veća tokom zimskog perioda godine, kao i na činjenicu da države i regioni sa umerenom klimom imaju veću smrtnost stanovništva u zimskom periodu u poređenju sa državama u hladnijim klimatima. Pored toga, brojne studije pokazale su da je mortalitet stanovništva izložen uticaju promene temperature vazduha, kako tokom hladnijeg, tako i tokom toplijeg perioda godine.

Osnovni cilj ovog rada je da istraži sezonske varijacije mortaliteta stanovništva Novog Sada pod uticajem temperature vazduha. Analiza je obuhvatila period od 1953. do 2013. godine, tokom kojeg je posmatran ukupan mortalitet, mortalitet starog stanovništva (65 i više godina), kao i mortalitet prema polu, dok su uzroci smrti posmatrani samo za period od 1998. do 2013. godine. U radu su posebno analizirani samo kardiovaskularni uzroci smrti I00-I99 (CVD), a na osnovu Međunarodne klasifikacije bolesti i srodnih zdravstvenih problema (MKB, verzija 10).

Kao indikator sezonalnosti mortaliteta stanovništva korišćen je koeficijent sezonalne varijacije mortaliteta (CSVM), a sa ciljem da se utvrde promene sezonalnosti mortaliteta tokom vremena, istraživana serija analizirana je kroz pet perioda. Koeficijent sezonalne varijacije mortaliteta pokazao je da je broj umrlih lica tokom zimskog perioda veći nego u periodu pre odnosno posle zime, dok je analiza uticaja temperature vazduha na mortalitet stanovništva pokazala da sa padom prosečne temperature vazduha mortalitet stanovništva raste. Ipak, i pored potvrđene sezonalnosti i uočenih promena u kretanju mortaliteta u odnosu na temperature vazduha, osetljivost stanovništva na promene temperature se tokom vremena smanjuje.

Ključne reči: *mortalitet, sezonalnost, Srbija, prosečna temperatura vazduha, kardiovaskularni mortalitet*

* Prirodno-matematički fakultet, Univerzitet u Novom Sadu, Novi Sad (Srbija);
e-mail: daniela.arsenovic@dgt.uns.ac.rs