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INFANT MORTALITY IN THE REPUBLIC OF MACEDONIA

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The aim of this paper is to identify the changes and current situation of the infant mortality in the Republic of Macedonia in the light of the global trends and of the changes in the Balkan countries. Besides the infant mortality rate, the analysis is covering the infant deaths by age, by birth order, by education and ethnic affiliation of the mother, as well as by the causes of death. It refers to a longer period of time and is based on available data from UN and Eurostat statistics, as well as, on the data from the State Statistical Office of the Republic of Macedonia.

The analysis shows that the Republic of Macedonia, during the whole analyzed period, stands out regarding all indicators. In the last decades, the infant mortality rate is highest compared to all Balkan countries (10.2 per 1,000 live births in 2013) and about three times higher than the EU 28 average (3.7 per 1,000 live births). Similar is the situation concerning the neonatal, early neonatal and perinatal mortality rates which in 2013 were: 7.7; 6.0 and 14.4 per 1,000 live births, respectively. The results from the regression model implicate that the low educational level of mothers have a statistically significant impact on the infant mortality rate, while about 94% of this indicator variations for the period 1990-2014 can be explained by the variations in the selected independent variables (age of infants, birth order-first birth and low educational level of the mothers).

In the last two decades, many projects and measures were taken in order to reduce the infant mortality in the Republic of Macedonia. Most of them were conducted in the last few years and their implementation is ongoing. The evaluation of their results should show whether they were properly implemented and what was their effectiveness. Regardless of this, we consider that additional measures and activities should be taken in the areas of: health promotion efforts; ensure quality of care for all women and infants; develop data systems to understand and inform efforts; promote social equity.

Key words: *Infant mortality rate, Infant deaths by age group, Causes of infant death, Infant mortality policies, and Health care policies*

INTRODUCTION

Infant mortality is an important indicator of the overall health, economic and social situation of a country. It is a recognized international measure of a nation's health. Determinants of the infant mortality are numerous and very complex. They range from broad national economic and lifelong issues, to general maternal risk conditions and reproductive behavior, chronically and infectious diseases, as well as infant-related conditions.

The empirical researches of the demographic history in certain countries are showing that the changes and low vital rates are characteristic for the countries who are facing the modernization process of the society and its partial interconnected processes such as the industrialization, urbanization, expansion of the education and health care, which is especially influencing the infant mortality rates (Wertheimer-Baletić A., 1996).

Today the infant mortality rate¹ (IMR) is considered as one of the leading indicators for the assessment of population health, especially with regard to the quality of care provided to pregnant women and newborns

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¹ Infant mortality rate represents the ratio of the number of deaths of children under one year of age during the analyzed year to the number of live births in that year. Source: Eurostat

throughout the pre-natal period, the delivery and postpartum period. The quality of this care directly affects the prevention of maternal and infant morbidity and mortality.

The main causes of infant death are diseases which are preventable and curable. This is the reason why infant mortality is treated as a development issue rather than a simple health problem. Infant mortality is a manifestation of the poor socioeconomic conditions that a certain community or a country in general faces. Infant mortality rate is a popular indicator that is commonly quoted on the agendas of public health and international development agencies. The significance of the issue can also be seen from the fact that it is one of the goals of the United Nations' Millennium Development Goals (MGDs) (Mulugeta Zewdu Fitsum, 2012).

Infant mortality is understood as the product of two major chains of events that begin with (The Task Force Report, 2005):

- A sequence of socioeconomic and biological forces on the mother's health that influence the outcome of her pregnancy.
- The adverse outcome of this sequence of events is usually the delivery of a premature, low birth weight or sick neonate.

The second component of infant mortality is:

- The likelihood that the infant will survive given their health status at birth. This component often reflects the medical care provided to high-risk pregnant women and their small, sick neonates.

The infant mortality rate is known as a good and sensitive indicator of the nation's health. This sensitive indicator is influenced directly and indirectly by a number of factors. In difficult situations, adults and the elderly may be able to survive better than infants, whose immune systems may be less able to cope with the environment. For this reason, infants are affected the most by the availability of health facilities, life style of the family, affordability of good food, sanitation, etc. In developing countries, infant mortality accounts for a relatively higher proportion of all deaths, whereas in the developed countries, it represents an increasingly small segment of total mortality. Infant mortality plays significant role in the demographic transition of a nation. There has been a debate for many years among demographers and public health scientists about the contribution of socio-economic development and the medical facilities provided by public health programs in the reduction of mortality. Caldwell (1986) has a similar view, giving credit to improvements in education and health as the determinants of low mortality in developing countries in the 20th century (Suwal V. Juhee, 2001).

The aim of this paper is to identify the changes and current conditions of the infant mortality in the Republic of Macedonia in the light of the global trends and of the changes in the Balkan countries, which were occurring in the past period.

The global trends are important in order to evaluate the progress of the infant mortality reduction plans on global level. Furthermore, the analysis continues with the changes in this specific area in the Balkan countries, without intention to cover all aspects, but just the most relevant for which comparison can be made. Special attention is focused on the case of the Republic of Macedonia, as a country which is characterized with different trends of the infant mortality, than the rest of the Balkan countries, particularly in the last decade. The analysis is covering the infant deaths by age, by birth order, by education and ethnic affiliation of the mother, as well as by the causes of death. The analysis refers to a longer period of time and is based on available data from UN and Eurostat statistics, as well as, on the data from the State Statistical Office of the Republic of Macedonia.

1. GLOBAL TRENDS IN THE INFANT MORTALITY

Substantial global progress has been made in reducing child deaths since 1990. The number of under-five deaths worldwide has declined from 12.7 million in 1990 to 6.3 million in 2013. It means that around 17,000 fewer children dying every day in 2013 than in 1990. Since 1990 the global under-five mortality rate has halved – from 90 deaths per 1,000 live births in 1990 to 46 in 2013. However, the global annual rate of reduction has steadily accelerated since 1990–1995 for more than tripling, i.e. from 1.2 per cent to 4.0 per cent in 2005–2013. According to preliminary estimates, similar changes were characteristic for all regions, except for Sub-Saharan Africa and Oceania (UN, World Mortality Report 2014).

In nearly all populations, deaths before age of one comprise the majority of the under-five mortality. Therefore, reducing infant mortality in line with Millennium Development Goal (MDG) 4 remains a key challenge, especially given the large countries variation of this indicator. With respect to infant mortality, the International Conference on Population and Development (ICPD) Programme of Action embraced the absolute targets of the World Health Association (WHA), Health for All, by 2000 resolution, aiming for all countries to achieve an infant mortality rate less than 50 deaths per 1,000 live births by 2000. For countries that already had comparatively low levels of infant and child mortality in 1994, the Programme of Action offered relative target of one-third reductions in infant mortality rates by 2000. For the period beyond 2000 the Programme of Action identified absolute targets, urging countries to achieve an infant mortality rate below 35 deaths per 1,000 live births by 2015.

The infant mortality rate has been used widely as an indicator of the population health. According the last estimates of the infant mortality rate made by the UN, there are significant changes in the value of this indicator for the period 1950-2015. Between 1950-1955 and 1970-1975 and from 1970-1975 to 1990-1995 the intensity of decline was more pronounced and in both periods the global infant mortality rate declined for about 66 per cent (Table 1). Then, the intensity of decline has reduced (around 57 per cent) and it dropped from 63 (1990-1995) to 36 infant deaths per 1,000 live births (2010-2015). Analyzed regionally by the level of development, the infant mortality rate in the least developed countries is 57 per 1,000 in 2010-2015, which is almost double than the ICPD targeted. The other less developed countries have reached the ICPD target, with an average infant mortality rate of 33 per 1,000 in 2010-2015. Meanwhile, the more developed regions, which had already reached a low infant mortality level of 11 per 1,000 in 1990-1995, saw a further decline to 5 per 1,000 live births by 2010-2015.

Table 1

Infant mortality rate, by development group and major area, 1950-1955, 1970-1975, 1990-1995 and 2010-2015

Development group or major area	Infant mortality rate				Percentage change		
	1950-1955	1970-1975	1990-1995	2010-2015	1950-1955 to 1970-1975	1970-1975 to 1990-1995	1990-1995 to 2010-2015
WORLD	142	95	63	36	66.7	66.5	56.9
More developed regions (a)	60	22	11	5	36.1	49.5	48.8
Less developed regions (b)	161	106	69	39	65.6	65.2	56.7
Least developed countries (c)	203	151	107	57	74.2	71.1	53.6
Less developed regions, excluding least developed countries (d)	155	98	60	33	63.3	61.4	55.5
Less developed regions, excluding China	177	119	76	44	67.1	64.1	57.2
High-income countries (e)	62	25	12	6	40.8	46.9	51.9
Middle-income countries (e)	158	103	64	35	65.1	62.0	55.5
Upper-middle-income countries (e)	135	79	42	19	58.0	53.1	44.5
Lower-middle-income countries (e)	183	126	79	44	68.7	62.6	56.5
Low-income countries (e)	195	141	113	60	72.4	79.9	52.9

(a) More developed regions comprise Europe, Northern America, Australia/New Zealand and Japan.

(b) Less developed regions comprise all regions of Africa, Asia (except Japan), Latin America and the Caribbean plus Melanesia, Micronesia and Polynesia.

(c) The group of least developed countries, as defined by the United Nations General Assembly in its resolutions (59/209, 59/210, 60/33, 62/97, 64/L.55, 67/L.43, 64/295) included 48 countries in January 2014: 34 in Africa, 9 in Asia, 4 in Oceania and one in Latin America and the Caribbean.

(d) Other less developed countries comprise the less developed regions excluding the least developed countries.

(e) The country classification by income level is based on 2014 GNI per capita from the World Bank.

Source: United Nations, Department of Economic and Social Affairs, Population Division (2015), *World Population Prospects: The 2015 Revision*, DVD Edition.

As far as the situation by continents, Africa has the highest level of infant mortality in 2010-2015 at 64 per 1,000 live births and it is far to reach the ICPD target (35 per 1,000 live births). Each of the world's other major areas has, on average, met the ICPD target by 2010-2015 (UN, World Mortality Report 2013). The data in table 1 is showing that the infant mortality depends on the level of development which each of the regions have reached, as well as on their income level.

Very significant is the fact that, the first day, week and month of life are the most critical for the survival of the newborns. Of the almost 6 million children who die before their fifth birthday in 2015, about 1 million will die on the day they are born. An additional 1 million will die in the first week, and around 2.8 million will die during their first 28 days of life (the neonatal period). Between 1990 and 2015, the worldwide neonatal mortality rate has fallen from 33 deaths to 19 deaths per 1,000 live births. As the decline in neonatal mortality has been slower than the decline in mortality for children aged 1-59 months, neonatal deaths now represent a larger share of total under-five deaths. Every region of the world is experiencing an increase in the proportion of under-five deaths that occur in the neonatal period (UN, World Mortality Report 2013).

Concerning the determinants of the infant mortality changes, particularly in the last decades, many studies were conducted. They point out that among the socio-demographic factors the most frequently studied ones are: age at first birth, sex of the child, education of the mother, type of birth, birth order, birth interval, household living standard, access to safe water and better sanitation facilities are. For instance, very low or very high age of the mother at first birth is associated with higher risk of child mortality (Kumar and File, 2011; Mutunga 2007; Ladusigh and Singh, 2006). Maternal education is also found to be negatively associated with child mortality. There are a number of channels through which the education of the mother works towards reducing the risks of childhood mortality. These include delaying marriage and subsequent pregnancy if the girl stays longer in school, better understanding of how to take a good care of her children as well as better income as a result of increased schooling (Iram and Butt, 2008; Mutunga, 2007; Ladusigh and Singh, 2006; Jacoby and Wang, 2004; Klaauw and Wang, 2004). The results from most of the

abovementioned studies indicate that the meaning of the biological factors is decreasing and that the socio-economic determinants are becoming more important for the infant mortality reduce.

2. COMPARATIVE ANALYSIS OF THE INFANT MORTALITY IN THE REPUBLIC OF MACEDONIA AND BALKAN COUNTRIES

In spite of its diversity, the Balkan countries still remain an area that have some similarities and that it should be studied as a unit. Today equally valid is the state of the Sjoberg and Wyzan, “Despite the great diversity of experiences, one should not lose sight of the fact that the Balkan countries are once again an integral unit whose component states have sufficient in common to make the concept meaningful” (Sjoberg O., Wyzan M.L., 1991). The analysis of the infant mortality in the Balkan region is made in order to evaluate the differences and changes between the countries, as well as to identify the position of the Republic of Macedonia regarding this indicator. Because of their common past and mutual future in the EU, the comparison of these countries is also made with the available EU 28 infant mortality indicators.

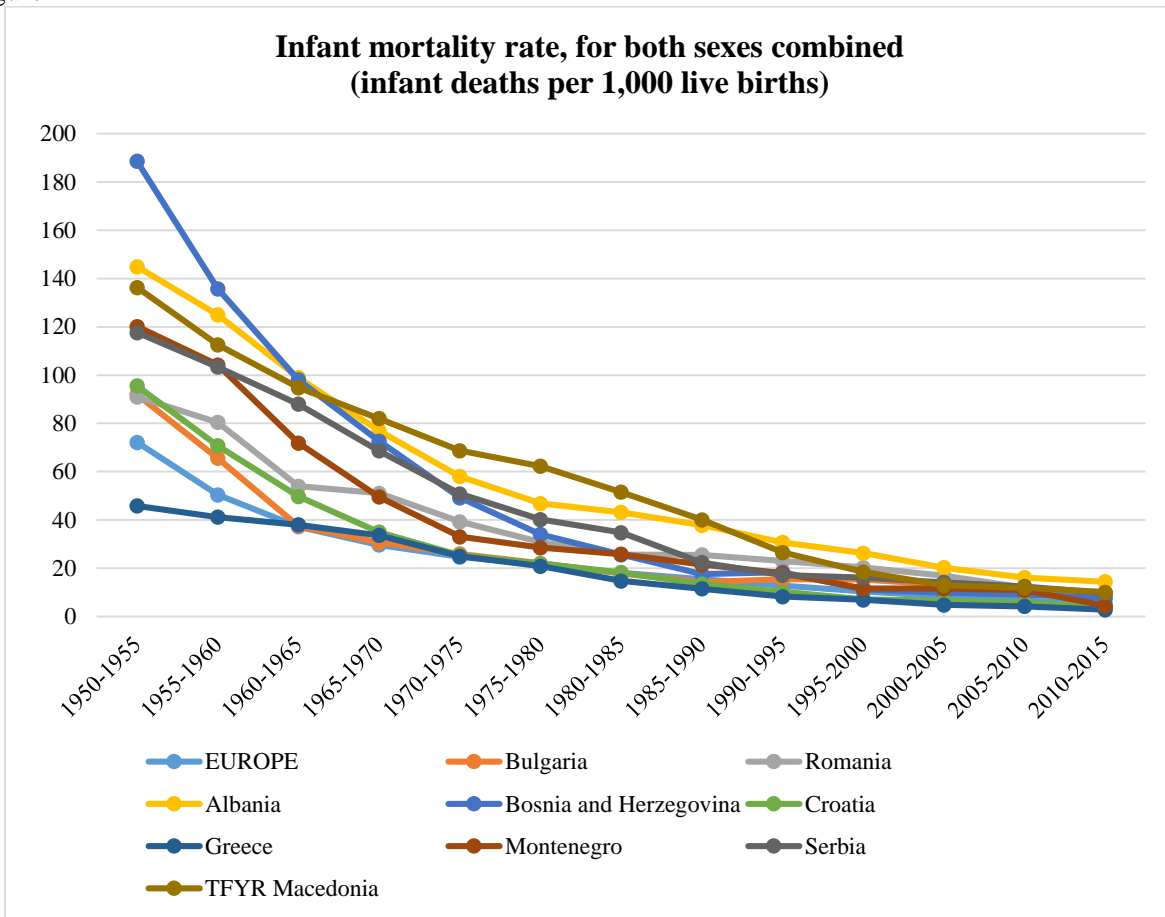
Former non-market economy of the Balkan countries underwent major political and social changes over the last two decades, and the collapse of socialized health systems led to the question of possible worsening of relevant health indicators. Thus, to address the specific issue of infant mortality as a relevant health indicator, we systematically considered trends in infant mortality in nine Balkan countries (Bulgaria, Romania, Albania, Bosnia and Herzegovina, Croatia, Greece, Montenegro, Serbia and Macedonia).

According the UN estimates of the infant mortality rate in these countries since 1950 up until 2015, Albania, Bosnia and Herzegovina and Macedonia always had the highest infant mortality rates (145, 189 and 136 per 1,000 live births in 1950-1955 and 10, 14, 10 per 1,000 live births in 2010-2015, respectively). The average infant mortality rate in Europe was 72 per 1,000 live births (1950-1955) and 5 per 1,000 live births (2010-2015), which is almost half than in the Balkan countries with highest infant mortality rate (Figure 1).

In the observed period the infant mortality rates decreased in all Balkan countries. These declines were substantial and steady. However, the intensity was different. In the nineties of the twentieth century, Macedonia has noticed very fast and high decrease of the infant mortality rate, while Bulgaria and Bosnia and Herzegovina had a slight increase of this indicator. In the beginning of the twenty first century, all countries, except Republic of Macedonia, had continued more or less, with the same intensity of the infant mortality rates decrease.

The UN World Population Prospects: The 2015 Revision, the projections with medium fertility variant, are showing that in the next decade (2015-2025) all Balkan countries are going to continue with decline of the infant mortality rate (UN, World Population Prospects: The 2015 Revision, 2015).

Figure 1



Source: United Nations, Department of Economic and Social Affairs, Population Division (2015), *World Population Prospects: The 2015 Revision, DVD Edition*.

The Eurostat statistics also is showing that one of the most significant changes in the recent decades has been the reduction in the infant mortality rates. Around 19 thousand children died before reaching one year of age in the EU-28 in 2013, and this was equivalent to an infant mortality rate of 3.7 deaths per 1 000 live births (Eurostat, http://ec.europa.eu/eurostat/statistics-explained/index.php/Mortality_and_life_expectancy_statistics, approached June 2015). In other words, one of the most significant changes that led to increases in life expectancy at birth was reduction in infant mortality rates. During the 15 years, from 1998 to 2013, the infant mortality rate in the EU-28 was almost halved. The most significant reductions in infant mortality were generally recorded within those EU Member States which tended to record higher levels of infant mortality in 1998, compared with the EU average. Despite this progression, some Member States still had relatively high infant mortality rates in 2013, for example Romania (9.2 deaths per 1 000 live births) and Bulgaria (7.3). In 2013, the lowest infant mortality rates in the EU-28 were recorded in Cyprus (1.6 deaths per 1000 live births), Finland (1.8) and Estonia (2.1).

As for the Balkan countries, they are facing some differences in the infant mortality. Beside the infant mortality rate, in order to see where the most significant changes have occurred, the further analysis is focused on the different types of the infant mortality in the Balkan countries and EU28.

According the Eurostat data, for the period 1960-2013, **the infant mortality rate** in 1960 was the highest in Macedonia (114.6 per 1,000 live births) and Bosnia and Herzegovina (107 per 1,000 live births). In 2013, Macedonia and Romania (10.2 and 9.2 per 1,000 live births respectively) stands out with the highest value

of this indicator (Table 2). Compared to the EU 28 infant mortality rate, which was 3.7 per 1,000 live births in 2013, the big differences are obvious.

Table 2

Different types of infant mortality rates in the Balkan Countries and EU28, 1960-2013

	1960	1970	1980	1990	2000	2004	2008	2012	2013
Infant mortality rate									
EU (28)		25.6	15.9	10.3	5.9	5.1	4.3	3.8	3.7
Albania	83.0	97.9	51.9	28.3	11.9	7.8	6.0		7.9
BiH	107.0	69.1	31.5	15.3	9.7	7.4	6.9	5.0	
Bulgaria	45.1	27.3	20.2	14.8	13.3	11.6	8.6	7.8	7.3
Croatia	70.4	34.2	20.6	10.7	7.4	6.1	4.5	3.6	4.1
Greece	40.1	29.6	17.9	9.7	5.9	4.1	2.7	2.9	3.7
Macedonia	114.6	87.9	54.2	31.6	11.8	13.2	9.7	9.8	10.2
Montenegro					11.1	7.8	7.5	4.4	4.4
Romania	75.7	49.4	29.3	26.9	18.6	16.8	11.0	9.0	9.2
Serbia					10.6	8.1	6.7	6.2	6.3
Early neonatal mortality rate									
EU (28)						2.5	2.1		
Albania						1.7			4.4
BiH	17.3	15.9	14.2	8.9		4.7	4.4		
Bulgaria	10.9	9.1	7.5	5.1	4.7	4.5	3.3	3.0	3.1
Croatia	21.0	15.9	12.2	5.9	4.2	3.4	2.7	1.9	2.3
Greece	12.3	14.5	11.2	4.8	2.9	1.8	1.1	1.2	1.8
Macedonia	18.6	14.4	15.1	12.6	6.9	7.4	5.1	5.0	6.0
Montenegro							4.5	2.8	2.8
Romania					6.2	6.8	4.1	3.2	3.8
Serbia					6.3	4.6	3.9	3.4	3.9
Perinatal mortality rate									
EU (28)									
Albania									
BiH	25.8	25.8	22.0	13.7		9.3	9.3		
Bulgaria	23.0	18.8	15.0	11.1	12.2	12.2	10.5	11.0	10.3
Croatia	33.1	25.6	17.7	10.3	9.4	7.8	6.7	5.0	5.9
Greece	26.4	27.4	20.3	11.9	7.2	6.3	3.8	5.6	5.0
Macedonia	28.2	25.4	24.8	21.0	15.8	18.2	14.6	12.8	14.4
Montenegro							8.6		
Romania					12.1	12.8	8.6	7.0	8.0
Serbia					11.2	9.9	8.9		8.6
Neonatal mortality rate									
EU (28)						3.4	2.9		
Albania						2.5			5.6
BiH	32.8	23.8	17.7	10.6		5.6	5.0		
Bulgaria	19.4	13.2	10.4	7.7	7.5	6.6	5.0	4.5	4.2
Croatia	35.1	20.6	14.7	7.5	5.6	4.6	3.5	2.4	3.2
Greece	19.5	19.6	13.9	6.5	4.2	2.6	1.8	1.9	2.6
Macedonia	41.4	29.4	23.0	17.4	8.6	9.6	7.3	7.8	7.7
Montenegro							6.2	3.5	3.5
Romania					9.2	9.5	6.2	4.7	5.4
Serbia					7.7	5.8	4.9	4.5	4.8

Source: Eurostat, http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=demo_minfind&lang=en

Concerning the infant mortality changes, based on the available data, can be concluded that infant mortality rate is noticing continuous decline until 2012. In 2013, six Balkan countries (Greece, Croatia, Romania, Macedonia, Albania and Serbia) recorded more or less emphasized rise of this indicator.

The global trends are showing that the number of infant deaths with age of zero days is increasing. The participation of the number of infant deaths with age of zero days in the total number of infant deaths confirm the same situation in the Balkan countries (Table 3).

Table 3

Number of infant deaths and share of infant deaths, by age of zero days, in the Balkan countries, 2007-2013

	2007	2008	2009	2010	2011	2012	2013
<i>Total number of infant deaths</i>							
Albania	205	217					282
BiH	231	237	224	216		161	
Bulgaria	690	668	729	708	601	536	489
Croatia	234	195	235	192	192	150	162
Greece	397	314	371	436	357	293	347
Macedonia	234	223	278	185	172	230	237
Montenegro	58	62	49	50	32	33	33
Romania	2574	2434	2250	2078	1850	1812	1677
Serbia	484	460	492	460	414	415	413
<i>Share of the infant deaths by age of zero days (in %)</i>							
Albania							35.5
BiH	16.0	21.1	29.9	34.3			
Bulgaria	16.1	15.7	16.7	14.8	21.5	17.5	19.6
Croatia	31.2	32.8	36.6	36.5	25.0	26.7	32.1
Greece	14.4	13.7	12.7	18.8	12.9	10.9	22.2
Macedonia	25.2	21.1	26.6	18.4	17.4	20.0	25.3
Montenegro	22.4	17.7	14.3	0.0	15.6	21.2	3.0
Romania	9.9	10.3	8.5	9.0	10.0	9.8	11.1
Serbia	30.0	27.0	29.1	24.8	30.7	27.0	32.2

Source: Eurostat, http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=demo_minfs&lang=en

In the period 2007-2013 Croatia has the highest, while Romania, with exception in 2013, has the lowest share of the infant deaths by age of zero days in the total number of infant deaths. Very concerning is the fact that in the last observed year, all countries, except Montenegro (where it raises) and Albania and Bosnia and Herzegovina (due to a lack of data), are noticing increase of the value of this indicator.

The Eurostat data shows that in all Balkan countries, except for Montenegro, in the period 1960-2013 the **early neonatal mortality rate**² had a trend of decrease, but in the last year was recorded increase in almost all countries. This indicator has the highest value in the Republic of Macedonia, Albania, Serbia and Romania (Table 2).

² The early neonatal mortality rate represents the ratio of the number of deaths of children under one week old during the analyzed year to the number of live births that year. (Eurostat methodology: http://ec.europa.eu/eurostat/cache/metadata/en/demo_mor_esms.htm)

*The perinatal mortality rate*³ is used as an indicator of the quality of prenatal and perinatal care, yet uncritical application of this indicator in international comparisons can be misleading. It depends on a number of factors and important determinants that need to be assessed separately before reaching conclusions about quality-of-care issues (Richardus JH, et al., 1998). Regarding this indicator, starting from 1980, Republic of Macedonia has its highest value, which although had a trend of decline until 2010, then started to rise and in 2013 amounts 14.4 per 1,000 births. The increase is also characteristic for Croatia and Romania, but not as high as in the Republic of Macedonia.

The importance of the *neonatal mortality rate*⁴ derives from the fact that it is unacceptable to be very high, unless the death of the infants is result of biological conditions. In the period 1960-2013 the value of this indicator was significantly decreasing in all Balkan countries. In 2013 Republic of Macedonia stands out with the highest neonatal mortality rate (7.7 per 1,000 live births), while Greece with the lowest.

4. MAIN FEATURES OF THE INFANT MORTALITY IN THE REPUBLIC OF MACEDONIA

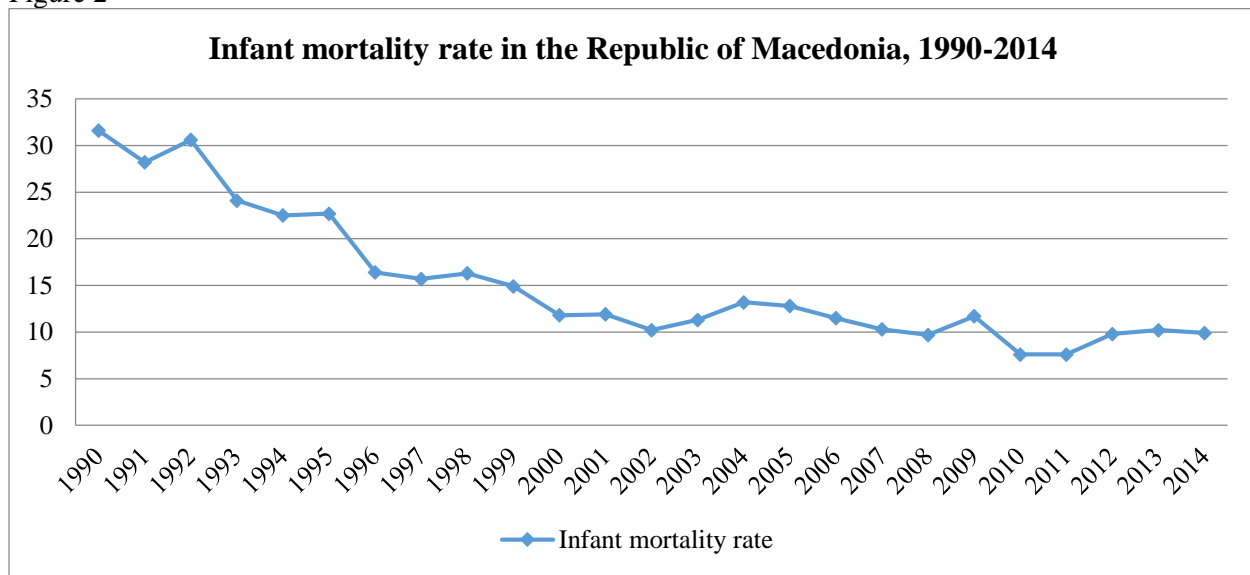
The abovementioned differences in the case of the Republic of Macedonia are imposing the need to make detailed analysis of the infant mortality in the country in order to evaluate what are the specific characteristics and main determinants i.e. where do they come from.

Regarding the changes of the infant mortality rate it is important to point out that the country has significantly slowed down the decline of the infant mortality. All available data point out that in the period 1990-2015 significant changes have occurred, but with emphasized differences since 2002. Both data sources indicate that in the nineties of the previous century, the infant mortality rate has decreased for around two times and after 2000 the intensity of the decline is significantly lower. According the UN estimates the annual rate of infant mortality decline, for the period 1990-1995 to 2000-2005 was 6.9%, while for the period 2005-2010 to 2010-2015 only 3.1%. The Eurostat data are showing that the infant mortality rate have decreased from 31.6 per 1,000 live births (1990) to 11.8 per 1,000 (2000). After 2000 it is noticing considerable oscillations and in 2013 the infant mortality rate reaches the level from 2002 (Figure 2). These changes are imposing the question what are the reasons for recorded slowdown in the fall of the infant mortality in the last decade?

³ The perinatal mortality rate is the ratio of the number of deaths of children under one week and the stillbirths during the year, to the number of births in that year (including stillbirths) and is expressed per 1,000 births. (Eurostat methodology: http://ec.europa.eu/eurostat/cache/metadata/en/demo_mor_esms.htm)

⁴ The neonatal mortality rate represents the ratio of the number of deaths of children who were under 28 days of age during the analyzed year to the number of live births. (Eurostat methodology: http://ec.europa.eu/eurostat/cache/metadata/en/demo_mor_esms.htm)

Figure 2



Source: Eurostat, http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=demo_minfind&lang=en

Besides the manifested changes of the infant mortality rate, Republic of Macedonia compared to other Balkan countries is specific regarding the types of infant mortality. The neonatal mortality rate in the country from 1960 until 1990 has decreased for 58%, in the period 1990-2000 for 51%, while from 2000 until 2013 only for 10.5% (Table 2). Its high current value and the slow decline since 2002 up until now, are pointing out the possible problems in this country regarding the infant mortality.

In 2013 Macedonia had the highest early neonatal mortality rate – (6.0 per 1,000 live births). Starting from 1980, the value of the perinatal mortality rate in Macedonia was the highest among the Balkan countries. It had a trend of decline until 2010, then started to rise and in 2013 reach 14.4 per 1,000 live births. These facts and figures are indicating that the country has very high number of stillbirths (in the last years they amount: 184 in 2012, 196 in 2013 and 171 in 2014), which is an indicator for further analysis of the prenatal health care quality and conditions. Concerning the fact that the perinatal mortality is a good indicator of success in health protection and points to the conditions of work in hospitals, where the majority of deliveries is carried out, it is obvious that in the Republic of Macedonia there are serious problems, i.e. there is a lack of appropriate measures of health prevention and control of the risk factors existing before delivery.

The main features of the infant mortality in the Republic of Macedonia are analyzed for the period 1990-2014. They include: age at birth, birth order, education of the mother, ethnical affiliation of the mother and the causes of death.

As to the situation with the number of infant deaths with age of zero days, the case of the Republic of Macedonia is also specific. In the period 2007-2013, the share of the infants with age of zero days in the total number of infant deaths was decreasing from 25.2% (2007) to 18.4% (2010) and then started to rise and in the last two years amounts 25.3% (2013), i.e. 26.2% (2014) (Table 4). Also, it is the only Balkan country where the number of infant deaths with age of zero days in 2013, have reached the same value as it was in 2007 (almost 240). In the analyzed period, the share of the death infants at age from 1 to 6 days was and remains highest. The mutual share of both age groups, in the total number of infant deaths is more than half in all observed years (except in 2011). It means that over 50% of the infant deaths occur in the first week of their life. In terms of significant reforms in the health system of the country, this are very disappointing and disturbing indicators. It imposes the need for more profound analysis in order to identify the main reasons for this very unfavorable situation.

Table 4

Structure of the infant deaths by age at birth in the Republic of Macedonia, 2002-2014

	Number of infant deaths	Age at birth			
		up to 24 hours	1-6 days	7-27 days	28 days to 11 months
2002	283	31.4	32.9	11.7	24.0
2003	305	29.8	29.5	15.1	25.6
2004	333	19.5	32.1	15.6	32.7
2005	287	28.9	28.2	17.4	25.4
2006	260	20.4	35.4	17.7	26.5
2007	234	25.2	32.9	18.4	23.5
2008	223	21.1	31.4	22.9	24.7
2009	278	26.6	33.5	18.7	21.2
2010	185	18.4	34.6	19.5	27.6
2011	172	17.4	29.7	18.6	34.3
2012	230	20.0	31.7	28.7	19.6
2013	237	25.3	33.3	16.9	24.5
2014	233	26.2	30.0	20.2	23.6

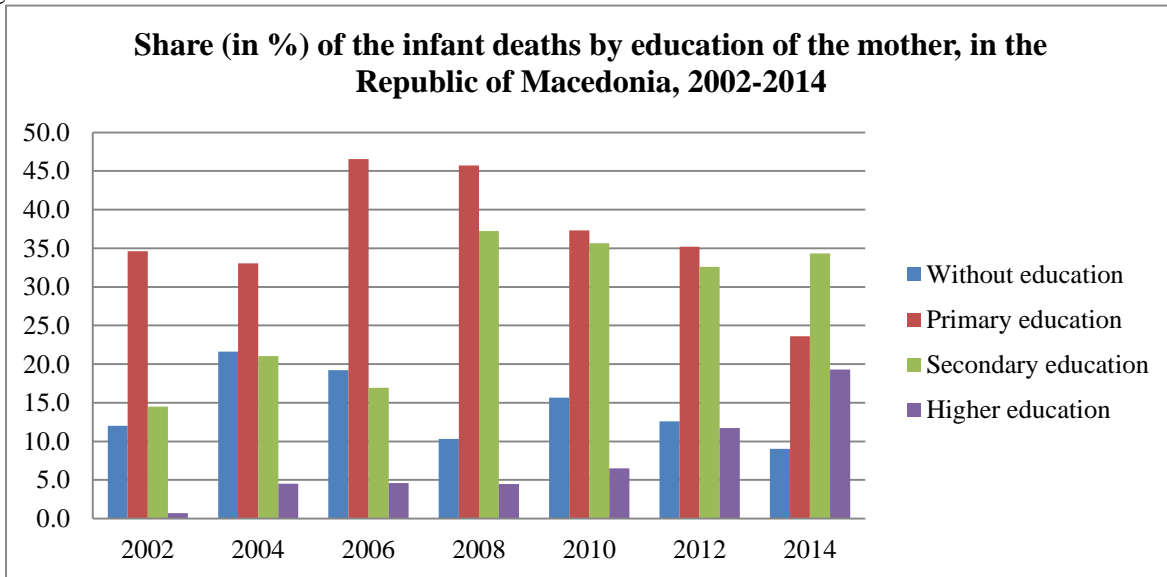
Source: State Statistical Office of the Republic of Macedonia, Statistical Review: Population and Social Statistics, *Natural Population Change in the Republic of Macedonia*, different years (2002-2014)

Relatively lower is the share of the infant deaths at age of 7 to 27 days and is characterized by significant oscillations. As for the age group from 28 days till 11 months, the participation is around 25 per cent, with exception in 2011 and 2012.

Regarding the structure of the infant deaths by birth order, in the observed period, most of the deaths are of the infants born as first by the birth order. That share was significantly increased from 31.1% (2002) to more than half 51.9% (2014), which in absolute number means 121 infants. Also, high is the number of the infants born as second and third, but their shares in the total number of infant deaths are decreasing in the last few years and in 2014 amounts 24.9% and 14.2%, respectively.

The analysis of the infant deaths by the education of the mother should point out how this socio-economic factor is reflecting on the number of infant deaths. The figure 3 displays that the share of death infants from mothers without education and with primary education is decreasing, from 19.2% (2006) to 9.0% (2014), i.e. from 46.5% to 23.6% respectively.

Figure 3



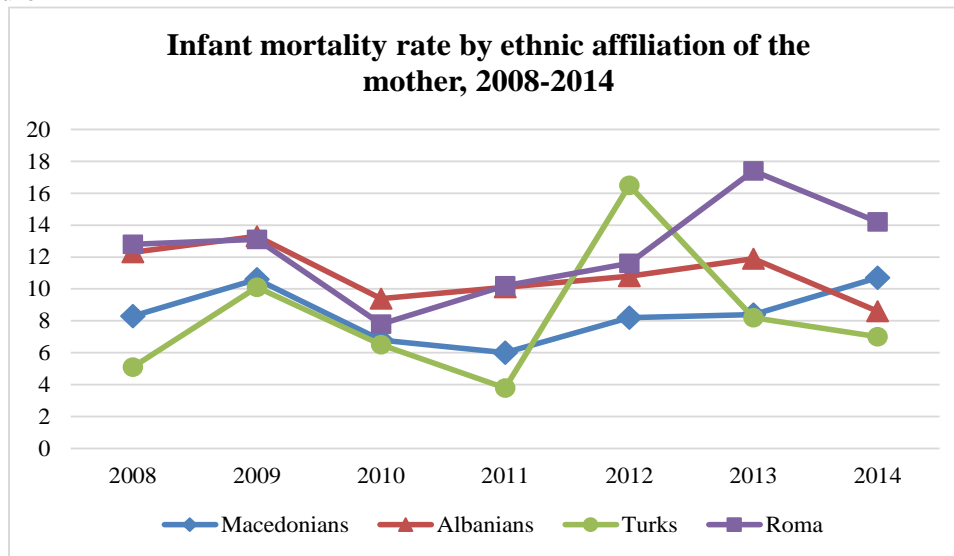
Source: *State Statistical Office of the Republic of Macedonia, Statistical Review: Population and Social Statistics, Natural Population Change in the Republic of Macedonia, different years (2002-2014)*

As for the infants from mothers with secondary and higher education, significant absolute and relative increase is recorded since 2008. In 2014 their share amounts 34.3% and 19.3%, respectively. This means that significant changes in short time period have occurred, which implicates the need for further profound analysis.

The infant mortality rates by ethnic affiliation of the mother are showing big differences and oscillations among the analyzed ethnicities in the country. Having in mind that the highest share of the total number of infant deaths belongs to Macedonians, Albanians, Turks and Roma, only this ethnic groups are considered for the analysis (Figure 4).

The highest value of this indicator, almost during the whole analyzed period, is characteristic for the Roma mothers, has a trend of increase from 2010, and in 2013 amounts 17.4 per 1,000 live births. Similar values, although slightly smaller, are noticed concerning the infant deaths of Albanian mothers, whose value is the highest among all analyzed ethnicities in 2009 (13.3 per 1,000 live births) and in 2010 (9.4 per 1,000 live births). The infant mortality rate of the Macedonian mothers, with exception in 2009 and 2014, is below 10 death infants per 1,000 live births. The situation of the Turk mothers is different, because they have the lowest infant mortality rates, whit exception of 2012 when it was 16.5 per 1,000 live births.

Figure 4



Source: State Statistical Office of the Republic of Macedonia, *Statistical Review: Population and Social Statistics, Natural Population Change in the Republic of Macedonia, different years (2008-2014)*

Regarding the changes in the infant deaths by causes of death, during the whole analyzed period 2002-2014, highest shares, as well as the highest absolute numbers, have the infants who died from certain conditions originating in the perinatal period⁵ (around or more than half of the total number of infant deaths). From the rest of the causes of death more significant are the infectious and parasitic diseases, although their share is in the interval from 3.4% (2007) to 8.6% (2014). Almost insignificant is the portion of the infant who died from external causes of mortality (no more than 1 in most of the years).

All abovementioned facts and indicators point out that the Republic of Macedonia is facing serious problems with the infant mortality. In order to identify the factors which are significantly influencing the infant mortality in the country a regression analysis was made, using the infant mortality rate as dependent variable, while the number of infant deaths by age, the birth order of the infant (first birth) and the primary education of the mother are taken as independent variables. The selection of this variables is based on the experience from the similar researches in this field, as well as the available data. The evaluated model refers to the period 1990-2014. The database used in the regression consist of annual data that are provided from the State Statistical Office of the Republic of Macedonia. The model has the following appearance:

$$d(Y_i) = \beta_0 + \beta_1 dX_{1i} + \beta_2 dX_{2i} + \beta_3 dX_{3i} + u_i$$

$$d(\hat{Y}_i) = -0,9127 + 0,2006X_{1i} + 0,1342X_{2i} + 0,3724X_{3i}$$

$$(0,3056) \quad (0,0968) \quad (0,1242) \quad (0,0728)$$

$$n=25 \quad RZK=0,24076 \quad R^2 = 0,94$$

or

⁵ Perinatal period is pertaining to the period immediately before and after birth. The perinatal period is defined in diverse ways. Depending on the definition, it starts at the 20th to 28th week of gestation and ends 1 to 4 weeks after birth.

Dependent variable: DINFANT

Variable	Coefficient	Std. error	t-statistic	Prob
C	-0.912696	0.305621	-2.986366	0.0070
DAGE	0.200561	0.096848	2.070886	0.0509
DORDER	0.134298	0.124242	1.080937	0.2920
DEDUCATION	0.372436	0.072866	5.111216	0.0000

Y_i = infant mortality rate (dependent variable)

X_{1i} = infant deaths by age – up to 24 hours

X_{2i} = the birth order of the infant (first birth)

X_{3i} = primary education of the mother

The time series for all variables are logged and differentiated and thus transformed into a stationary series, which makes the model suitable for analysis. The independent variables are highly correlated with each other, but none is perfect function of another, i.e. there is no multicollinearity (FRV is less than 5).

By comparing the calculated value with the tabulated value of the F statistics, the significance level of 0.05 where

$$F = 114.83 > F_{22}^3(0.05) = 3.05$$

we can conclude that for the analyzed period (1990-2014) in the Republic of Macedonia, the selected explanatory variables (age of infants, birth order-first child and low level of maternal education) have, i.e. accomplish significant impact on the infant mortality rate changes, which means that the regression as a whole is significant. Also, the coefficients of correlation between the dependent variable (DINFANT) and separate independent variables are high and positive (above 0.85).

If we analyze them separately, the regression coefficient C of the constant regression coefficient for the low educational level of mothers have a statistically significant impact on the infant mortality rate (resulting value of the t statistic is greater than the critical value of the t test, the significance level of 0.05). However, the regression coefficient for the age of the infant shows insignificant statistical dependence with very small difference, so we can assume that this variable is on the margin to be considered as statistically significant for the infant mortality rate. Almost the same is the situation with the regression coefficient for the birth order of the infant. From there it can be concluded that the demographic variables for the observed period did not show high significance for the infant mortality rate. Only the socio-economic variable i.e. the education of the mother is an important factor.

The results of the estimated model confirm that when the percentage of the mothers with primary education increases by 1%, we can expect that it will lead to an increase of the infant mortality rate by 0.372 (assuming other three factors to remain constant).

According to data obtained, the determination coefficient shows that about 94% of the infant mortality rate variations for the period 1990-2014 can be explained by the variations in the selected independent variables (age of infants, birth order-first birth and low educational level of the mothers). The rest of the variations of about 6% can't be explained by the model or are due to other factors.

5. POLICIES AND MEASURES FOR INFANT MORTALITY DECLINE IN THE REPUBLIC OF MACEDOINA

The Republic of Macedonia continuously was providing institutional care for the mothers and children, including the infants, since the end of the fifties of the previous century. The Institute for Health Protection of Mothers and Children of the Republic of Macedonia (established 1957) activities aims to strengthen and support the health of mothers and children and ensure access to high quality preventive and primary health

care for mothers and children. The main goal of the Institute's activities is to provide an integrated and holistic approach in improving the health of these two most vulnerable groups, taking into consideration the healthy start to life of the infants as the basis for good health throughout the lifecycle. For that purpose in this institution there are two departments: a) Department of improving the quality of health care for mothers and children, which includes: the sector of planning, monitoring and evaluation activities and the sector of health promotion and education; b) Department for monitoring the growth and development of the children born with risk (The Institute for Health Protection of Mothers and Children in the Republic of Macedonia, 2015, <http://www.zds.com.mk/majkideca.html>).

In the last two decades, many projects and measures were taken in order to reduce the infant mortality in the Republic of Macedonia. Without intention to address all of them, we are pointing out several.

In the period 1998–2001, the Ministry of Health of the Republic of Macedonia (MoH), supported by the World Bank, started a project to reduce the perinatal mortality. It aimed to develop a national strategy for perinatal care, introduce an evidence-based medical training programme and develop the national neonatal intensive care network. Most of the project objectives were achieved despite numerous obstacles: a) meeting basic educational needs of neonatal providers at secondary and tertiary level, including both doctors and nurses; b) structural development of a tertiary care unit in the Clinic for Obstetrics and Gynecology, relocation of the tertiary care unit in the Clinic for Pediatrics and development of a neonatal transport service; c) provision of equipment to secondary and tertiary care units and the transport service, staged according to operating bed numbers and training programme; d) inclusion of neonatal rotations in pediatric training and of basic neonatal information in undergraduate medical training; e) introduction of advanced neonatal training for nurses and midwives; f) establishment of a center for continuous medical education, development of an 8-week training programme for doctors and nurses, and training of ten educators; g) establishment of a Perinatal Committee to guide and integrate perinatal care at all levels of implementation; h) development of clinical protocols based on the best available evidence, including the Cochrane database and Welsh database of perinatal trials; i) establishment of a Maternal, Perinatal and Infant Mortality Committee to investigate all maternal, perinatal and infant deaths; j) development and implementation of standardized psychometric and neurological testing for all high-risk neonates and providing audit data on long-term morbidity and appropriate intervention into school age; k) development of a strategy for perinatal care (Gjorgjev Dragan, Tozija Fimka, 2004).

The Ministry of Health of the Republic of Macedonia in 2001, identified a considerable problem in the area of maternal and child health and approached to the International Development Agency of the World Bank for credit, to set up a health sector transition project. *Funding was granted to develop a national perinatal service with a primary goal of reducing the PMR.* Education was given priority in the form of a hospital based initiative to develop the capacity of health professionals to introduce evidence-based perinatal practice into 16 participating hospitals. A “train the teachers” approach was used, with trainees introduced to modern education and clinical practice in Sydney and subsequently supported to train their colleagues in Skopje (Heather E Jeffery, Mirjana Kocova et al., 2004).

In 2009, the *National Strategy for Sexual and Reproductive Health in the Republic of Macedonia 2010-2020* was adopted. The purpose of this document is to provide a broad platform for cross-sectorial approach for the realization of the sexual and reproductive rights and to establish strategic framework for action for all partners, at all levels of prevention, in all sectors of the society, with proper sustainable financial framework of activities. Certainly, this document will only provide a global framework about the priority issues and conditions in the Republic of Macedonia in the area of sexual and reproductive health, by placing emphasis on recommendations for interventions with clear targets and tasks, whose implementation should give adequate results (Ministry of Health of the Republic of Macedonia, <http://www.moh.gov.mk/>).

In achieving the goal for reducing infant mortality, very important is the adoption of the document: *Improving Maternal and Infant Health: Safe Motherhood Strategy in the Republic of Macedonia 2010 – 2015*. This strategy is a guiding instrument for actors in mothers and infants health in the country and

incorporates the new evidence or best practices in all of its segments, from the period of pre-conception to the post-natal care in the first year of life of the newborn, as an overall process of creation conditions for safe motherhood. This Strategy is based on a profound analysis of the conditions in the perinatal care in the country, reflecting the strong and weak points of current practices. Based on the identified gaps, the Strategy proposes focused action to address the insufficiencies within the system, and overall improvement of the health of the mothers and newborns in the Republic of Macedonia. The expected result from the implementation of this Strategy is to ensure healthy and safe pregnancy, motherhood and perinatal care, through equitable and efficient provision of health services, increase of the capacities of the trained staff, and special attention on marginalized and vulnerable groups. All goals and activities are referring to four key periods: Pre-conception period, Prenatal care period, Delivery period, Post-natal care period (Ministry of Health of the Republic of Macedonia, <http://www.moh.gov.mk/>).

In 2012, the Grant Arrangement for the project “*Set up of an integrated system of maternal and child care*” was signed by the Minister of Health of the Republic of Macedonia and the Ambassador of the Netherlands (<http://www.rvo.nl/subsidies-regelingen/projecten/set-integrated-system-maternal-and-child-care>). The project is for the improvement of the existing facilities and structures for maternal and child health care in the country, through upgrading and modernizing regional secondary hospitals in general and gynecology. The system of community nursing during and after pregnancy will be improved by building capacity and training of the nurses and also the system of preventative health care and immunization for all children aged 0-5 will be improved. The objective of the project is to reduce perinatal mortality, infant mortality and maternal mortality rates, as well as reducing disabilities as a result of deficiencies during pregnancy, delivery and infant care. In addition, lower health care costs are one of the objectives by shifting care from tertiary to lower levels of care.

Starting from October 2014, the public health institutions in the Republic of Macedonia started to implement the project: *Reducing infant mortality - Strengthening neonatal services* (http://www.linkacross.org/en/index.php?option=com_k2&view=item&id=117:reducing-infant-mortality&lang=en). The purpose of this project initially is focused on the tertiary level of the neonatal intensive care. Reducing the infant mortality requires to improve the cooperation between various institutions and levels, as well as to other relevant sectors, at national and local level. The access to quality health services, to gender equality and social status, as well as the protection of human rights, should continue to be promoted through a coordinated multi-sectorial approach. In this context, the education and social protection play an important role. Particular attention should be pay to the most vulnerable groups, as the Roma population, the poor and persons who don't have any kind of insurance.

However, despite the implementation of all projects, measures and activities in purpose to reduce the infant mortality in the Republic of Macedonia, the situation is still unfavorable. Starting from 2007, the infant mortality rate is increasing. Very problematic is the fact that beside all measures, which were taken in order to reduce the mortality of infants with age of zero days and the early neonatal mortality, in 2014, the number of this cases (61 and 70, respectively) is more than half of the total number of infant deaths.

The majority of the previously mentioned activities for reducing infant mortality were conducted in the last few years and their implementation is ongoing. The evaluation of their results should show whether they were properly implemented and what was their effectiveness. Regardless of this, having in mind the positive experiences from other countries, we consider that there are recommendations in few areas which can be taken into account, for improving the plans of infant mortality reduction.

Implement Health Promotion Efforts - Health promotion should help the individuals to understand influences of health, become motivated to strive for optimal health and change their lifestyle to move toward a state of optimal health. Concerning the mothers and newborns care this efforts should include: incorporation of messages on healthy pregnancies and healthy infant care into social marketing and education campaigns; educate communities and service providers on the issues and impact of infant

mortality within the community in order to develop additional supporters for improving birth outcomes; support breastfeeding promotion for all mothers etc.

Ensure Quality of Care for All Women and Infants - Implementing measures to ensure high-quality and effective health care for all pregnant women and infants can have a positive impact on improving birth outcomes and lowering health care costs. It can include the following measures: increase the collaboration of the key stakeholders for perinatal outcomes across the state (the state health care authorities, state infant mortality reduction programs, birthing hospitals, medical associations, health insurers, community health centers); ensuring access to appropriate consultation and referral for pregnant women to a higher level of care when indicated; ensure access to comprehensive post-delivery follow up care in the hospitals; regular post-delivery services to all women, not just those with poor birth outcomes.

Develop Data Systems to Understand and Inform Efforts - Developing and using data systems, however, is a specific recommendation because building data infrastructure is foundational to understanding a problem, implementing interventions and evaluating comprehensive efforts. Key partners in developing data systems may include: hospitals, health insurers, vital statistics, chronic disease programs, fetal and infant mortality review programs (if there are any). Enhancing and supporting ongoing data collection and monitoring systems through linkage of birth certificates with infant death certificates, newborn screening, immunization registries and maternal and infant hospitalizations, are crucial next steps to developing a comprehensive picture of infant mortality and strategies to improve birth outcomes.

Promote Social Equity - Different population groups experience different burdens of infant mortality and poor birth outcomes. Distinct burden is typically manifested as differences in socio-demographic risk factors, such as income level, educational attainment, poverty or ethnic group. The government can consider the following options to promote social equity to reduce infant mortality and improve birth outcomes: support working mothers and families; ensure health care services are provided in a manner compatible with the cultural beliefs, practices and preferred language of the consumer; develop, recruit and train a diverse network of culturally competent health professionals throughout the country.

All the above mentioned recommendations about infant mortality reduction programming should improve the outcomes. Prevention programming aimed at both individuals and communities is not only saving lives, but also conserving limited resources. Health service indicators such as immunization rates, well child visits and insurance coverage, are much higher now than in the recent past, due to the concerted efforts of all service participants, providers and administrators. However, Republic of Macedonia still needs to improve the infant mortality ranking. For that purpose, it is necessary to implement accountability mechanisms despite the existing laws, which should prompts bigger dedication for infant mortality reduction. Also, strengthening the technical and managerial capacities of all parties responsible for the wellbeing of mothers, infants and children, will provide a fair service delivery to all, especially to the socially excluded with higher risk, poor health, without or with low level of education and in the poorest families with many children.

CONCLUSION

From the analysis of the infant mortality in the paper several conclusions derives:

All recent studies show that the substantial global progress has been made in reducing under-five child death and infant mortality since 1990. Despite these gains, progress of the under-five child mortality remains insufficient to reach MDG 4 (reduce by two thirds, between 1990 and 2015, the under-five mortality rate), particularly in Oceania, Sub-Saharan Africa, Caucasus and Central Asia, and Southern Asia (UN, Millennium Development Goals Report 2015). Regarding the infant mortality, the global trends are showing that despite the impressive improvements in most regions (decline of the infant mortality rate), the average value of this indicator in most of the sub-groups of less developed regions have not yet met the

ICPD targets (35 per 1,000 live births), held back in particular by high levels of infant mortality still prevailing in parts of Africa.

In the last five decades significant reduction of the infant mortality in the Balkan countries was noticed, but with different intensity, implicating relatively less emphasized differences. Republic of Macedonia, during the whole analyzed period, stands out regarding all indicators. The average infant mortality rate in the EU is 3.7 per 1,000 live births in 2013, while in the Balkan countries the value of this indicator is moving from 3.7 per 1,000 live births (Greece) to 10.2 per 1,000 live births (Republic of Macedonia). Concerning the types of infant mortality rate, in 2013 they all have the highest value in the Republic of Macedonia (the neonatal mortality rate is 7.7 per 1,000 live births, the early neonatal mortality rate is 6.0 and the perinatal mortality rate is 14.4 per 1,000 live births). Very specific is the situation in 2013 when in most of the Balkan countries these indicators have started to increase.

All available data point out that regarding the changes of the infant mortality in the Republic of Macedonia continuous decline of the infant mortality rate is noticed since 1950 up until now, but with various intensity and emphasized differences since 2002. In the period 1990-2000 the infant mortality rate has decreased for around two times and after 2000 the intensity of the decline is significantly lower. The value of this indicator in 2013 has reached the level from 2002. Compared to the EU 28 it is nearly three times higher, which is very big difference.

The profound analysis of the infant mortality features since 1990, based on the State Statistical Office of the Republic of Macedonia, shows:

Beside the neonatal mortality rate, the perinatal mortality rate is very high, which implicates that the country has very high number of stillbirths.

The mutual share of infant deaths with age of zero days and from 1 to 6 days in the total number of infant deaths is more than half in all observed years (except in 2011), which means that over 50% of the infant deaths occur in the first week of their life. It imposes the need for more profound analysis in order to identify the main reasons for this very unfavorable situation.

Most of the deaths are of the infants born as first by the birth order. Their share was significantly increased from 31.1% (2002) to more than half 51.9% (2014).

Until 2012 prevails the share of the death infants from mothers without and with primary education. In the last years considerable is the increase of infant deaths from mothers with higher education.

Almost during the whole analyzed period, highest infant mortality rate is characteristic for the Roma mothers (17.4 per 1,000 live births in 2013).

Regarding the infant deaths by causes of death more than half of the total number of infant deaths are caused by certain conditions originating in the perinatal period. From the rest of the causes of death more significant are the infectious and parasitic diseases.

The results from the regression model implicates that the low educational level of mothers have a statistically significant impact on the infant mortality rate, while about 94% of this indicator variations for the period 1990-2014 can be explained by the variations in the selected independent variables (age of infants, birth order-first birth and low educational level of the mothers).

In the last two decades, many projects and measures were taken in order to reduce the infant mortality in the Republic of Macedonia. Most of them were conducted in the last few years and their implementation is ongoing. The evaluation of their results should show whether they were properly implemented and what was their effectiveness. Regardless of this, we consider that additional measures and activities can be taken into account for improving the plans of infant mortality reduction in the following areas: health promotion efforts; ensure quality of care for all women and infants; develop data systems to understand and inform efforts; promote social equity.

In general, we suggest that interventions designed to reduce infant mortality should pay attention to the socioeconomic factors along with the preventive and curative healthcare interventions. The data on national level gives us a general picture, but while designing and implementing activities, the peculiarities of each concerned group and regional differences should be considered.

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