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GEOGRAPHIC PERSPECTIVE OF A MULTIDIMENSIONAL PHENOMENON: LOCAL DISPARITIES IN INFANT MORTALITY RATES IN NEAMŢ COUNTY, ROMANIA

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Abstract: Infant mortality is considered one of the most sensitive indicators of living standards, population health literacy level and healthcare system efficiency. Based on the current statistical data collected on Neamţ County, this research aims to capture the infant mortality territorial disparities existing at the local level. Results show that infant mortality index and attached thereto - lethality and mortinatality - have higher levels in rural areas, but with a downward trend for the period under study. There are high-risk areas requiring studies with rigorous methodology for evaluating health and its determinants at population level.

Keywords: deaths under one year; stillbirths; spatial differences; urban; rural

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INTRODUCTION

Population health status is a social and biological complex phenomenon, with many components and a multi factorial conditioning, there for, to asses and diagnose population health status a unique indicator does not exist, but several statistical indicators can be used. Each one has his own value in revealing different aspects of health (Marcu, 2002; Zanoschi, 2003).

In the complex aspects of morbidity and population health, children are persons with important demographic, functional, adaptation and health particularities, and they often represent the population segment most suitable for studying environmental and social factors impact on health (Chen et al., 2001). Considered one of the most sensitive indicators of living conditions, population health literacy level and efficiency of the entire healthcare system infant mortality rate is an indicator which reflects the intensity of children deaths before their first anniversary (Reidpath & Allotey, 2003).

Indicator of global interest, subject widely analyzed by medical and social sciences, infant mortality implies a geographical approach through territorial differences that do exist at

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global, regional and local level (Kleinman et al., 1976; Kalipeni, 1993; Koua & Kraak, 2004; Norman et al., 2004; Storeygard et al., 2008). Geographical perspective must be taken into account in any study that has as its main goal a complex assessment of a multidimensional phenomenon, like infant mortality.

Our research aims to underline the existing spatial differences in Neamţ County, to identify spatial patterns, time trend and to point out the territories that need special attention and a more profound analysis for understanding the causes that are generating them. Analysis conducted at a small scale, as in our case, offers a better identification of territorial „*hotspots"* and guides researches and policy makers to look more closely at the local environment (Waldhoer et al., 2008).

International comparisons of infant mortality has drawn researchers attention on country level (Hobcraft et al., 1984; Wagstaff, 2000; Aleshina & Redmond, 2005; Fantini et al., 2006), but it is well know that important variations exist not only between the countries, but within countries. Often, one territory (country, region or county) can offer different examples of evolution and even contrasting situations. Romania is no exception. In the last years, following the global trend, Romania achieved significant progress in reducing infant mortality. In 1990 the value for this indicator exceeded 26‰ (one of the highest values in Europe), in 1999 infant mortality rate goes below 20‰, and it has continued to diminish until 10.1‰ in 2009. In spite of all the improvements, infant mortality is still twice the European Union's average (Rotariu, 2009; Eurostat, 2011).

If we look closer to regional level, geographic variations and typologies exist and can be identified. Northeast region, followed closely by the southeast, has its unwanted leading place in the spatial distribution of infant mortality rate (Dumitrache, 2004). Highly rural population, unemployment, insufficient human and technical resources in the medical infrastructure or, more general, socioeconomic conditions are known as the „*invisible"* causes behind the numbers. At the same time, country center and Bucharest region are lowering the national average. These two areas with their different ethnic structure and different demographic characteristic had for the last two decades values that show that important improvements, at national and regional level, can be achieved.

A similar example, but at a smaller scale, is to be found at the county level (Iordache, 2009; Radu et al., 2010). Placed in the northeast of Romania, in the poorest region of the country, with 62.23% of the population living in rural communities and 51% of its surface represented by the mountain areas (western part of the district), Neamţ County is the chosen space for our analysis. Its social and geographical characteristic are perfectly illustrating that identification of territorial disparities is a sine qua non that must be taken in any research that is seeking a profound analysis of causalities, and for that geographic perspective of infant mortality rate is a important tool which, sometimes, has been neglected.

DATA AND METHODOLOGY

Using mathematical and statistical methods we have calculated following indicators: infant mortality, lethality and mortinatality for a previous and available period of time (2000 - 2009). In the next step we analyzed the obtained data and identified a trend influenced by exogenous and endogenous factors. With the help of GIS techniques we have created cartographic material for allowing us to identify spatial distribution of the three mentioned indicators.

Regional Direction of Statistics Neamţ was the source information, and the given data represents the statistical information collected for every commune in the county regarding the number of live births, stillbirths and deaths under one year.

RESULTS

Infant mortality

In analyzed period in Neamţ County there were 969 deaths under one year, marking an average of 97 deaths / year. Annual variations are significant, the number of deaths under one year in 2009 being nearly four times smaller than corresponding value for year 2000 (figure 1). This data have determinate an annual average rate for infant mortality of 16. 31‰.

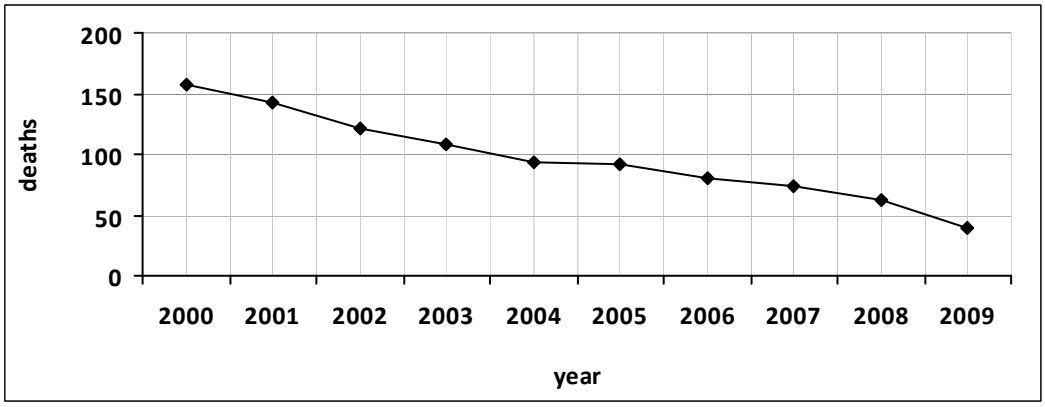

Figure 1. Evolution of number of deaths under one year between 2000 and 2009
(Data source: Regional Direction of Statistics Neamţ)

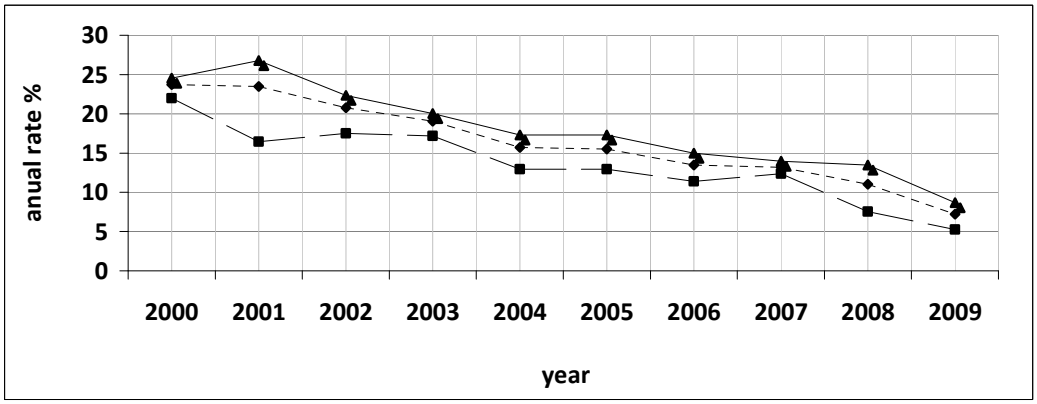

Figure 2. Evolution of infant mortality rate in Neamţ County between 2000 and 2009
(Data source: Regional Direction of Statistics Neamţ, own calculations)

During this period, the infant mortality was higher in rural areas (average annual rate in urban was 13.55‰ and 17.94‰ in rural), but with downward trend in both environments (figure 2)

Spatial distribution of infant mortality rate is characterized by heterogeneity, with surprising findings, and clear differences between municipalities. In rural space our index covers a wide range of values, starting from 0 (Ceahlău is the only locality where no deaths under one year were registered) to levels higher than 30‰ (Costişa, Taşca, Tazlău) and even over 40‰ (Icuşesti 42.41‰). Significant territorial variations must be mentioned concerning communes from the mountain region (western part of county). Infant mortality rates range from less than 10.00‰, case of Poiana Teiului, to values exceeding rural average, like Bicazu Ardelean and Taşca, were the indicator level is above 28.00‰ (figure 3). In the remaining territory of Neamţ County infant mortality rate is below urban average only in Piatra Neamţ - 9.89‰ and higher in the other urban localities: Roman - 15.81‰, Bicaz - 20.54‰, Târgu Neamţ - 18.85‰, Roznov - 19.90‰.

Proximity of a city is seen to have a positive effect on infant mortality, through better access to specialized medical healthcare. In our county the communes where periurbanisation process in recognized, especially those in the proximity of Piatra Neamţ, it can be noticed the small impact on the evolution of infant mortality, only Alexandru cel Bun and Girov have values under 12.00‰. The same scenario is encountered for other cities their influence on closest communes being minimum.

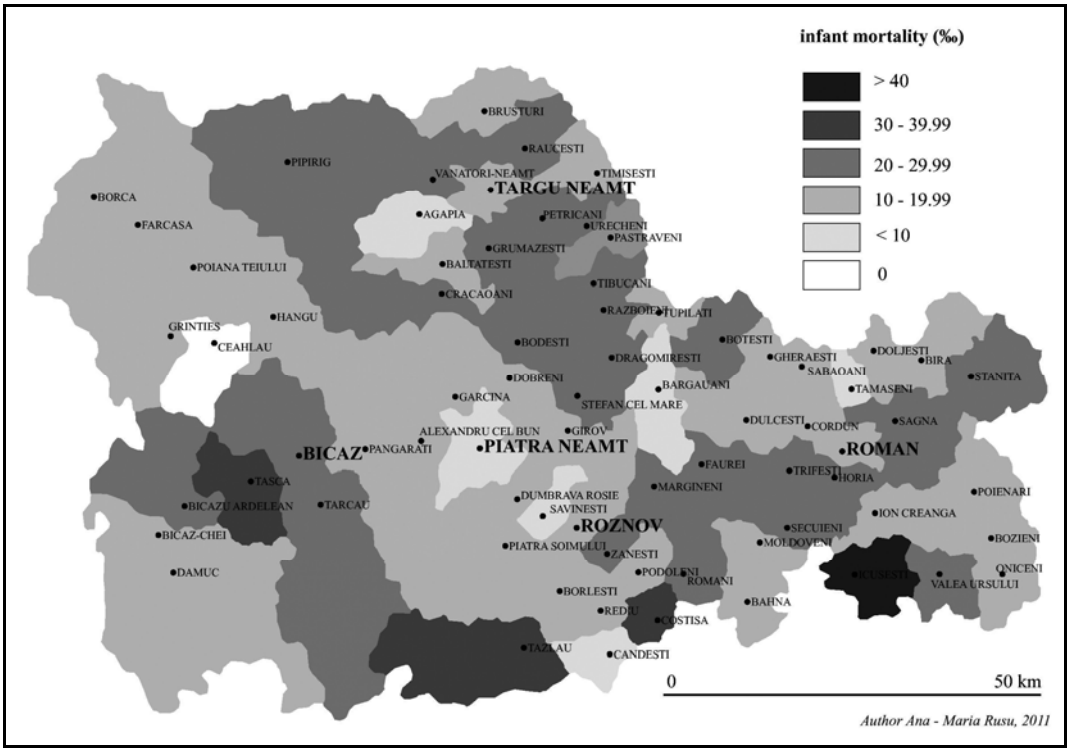

Figure 3. Average annual infant mortality rate in Neamţ County, 2000 - 2009
(Data source: Regional Direction of Statistics Neamţ, own calculations)

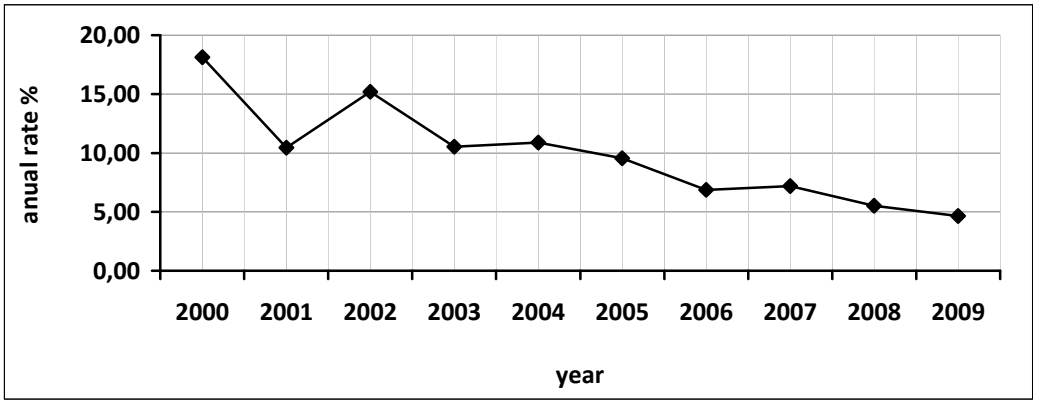

Figure 4. Evolution of infant mortality rate in Piatra Neamţ between 2000 and 2009
(Data source: Regional Direction of Statistics Neamţ, own calculations)

Useful information can be found not only by looking at the rates, but also looking at the absolute numbers. We can discover where most deaths under one year happen, where infant deaths are concentrated. This kind of analysis offers suggestive hints especially in rural areas. In Neamţ County almost 30% of deaths under one year occurred in only 9 communes (Borleşti, Dolješti, Icuşeşti, Petricani, Pipirig, Săbăoani, Sagna, Vânători Neamţ).

Knowing the right place where to look, it is the perfect start for any research. Geographical perspective of the phenomenon is showing its usefulness, and must become a

mandatory point in any study that is seeking to understand the connection between place and health, in general, and between place and infant mortality, in particular**.**

Although the general characteristic for infant mortality in Neamţ County had a downward trend different types of evolution can be identified (Muntele & Burlea, 2010). If for the county cities the situations is clear, with a constant distribution of deaths under one year during the ten years, and an important dropping of infant mortality in Piatra Neamţ (infant mortality level reduced 3 times, figure 4), in the rural environment the picture is more complex. We have communes where deaths under one year happened sporadic just in two or three years, (Agapia, Bârgăuani, Cândeşti, Moldoveni), but we can also distinguish localities with a steady presence of this phenomenon, and that is generating higher averages (Dolješti, Oniceni, Săbăoani, Icuşeşti and Răuceşti).

Although a general overview of the infant mortality trends in Neamţ County suggests an important progress, the picture is more complex when each district of the county is being analyzed. Birth rate and fertility rate decreased, number of newborns dropped, especially in the villages, international migration of adult population for work has grown, and even worsening of living conditions, all are behind of infant mortality decline. Even in the best examples of the county, in terms of infant mortality, communes Ceahlau (without deaths under one year) and Agapia (infant mortality average -5.81‰) (both of them with low fertility rates), arguments for justifying the numbers must be brought. In the first case the existence of a medical-social unit, seems to outline the importance of accessibility to specialized medical healthcare. In second case a high percentage of women (60% of population) due to the presence of a monastery of nuns may be a plausible explanation.

Analysis of infant mortality evolution in any community can be a very tricky job that requires researches special attention and forces them to decrypt the sensitive connections that exist with local environment.

Lethality

Lethality is a structure indicator which shows the proportion of infant mortality in the total structure of mortality for all ages in a territory and for a specific period of time. The proportion of deaths under one year (lethality 0 - 1 year) was 1.54% in the structure of general mortality for Neamţ County, with small differences between the two residential environments: 1.44% in urban areas and 1.59% in rural ones.

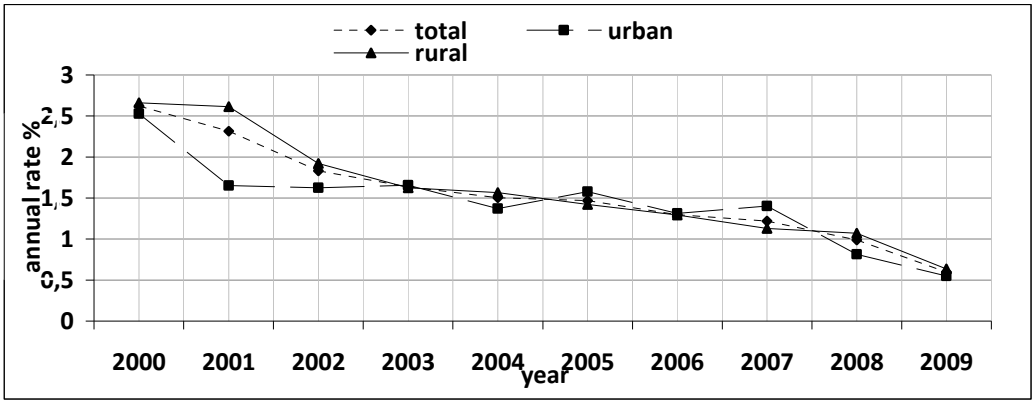

Figure 5. Evolution of lethality 0 - 1 year in Neamţ County between 2000 and 2009
(Data source: Regional Direction of Statistics Neamţ, own calculations)

During the ten year period, lethality 0 - 1 declined, without a constant distribution between the two areas. Characteristic for our interval it has been the shifting of priorities during

the years. Between 2000 and 2002, 2008 and 2009 the indicator rate was higher in the rural space, for the rest of the period it was identified the dominance of urban value (figure 5).

Although there have not been very large differences in time and in spatial distribution for lethality rate, we can identify some particularities. Year 2001 is, by far, the year with the highest annual average -2.69%. In the same year, deaths under one year had registered the higher proportion in Oniceni, Pipirig, Taşca, Valea Ursului, all of them with values above 9% in 2001 scored the maximum value for the decade in Icuşeşti, when deaths under one year have represented 11.29% from all deaths in this community. All five communes mentioned above have average annual lethality rate higher then 3,3%, and, as in infant mortality case, Icuşeşti has the highest rate of all (figure 6).

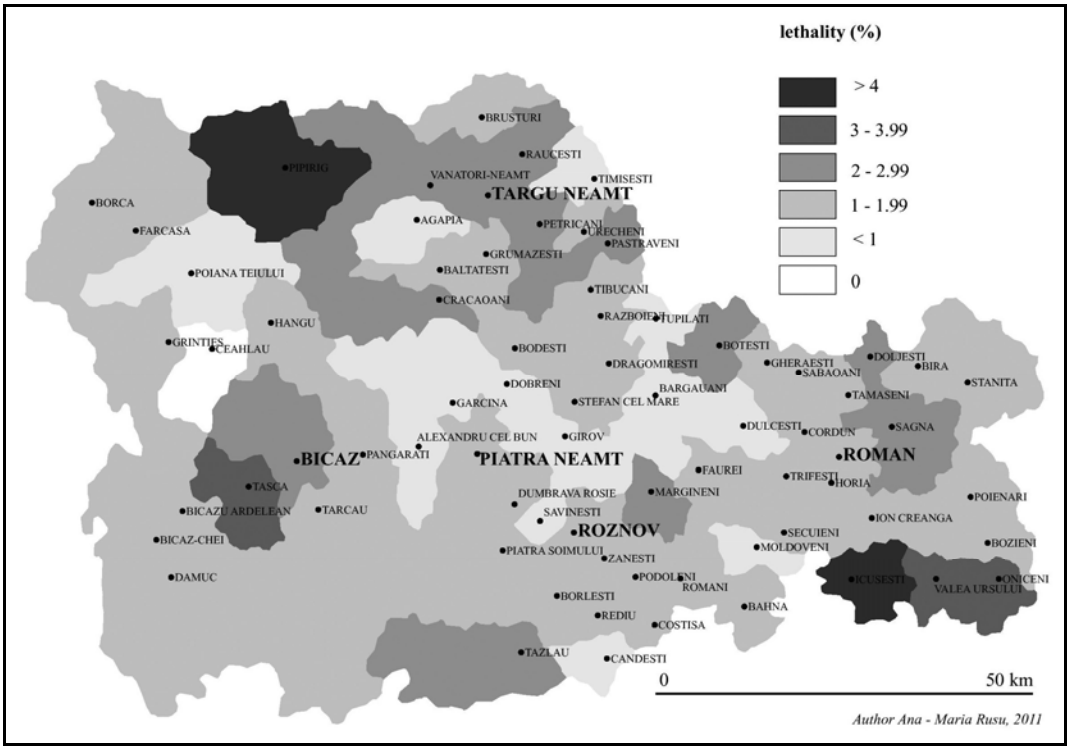

Figure 6. Average annual lethality 0 - 1 year rate in Neamţ County, 2000 - 2009
(Data source: Regional Direction of Statistics Neamţ,own calculations)

Mortinatality

This indicator represents the proportion of stillbirths from all born (dead and alive) and international comparisons are very difficult to made due differences in defining the notion of „*stillbirth*" from country to country (Gourbin & Masuy - Stroobant, 1994).

Romania registers moderate values of this indicator. Since 1950 when the values were high -24.6‰, it has continuous dropped to 6.5‰ in the mid nineties and went below 5‰ after 2007.

Between 2000 and 2009 in Neamţ County were registered 114 stillbirths in the cities and 266 in rural communities, which means higher values in rural areas, but with a general descendent trend (figure 7) and a different spatial pattern (figure 8).

This situation is not surprising, thus the fact that in the cities mothers are better monitored, have easier access to specialized medical care and are better informed on the possible risk that may occur during pregnancy.

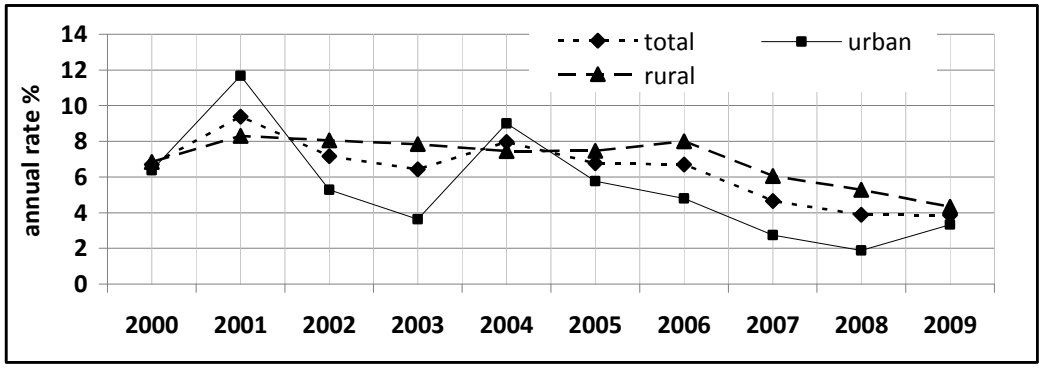

Figure 7. Evolution of mortinatality in Neamţ County between 2000 and 2009
(Data source: Regional Direction of Statistics Neamţ, own calculations)

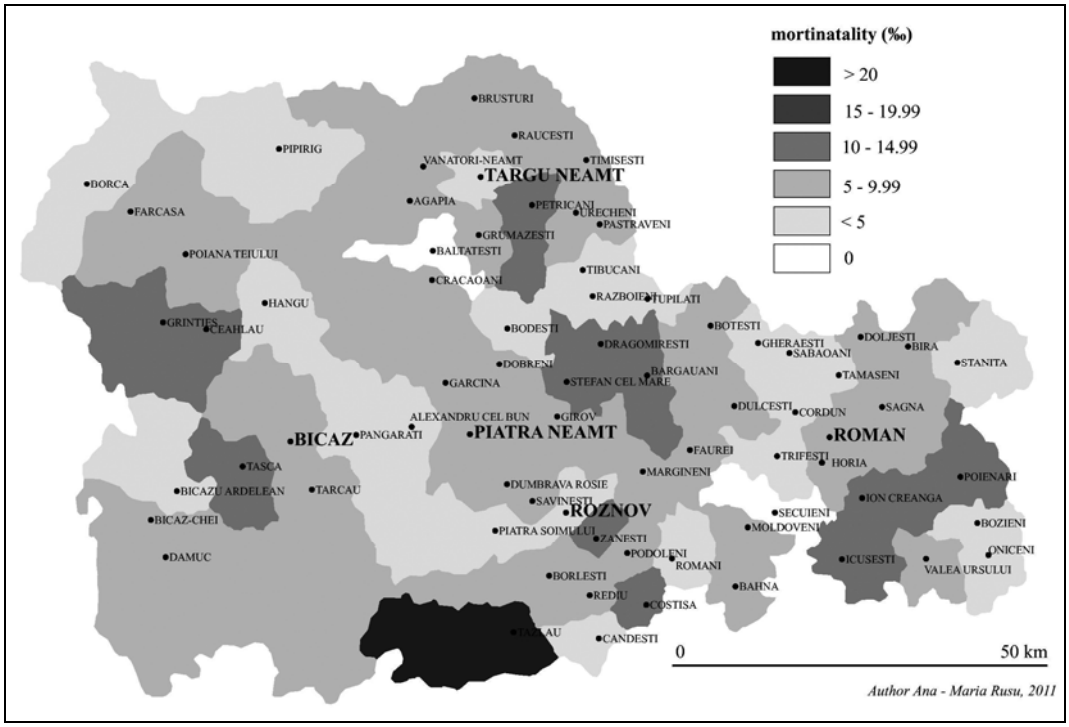

Figure 8. Average annual mortinataliy rate in Neamţ County, 2000 - 2009
(Data source: Regional Direction of Statistics Neamţ, own calculations)

In urban environment, Bicaz can be distinguished as a negative case, having the highest average, showing in five out of ten years values over 10‰, marking at the same time, the urban maximum (23.25‰) in 2007. Piatra Neamţ and Roman with a large number of births have registered annually stillbirths, without causing higher levels of mortinatality.

In rural areas the phenomenon is more sporadic, sometimes just one case in all period, that being reported to a small number of births in a year, generates a high level of mortinatality, after which it *„dissolves"* for all interval. Must be outlined the case of Bălţăteşti commune, which between 2000 and 2009, had no case of stillbirth. As local particularity must be mentioned high levels of the indicator, in the majority of the communes, in year 2001.

DISCUSSION

Based on our results, we established a classification of urban and rural areas in risk classes, a hierarchy of the municipalities according to infant mortality and mortinatality rates between 2000 and 2009. Classes are labeled from A to F: A has the lowest risk (without deaths under one year or without stillbirths) and F has the highest risk. Settlements that are found in the same risk class, for both infant mortality and mortinatality, are marked in bold letters, to allow an easier identification of the communities that need a special attention.

We have distinguished some risk territories for one or both aspects: 42.02% of rural localities are in areas with values above Neamţ County average, regarding infant mortality rate (categories D, E, F - infant mortality rate over 20.00‰); as for mortinatality 17.56% are territories with high risk (categories D, E, F - mortinatality rate over 10.00‰), and Tazlău commune has both indicators with high levels (table 1).

Table 1. Distribution of rural and urban settlements in risk classes according to infant mortality and mortinatality levels
(Data source: Regional Direction of Statistics Neamţ, own calculations)

Infant mortality ‰		Mortinatality ‰	
RURAL			
Without deaths under 1 yr (A) n=1	Ceahlău	Without stillbirths (A) n=2	Bălţăteşti, Secuieni
< 10‰ (B) n=5	Agapia, Bârgăuani, Cândeşti, Săvineşti, Tămăşeni	< 5‰ (B) n=18	Alexandru Cel Bun, Bicazu Ardelean, Bodeşti, Bozieni, Câdeşti, Cordun, Gherăeşti, Pângăraţi, Piatra Şoimului, Pipirig, Războieni, Români, Săbăoani, Staniţa, Tămăşeni, Ţibucani, Trifeşti, Tupilaţi
10-19,99‰ (C) n=34	Alexandru cel Bun, Bahna, Bălţăteşi, Bicaz Chei, Bira, Borca, Borleşti, Bozieni, Brusturi, Cordun, Dămuc, Dobreni, Doljeşti, Dulceşti, Dumbrava Roşie, Fărcaşa, Gherăeşti, Girov, Grinţieş, Hangu, Ion Creangă, Moldoveni, Oniceni, Pângăraţi, Păstrăveni, Piatra Şoimului, Podoleni, Poiana Teiului, Poienari, Rediu, Săbăoani, Timişeşti, Tupilaţi	5-9,99‰ (C) n=35	Agapia, Bahna, Bicaz Chei, Bira, Borca, Borlesti, Boţeşti, Brusturi, Ceahlau, Crăcăoani, Dămuc, Dobreni, Doljeşti, Dulceşti, Dumbrava Roşie, Fărcaşa, Făurei, Girov, Grumăzeşti, Hangu, Horia, Mărgineni, Oniceni, Păstrăveni, Podoleni, Poiana Teiului, Răuceşti, Rediu, Sagna, Săvineşti, Tarcău, Tasca, Timişeşti, Valea Ursului, Vânători- Neamţ
20-29,99‰ (D) n=25	Bicazu Ardelean, Bodeşti, Boţeşti, Crăcăoani, Dragomireşti, Făurei, Grumăzeşti, Horia, Mărgineni, Petricani, Pipirig, Răuceşti, Războieni, Români, Sagna, Secuieni, Staniţa, Ştefan cel Mare, Tarcău, Ţibucani, Trifeşti, Urecheni, Valea Ursului, Vânători Neamţ, Zăneşti	10-14,99‰ (D) n=13	Bârgăuani, Costia, Dragomireşti, Garcina, Grinţieş, Icuşeşti, Ion Creangă, Moldoveni, Petricani, Poienari, Ştefan Cel Mare, Urecheni, Zăneşti
30-39,99‰ (E) N=3	Costişa, Taşca, Tazlău	15-19,99‰ (E) n=0	-
> 40,00‰ (F)	Icuşeşti	> 20,00‰ (F)	Tazlău

Infant mortality ‰		Mortinatality ‰	
RURAL			
n=1		n=1	
URBAN			
< 10‰ (B) n=1	Piatra Neamţ	< 5‰ (B) n=1	Târgu Neamţ
10-19,99‰ (C) n=3	Roman, Roznov, Târgu Neamţ	5-9,99‰ (C) n=4	Bicaz, Piatra Neamţ, Roman Roznov,
20-29,99‰ (D) n=1	Bicaz	10-14,99‰ (D) n=0	-

All this values are important indicators for risk areas, suggesting to researchers the right place where detailed analyses must be conducted for finding a plausible explanation for their determinants. So, geography does matter and local disparities are becoming an important tool for indentifying the causes.

In our case, spatial differences, as they appear from the significant numbers, can be found not only between different levels: urban - rural, high areas - low areas, but also within the same level. If quality of living conditions, medical healthcare infrastructure or accessibility can be invoked as arguments to justify disparities between levels, to assess the differences within the same level we have to look more closely, to *„zoom in"* on local environment (Stativă et al., 2005; Comber et al., 2011).

As mentioned before, in rural space we can find a wide range of values, with surprising situations. Infant mortality rate in communes from the mountain regions goes from 0 (commune Ceahlau) to more than 30‰ in Tasca case. Here the pollution may be a possible explanation, with the limestone exploitation and cement factory leaving their mark on the environmental quality**.** The same argument is valid for communes in the proximity of Săvineşti - Roznov chemical platform, where nitrate pollution was (and still is?) a fact that no one could deny it (Vasilov et al., 1999).

We cannot discuss about local disparities without taken into account the social characteristics of a specific community. Ethnic and even confessional structure may have a strong impact in time and space evolution of the index.

Unemployment, social exclusion, low level of mother's education, poor living conditions are to be found in the Roma communities (United Nations Development Program, 2006; European Union Minorities and Discrimination Survey, 2010; Masseria et al., 2010). Is no news that all mentioned before have strong connections with infant mortality level. The communes where the Roma population is present in a significant proportion have higher rates and higher numbers of deaths under one year (Boţeşti, Crăcăoani, Dragomireşti).

When ethnic and confessional structure (Catholics from Moldova are known for traditional demographic behavior, with higher fertility rates) (Muntele & Atudorei, 2011) play an important role in day to day life of a community, like in Icuşeşti case, it can be noticed the impact on infant mortality rate. The commune mentioned above has the highest average of the index and registers deaths under one year for all ten years.

Cultural background and location factors interact and bring their contribution to infant mortality evolution.

Although this article does not aim to analyze determinant causes for high levels of infant mortality rate, we must remember that the most frequent factors are:

a) for high infant mortality rate:

- endogenous factors: early childbearing, maternal diseases during pregnancy, inappropriate treatments during pregnancy, lifestyle habits during pregnancy (food deficiencies, stress, occupational exposure to different type of hazards), prematurity;

- exogenous factors: from natural environment (physical, chemical, geographical and biological factors), socioeconomic factors (living conditions, family climate, bad eating habits, mothers low level of health literacy, low accessibility to primary and specialized medical health care).

b) for mortinatality - in general, there are involved maternal diseases during pregnancy, congenital anomalies of the fetus, complications arising during birth. In Neamţ County main causes that are generating children deaths before their first anniversary, as they appear from official health statistics, are respiratory diseases (44%), complications during pregnancy (36%), malformations and congenital anomalies of the fetus (14 %). Determinants can be found in the genetic background, lifestyle of mothers during pregnancy and even in natural and built environment. In all territories identified as high risk areas, there should be carried out specialized investigation to assess causal and risk factors that are involved in producing unfavorable health indicators in Neamţ County, a small but important stage that must be covered in any research that has its major challenge - understanding the multi-causality chain.

CONCLUSIONS

Of all indicators used to evaluate population health status, infant mortality has important demographic, personal, psychological and social implications. Infant mortality level synthesizes the impact of endogenous and exogenous factors and evaluates the efficiency of healthcare programs.

In Neamţ County, infant mortality index and ones attached to it - infant lethality and mortinatality - have higher levels in rural areas, but with a descendent trend for period under study (2000 - 2009); there are high risk areas in the county in terms of this indicators valued separately or in combination, which requires rigorous methodological studies for assess health and its determinants at population level.

Analysis of infant mortality at a smaller scale is giving to scientists a better perspective and a better understanding of its relations with socioeconomic and biological determinants.

Identification, monitoring and description of local disparities are key points for policy makers and stakeholders. From this perspective, geographical approach of local disparities in infant mortality rate is the first step for finding the most suitable measures to reduce them, measures tailored for any administrative level in which they occur.

Geography, through its specific methods and techniques, especially with the help of GIS tools needed for visualization of territorial disparities (Tanser & Le Sueur, 2002) can bring together researchers and stakeholders for a cross - sectoral approach that aims to develop most suitable strategies to reduce infant mortality inequalities, taking into account the special needs of every disadvantage community.

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