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THE INFLUENCE OF SOCIO-ECONOMIC FACTORS UPON PUBLIC HEALTH ON THE EXAMPLE OF PODKARPACKIE VOIVODSHIP

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ABSTRACT. This study concentrates on intraregional disparities in health and spatial distribution of socio-economic factors that may affect health outcomes. The example of Podkarpackie voivodship rural and urban areas provides viable evidence for at least the partial importance of socio-economic variables in explaining intraregional health disparities. A total of eight factors that influence hospitalization rate were distinguished for urban and rural areas. Global regression models were created using the socio-economic factors, which succeeded in explaining a considerable amount of variation in hospitalization rates both in urban and rural areas. Unfortunately, these models failed to explain local health determinants and so more sophisticated statistical models are necessary in order to fully understand intraregional health disparities.

KEY WORDS: Poland, Podkarpackie voivodship, regional health, hospitalization rate, health disparities, socio-economic factors.

INTRODUCTION

Any evaluation of socio-economic impacts upon intraregional health will be impartial. Multiple, complex, and often difficult to gather variables have prompted the exploration of health outcomes using sophisticated, multivariate analyses usually based upon census or health survey data. It is obvious that socio-economic factors do not play a major role in health disparities within populations and regions as genetic, environmental, accidental, quality and accessibility of healthcare and many other determinants collectively do (to various degrees). However, socio-economic factors are connected with a very important health determinant – life-style (Korprowicz, 1999). Life-style includes nutrition, habits, level of stress, and propensity to exercise, all of which are responsible for one's

health and well-being. Notably, some of these issues are also shaped by cultural influences. The most important aspect of life-style, though, and one affected by one's culture, is that of leisure activity choices.

Social and economic factors that affect population health have been examined in a large number of studies by geographers, sociologists, epidemiologists, ecologists, and economists alike. All of the research done shows clear relationships between health and such variables as gender (Sayer, Britt, 1996), age (Huisman et al., 2003), migration status (Bentham, 1988), education (Mackenbach, Kunst, 1997), employment (Mormot, 1994), poverty (Rosenberg, Wilson, 2000), and even place itself (the so-called 'neighbourhood effects') (Spielman, Yoo, 2009). In the early nineties, a dispute began over the prevalence of contextual (regarding place) or compositional (regarding population) factors in shaping health, and has yet to be settled (Smyth, 2008). There are several studies which explore the impact of the entire socio-economic environment upon health by utilizing multivariate analysis on various spatial dimensions in order to explain health inequalities (Frohlich, Mustard, 1996; Cavalini, De Leon, 2008). Generally, based on a brief review of western literature, an older, non-migrant, poorly educated, blue-collar or unemployed female in the lowest income quintile and living in a deprived area is the most likely to suffer from a disease.

Much less attention has been paid within Poland to the relationships between socio-economic variables and health. However, a few studies concerning this topic should be mentioned, as their authors explore socio-demographic and economic aspects of health (Duch, Uramowska-Żyto, 1990; Frąckiewicz, 1990). The traditional geography of health in Poland dates back to Kolago's key concepts and ideas published in 'Przegląd Lekarski' ('Medical Journal') shortly after the World War II (Kolago, 1948). Some authors attempted to use multivariate statistical methods to explain health disparities (Parysek, 1987; Michalski, 2010). Nevertheless, a dominant issue in Polish health geography has been the relationships between health, the state of the environment and industrial pollution. These issues were investigated by such authors as B. Zemła (1987), T. Mantorska (1990) and W. Kałamucka (1993).

GOALS, SETTING AND DATA ORGANIZATION

The aim of this study, using the example of Podkarpackie voivodship, is to present viable evidence of intraregional associations between socio-economic characteristics of population and health, by using the number of hospital stays as the explanatory variable. While investigating these associations a clear distinction between health determinants and health disparity determinants ought

to be made in order to formulate appropriate research questions. Accepting the latter as an assumption, socio-economic factors do affect health in a way that they correlate with hospital prevalence rates, even though sometimes no direct, cause-effect relations can be found. Accordingly, this study endeavors to answer two main questions: to what extent health disparities as measured by hospital stays can be explained by socio-economic factors in rural and urban communities of Podkarpackie voivodship and what is the role of particular factors in various areas in relation to the global regression models.

This study uses, as an example, Podkarpackie voivodship (17.8 thousands km^2, 2.1 million inhabitants in 2008 by Central Statistical Office Regional Database), which is divided into 25 poviats and 159 gminas (45 urban and rural-urban, 114 rural gminas). The data utilized was gathered from three sources: Podkarpackie Centrum Zdrowia Publicznego in Rzeszów (Center of Public Health of Podkarpackie voivodship in Rzeszów), which provided the hospital stays (without health resort hospitals) data, the Central Statistical Office running records and the 2002 Polish National Census, both of which provided the socio-economic data.

Two limitations of this study, which result from including hospital stays as a dependent variable, need to be mentioned. The first one includes the data collected, which treats multiple hospital stays by one person during the year as separate cases. The second one concerns a lack of time of hospital stays and including all hospital admissions regardless of their causes (except labours). Hence, the examined relationships provide only general and simplified information about socio-economic factors affecting health disparities.

For this research, the voivodship was divided in a way contrary to the legal classifications to avoid including towns of a much more rural character as urban areas. Accordingly, the data was organized in such a way that towns and rural areas of urban-rural gminas are considered separately. Gminas were grouped as follows:

1) urban areas were distinguished as gminas with more than 2,000 inhabitants, a population density of more than 250 people per km^2 and a share of households with individual homesteads in the gmina lower than 33.3 %,
2) other gminas not meeting these requirements were labeled as rural communities.

As a result, 38 urban areas and 150 rural areas were included in this analysis.

A total of 45 variables were chosen (demographic, social and economic, all standardized by gminas' population), which were expected to show associations with the dependent variable – the average number of hospital stays per 10,000 inhabitants during the span of five years between 2003 and 2007 (hospitalization rate). The hospitalization rate was calculated for each gmina. All the data included

Table 1. Significant Spearman rank correlation coefficients for demographic, social, and economic variables in rural and urban gminas of Podkarpackie voivodship

Factors	Spearman rank correlation coefficients with average number of hospitalizations (per 10,000 inhabitants) variable during 2003–2007	
Demographic variables	**Rural areas (n = 150)**	**Urban areas (n = 38)**
Average population density	**–0.37*****	0.31
Average share of women	**–0.18***	**0.36***
Average population inflow rate	0.07	**–0.51****
Average population outflow rate	**0.39*****	0.19
Share of divorced and separated	**0.33*****	**0.53*****
Share of population aged 10–14	–0.12	**–0.33***
Share of population aged 30–34	**–0.24****	–0.09
Share of population aged 35–39	**–0.33*****	–0.22
Share of population aged 45–49	**0.21****	0.09
Share of population aged 50–54	**0.23****	**0.38***
Share of population aged 55–59	**0.21****	**0.37***
Social variables		
Average number of people per apartment	–0.04	**–0.37***
Average number of people per room	0.04	**0.36***
Average housing area per person	–0.04	**–0.53*****
The share of households with 5 persons or more	–0.08	**–0.55*****
Economic variables		
The share of employed in agriculture	**0.30*****	–0.07
The share of employed in services	0.03	**0.34***
Average unemployment rate	**0.25****	0.15
The share of pensioners and social benefiters	**0.21***	0.07
The share of households with agriculturally-slated land use	–0.08	**–0.44****
Share of households with individual homestead	–0.10	**–0.48****
Average share of agriculturally-slated land in gmina's total area	**–0.25****	–0.15
Average share of arable land in gmina's total area	**–0.24****	–0.15
The average share of forests	**0.25****	–0.05
Average data for 2003–2007, 2002 National Census data In italics	*** p<0.05 ** p<0.01 *** p<0.001**	

Source: Author's calculations based on the data collected from Central Statistical Office – www.stat.gov.pl

was from the same time period, except variables based upon data extracted from the 2002 Polish National Census. Spearman rank correlation coefficients were calculated twice for each variable, once each for urban and rural areas, in an effort to discover which variables were significant and viable ($p<0.05$ and with correlation coefficient exceeding +/– 0.2) and therefore important to work with. The selected relevant variables are presented in Table 1, a total of 24 variables were significantly correlated with the dependent variable (15 in rural areas and 13 in urban areas). Interestingly, rural gminas showed a stronger relationship with economic variables, whereas their urban counterparts were more correlated with social variables, especially those concerning housing conditions.

METHODS

Principal component analysis and factor analysis were applied in order to reduce the number of variables and extract the prevalent factors influencing both rural and urban health (as measured by the hospitalization rate during 2003–2007) in Podkarpackie voivodship. These methods have often been praised for their applicability in health geography (Michalski, 2002) and have been successfully used in geographical analysis, as, for example, in assessing non-spatial factors for healthcare access (Wang, Luo, 2005).

Factors for rural and urban areas were derived from the principal component analysis and subsequently reduced to the top four factors for rural areas (79.5% of the total variance explained) and the top four factors for urban areas (83.9% of the total variance explained). Limiting the number of factors to four for each model, as suggested by the examination of a scree plot, provided satisfactory and comprehensible results. Next, using the VARIMAX rotation in order to maximize the total explained variance per each of four factors, the following factors were obtained:

A) Rural areas

1) **Factor 'Forested area' (X_1)** includes differences in land-use, showing a high share of forests and a low share of agricultural areas (32.5% of total variance explained);
2) **Factor 'Resident retention' (X_2)** includes a low share of people aged 45–59, a low emigration rate and a small share of divorced or separated inhabitants (22.9% of total variance explained);
3) **Factor 'Ageing'(X_3)** includes a high share of population living off pensions or social benefits, and a small share of people in their thirties (12.7% of total variance explained);

4) **Factor 'Economic development' (X_4)** includes a low unemployment rate and a low number of people employed in the services sector (11.4% of total variance explained).

B) Urban areas

1) **Factor 'Ruralization' (Z_1)** includes a sizeable housing crowdedness and a high concentration of homesteads (28% of total variance explained);
2) **Factor 'Housing conditions' (Z_2)** includes a high housing space per person but low per room and a high immigration rate (21.8% of total variance explained);
3) **Factor 'Employment in service sector' (Z_3)** includes high employment in the service sector (8.9% of total variance explained);
4) **Factor 'Small town-like demography' (Z_4)** includes a high share of children, a low share of people in their fifties and a low share of women (26.5% of total variance explained).

In order to estimate the influence of the presented factors upon public health, two multiple regression models were created using the average hospitalization rates during 2003–2007 as the dependent variables (Y_{rural}, Y_{urban}) and the obtained factors as explanatory variables. Standard residuals of the aforementioned models helped to present spatially distributed deviations from the models of rural and urban gminas.

HOSPITALIZATION RATE IN PODKARPACKIE VOIVODSHIP

Podkarpackie voivodship is well known to be one of the healthiest Polish voivodship. The evidences for this can be found in the latest Central Statistical Office reports, which rank Podkarpackie as first among all Polish voivodships as far as life expectancy is concerned (Raport Głównego Urzędu Statystycznego, 2009). However, hospital morbidity increased by about 25% from 2003 to 2007 in this area. One of the main interests of geographers is the spatial distribution of hospitalizations. This distribution varies greatly between gminas in Podkarpackie, peaking at nearly 2,900 stays per 10,000 people in the rural area of Przemyśl and bottoming out at about 1,000 stays per 10,000 people in the town of Pilzno. This is shown in Fig. 1.

A clear-cut disparity can be observed between the eastern and western parts of the voivodship in the average hospitalization rate during 2003–2007. The gminas near the eastern borderland are sharply distinguished by a much higher hospitalization rate than the gminas located in the western and central parts of the voivodship. As shown above, the differences are almost threefold. Socio-economic

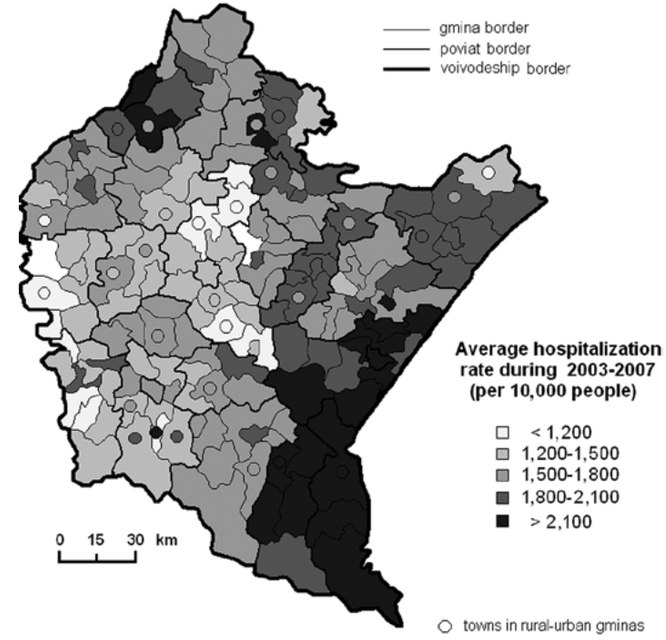

Fig. 1. Average hospitalization rate in the Podkarpackie voivodship during 2003–2007 (by gminas)

Source: Author's calculations based on the data obtained from the Podkarpackie voivodship Center for Public Health

factors, then, are expected to have a greater impact upon health in the eastern borderland, as this region has always been regarded as poor and backward, which partly results from low accessibility and unemployment (particularly in the Bieszczady Mountains), despite the fact that the same gminas' governments are relatively wealthier (Sobala-Gwosdz, 2005). However, touristic attractiveness has helped to improve the standard of living in this area. By contrast, a high hospitalization rate is not evident in the similarly poor and nearly inaccessible areas of the southwestern part of the voivodship, where the Magurski National and Jaśliski Landscape Parks are located. A high hospitalization rate can also be observed in the northern part of the voivodship. This is understandable, as this area is part of the former Central Industrial Region (Centralny Okręg Przemysłowy, COP). Environmentally-related factors such as air, ground or water pollution indisputably play a crucial role there. Moreover, when looking at the hospitalization rate in relation to hospital locations, it seems that this factor is insignificant. The Rzeszów area, with many hospitals, has fewer hospitalizations

than the desolate Bieszczady gminas, which have only one poviat hospital in Ustrzyki Dolne. Undoubtedly, an explanation for the variation in hospitalization rates in Podkarpackie voivodship is much more complex than it seems at first glance.

RESULTS

As a result of the research conducted, four factors, both for urban and rural areas, which most influence hospitalization rate, were isolated. Furthermore, the factor scores obtained from the factor analysis provided a spatial distribution of each socio-economic factor across the urban and rural gminas of Podkarpackie voivodship. High factor scores indicated socio-economic processes evidenced by the aggregated variables explaining the hospitalization rate. Fig. 2 and 3 depict factor scores for the rural and urban areas.

On the presented maps, the factor 'Forested areas' illustrates a high share of sylvan areas in southern (Bieszczady Mountains) and northern (Sandomierska Primeval Forest) parts of the voivodship and a low share of arable lands in the same places. Surprisingly, a high share of forested areas may contribute to a higher hospitalization rate and agriculturally slated land to better health. On the other hand, forested areas of gminas surrounding the Magurski National Park do not follow this pattern. Naturally, these are not cause-effect relationships, but potential factors which partly explain health disparities. The 'Resident retention' factor results from demographic structure and may have a positive impact upon the hospitalization rate in the northwestern and central parts of the voivodship. This suggests that stronger relationships between people and places may improve health outcomes. Notably, inhabitants of gminas located near big cities do not show a high level of resident retention because of suburbanization processes. The 'Ageing' factor concerns areas located in the northeastern borderland, where poor health outcomes are observed. Relatively older societies have a high concentration of people who are more prone to contract diseases and more often require hospital care. Finally, the 'Economic development' factor clearly distinguishes areas near big cities as better developed, whereas the whole eastern borderland along with Brzozów and Strzyżów Poviats noticeably grapple with high unemployment. This undoubtedly favours higher hospitalization rates.

In urban areas, towns located in the central and northeastern areas of the voivodship (except Rzeszów) show features of 'Ruralization' exhibited by large households and the presence of many homesteads within city borders. In detail, ruralization can be seen in the suburbanized gminas adjoining Krosno and Rzeszów. In these two areas, and others, the factor 'Housing conditions' indicates greater

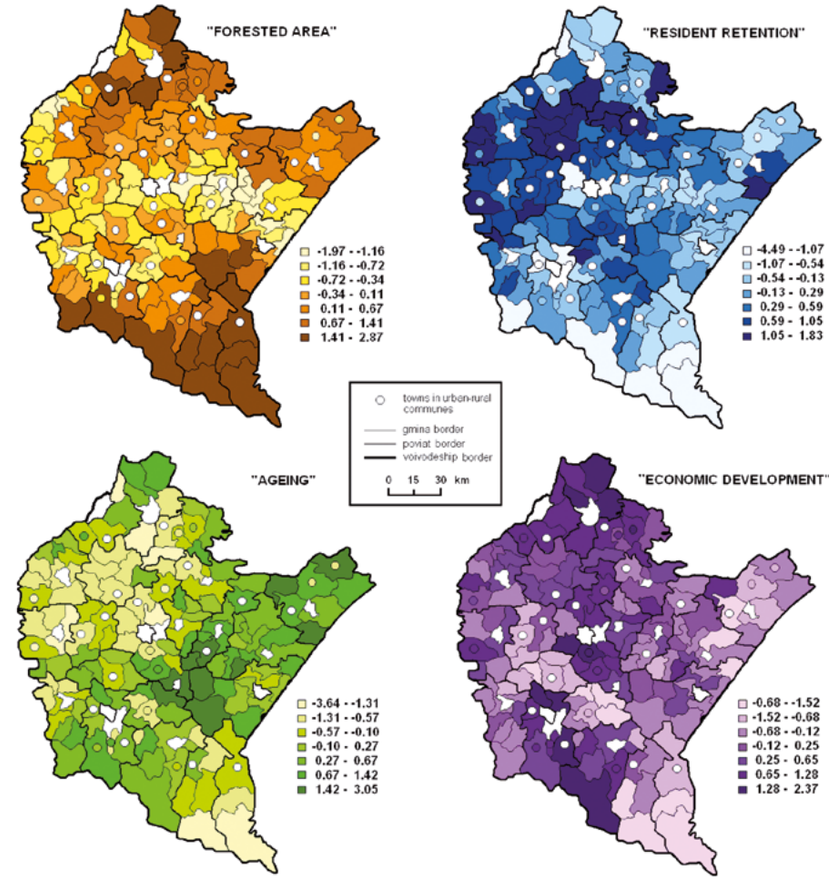

Fig. 2. The scores of factors influencing the average hospitalization rate during 2003–2007 in rural areas of Podkarpackie voivodship

Source: Author's calculations

housing spaces as well as a relatively high immigration rate, both of which favour better health outcomes. The 'Employment in service sector' factor involves the share of population employed in the service sector and plays a crucial role in the largest, multifunctional cities. The towns of Mielec and Stalowa Wola, with long industrial traditions, as well as Krosno, where a few factories are located, do not have a lot of people employed in the service sector, but only Mielec and Stalowa Wola have a higher hospitalization rate. Towns located in the central and eastern parts of Podkarpackie voivodship (again, except Rzeszów) have a low population

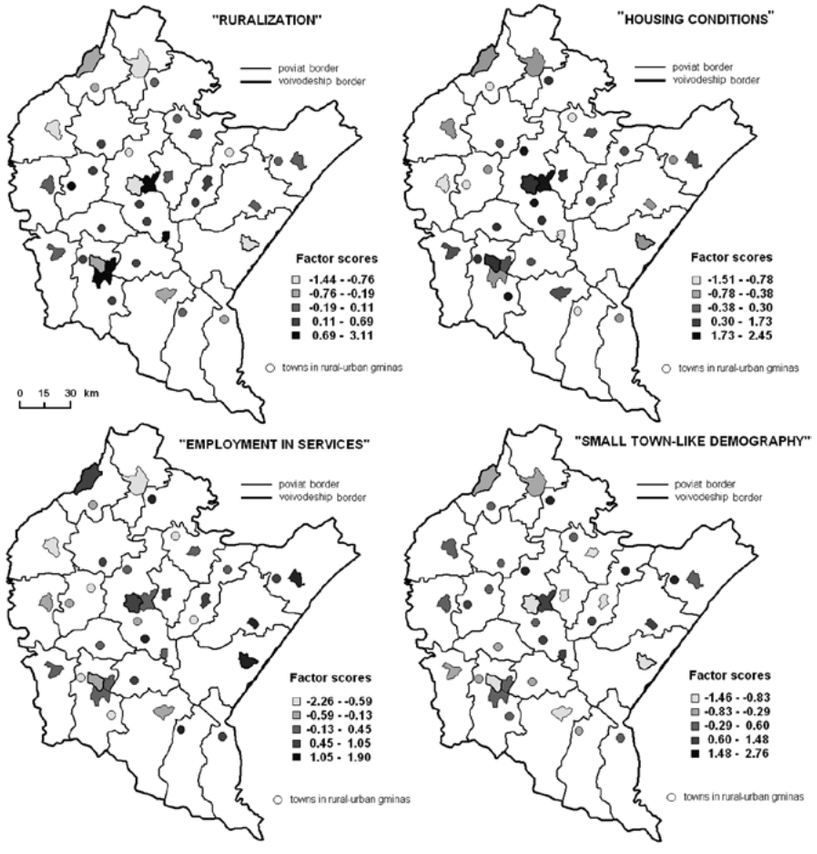

Fig. 3. The scores of four factors influencing average hospitalization rate during 2003–2007 in Podkarpackie voivodship urban areas

Source: Author's calculations

level of people over the age of fifty and a lower feminization rate – both groups are more likely to be hospitalized. Such a favourable health-demographic situation is common among small towns, which are still demographically young and lose women due to their emigrations to larger cities.

Further analysis included two multiple regression models which were created both for rural and urban areas including four factors influencing the hospitalization rate in Podkarpackie voivodship. These models helped to establish the extent to which the four factors are able to explain the variation in hospitalization rates. The regression equations, presented below, were produced after removing outlying

gminas. If gminas had a standard residual greater than 2×sigma or unusually high Cook's distances, they were excluded from their respective models, resulting in the removal of two urbanized (Rzeszów and Ustrzyki Dolne) and ten rural gminas (Iwonicz Zdrój – town, Cisna, Krempna, Narol – town, Narol – rural area, Sokołów Małopolski – town, Czarna, Przemyśl – rural area, Orły and Żurawica).

A) Rural areas

Hospitalization rate = 0.0132 × FORESTED AREAS – 0.0128 × RESIDENT RETENTION+ 0.0076 × AGEING – 0.0115 × ECONOMIC DEVELOPMENT + /– 0.1665

Global regression model:

$$Y_{rural} = 0.0132X_1 – 0.0128X_2 + 0.0076X_3 – 0.0115X_4 +/- 0.1665$$

$R^2 = 0.42$, $p<0.001$ for all factors.

B) Urban areas

Hospitalization rate = –0.0131 × RURALIZATION – 0.0135 × HOUSING CONDITIONS + 0.011 × EMPLOYMENT IN SERVICES – 0.0119 × SMALL TOWN-LIKE DEMOGRAPHY + /– 0.0041

Global regression model:

$$Y_{urban} = –0.0131Z_1 – 0.0135Z_2 + 0.011Z_3 – 0.0119Z_4 +/– 0.0041$$

$R^2 = 0.52$, $p<0.01$ all factors except Z_4 – EMPLOYMENT IN SERVICES ($p<0.05$).

As shown above, significant and viable regression models were created based on the employed factors. The model for rural areas explains about 42% of the total variance in the hospitalization rate. The residual 58% remains to be explained by non- socio-economic factors. These same socio-economic factors have more impact for urban hospitalization rates, with 52% of the total variance explained. The latter outcome may result from the method used (utilizing a smaller sample) but the greater importance of socio-economic factors across urban gminas is to be expected anyway. Economic variables turned out to be more important in rural areas, evidenced especially by the 'Forested areas' and 'Socio-economic development' factors. These two variables are very much alike due to their common connection with occupation. The former has its roots in the economic role of natural resources provided by different land types and uses, namely agriculture and forestry, which are the main job providers in rural areas. The latter refers to unemployment and influences the economic and social environment of rural areas.

Although only socio-economic factors were taken into account, they do also overlap with other health determinants. This may be another cause of the relatively high variance explained by both models. Social factors are more likely to influence hospitalization rates in urban areas, especially those factors concerning 'Housing conditions' and 'Ruralization'. Crowdedness can deteriorate one's health, and households with limited housing space are more likely to suffer from a disease because they are more likely to be deprived. Generally, both rural and urban areas show a high relationship between hospitalization rates and deprivation, as many factors greatly contribute to income (rural areas) and standard of living (urban areas).

Spatially, there are some gminas in both rural and urban areas which do not match or significantly differ from the presented models (Fig. 4). These differences suggest that other, local factors not included in this analysis may play a crucial role in determining health outcomes. In rural areas of Podkarpackie voivodship, socio-economic factors do not thoroughly explain hospitalization rates in southern gminas, western borderland areas and a few communities to the north. Three areas came to prominence – the rural surroundings of Przemyśl and Bieszczady Mountains gminas (with the highest hospitalization rates), Tarnobrzeski Poviat, and several communities in Dębicki and Jasielski Poviats (with the lowest hospitalization rate). Evidently, the majority of these areas lie in the vicinity of cities with industrial functions. Their locations highlight a very

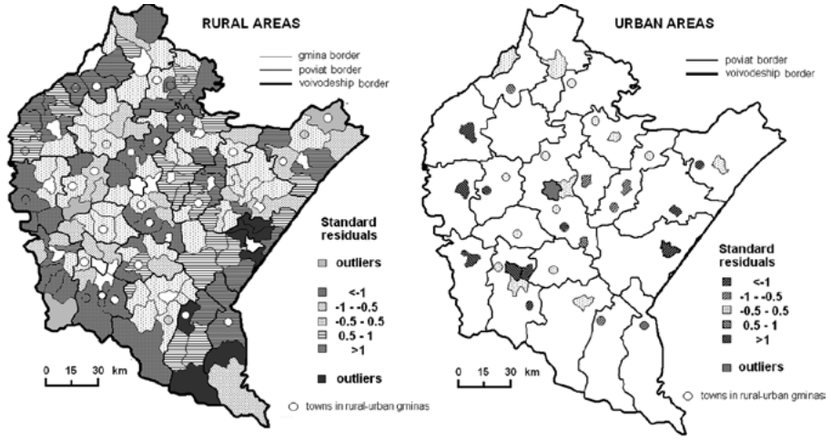

Fig. 4. Residuals from regression models including four factors for rural (left) areas and urban (right) with average hospitalization rates during 2003–2007

Source: Author's calculations

important methodical finding, and suggest the need for distinguishing suburban areas and analyzing them separately (from urban and rural analyses). A way to obtain satisfactory results for outlying areas is to utilize a geographically weighted regression model (Fotheringham et al., 2002).

Urban areas located in the western and eastern parts of the voivodship slightly deviated from the model, what may be explained by the fact that these areas encompass the largest cities. The produced factors failed to explain the hospitalization rate in Rzeszów, the voivodship capital and the largest city in this region.

The same situation occurred in Ustrzyki Dolne, the largest town in the Bieszczady Mountains area. Socio-economic variables turned out to be the most useful ones in determining health outcomes in small towns, but it would appear that there are many other factors influencing health in larger cities, especially multifunctional metropolises. Industrial cities, on the other hand, seem to be pretty well explained by the models generated. In general, socio-economic factors provide viable explanations of hospitalization rate differences throughout the cities of Podkarpackie voivodship.

In summary, the central and western parts of the Podkarpackie voivodship rural area show the best health outcomes as measured by hospitalization rate. This is mainly because of high resident retentions, relatively high economic developments and slower ageing processes. The opposite situation exists in the southeastern part of the voivodship, but in this area health outcomes are also shaped by land-use with a majority of forested areas. The latter also play a role in the northern and northeastern rural Podkarpackie, although the worse health there is not explained by the economic development factor. In urban areas, housing conditions and ruralization of gminas help to explain better health in the central part of the voivodship. Smaller towns show a demographic situation favourable to improved health. On the other hand, larger cities, especially industrial ones, show worse housing conditions, demographic situations and a low share of people employed in the service sector. This situation fosters health deterioration.

CONCLUSIONS

Socio-economic variables play a vital role in shaping the state of health in the Podkarpackie region, though the calculated factors appear to be more important in urban areas (mainly demographic and social factors) than in rural areas (mainly demographic and economic factors). A comparison of the results obtained by foreign studies shows some differences in factor importance, especially in the fields of education and migration. No evident relationship between the gminas

with the highest share of well or poorly educated inhabitants and hospitalization rates was found. Contrary to other studies, Rosenberg and Wilson (2000) also did not find a viable relationship between education and chronic conditions of their examined group. The gminas with a low share of migration and/or a high resident retention rate were relatively healthier. Foreign studies reported a result inverse to this one, as they found that people with better health are more likely to migrate while those with poor health do not move. However, according to the analysis conducted by Verheij et al. (1998), due to selective migration, the people who moved were healthier, but areas that attracted those migrants became healthier only after a consideration of demographic and socio-economic factors. Polish rural society, though, is much less mobile than foreign nations, which implies that social, intraregional relationships as well and much lower migration rates would rather be favourable to community's health.

This study revealed hospital admissions in Podkarpackie voivodship to be determined by social and demographic processes (ageing, resident retention, economic development) as well as those connected with standard of living levels and disposable resources existing in particular areas (housing conditions, land-use). There are sizeable differences in spatial distribution of particular factors. Some factors only play a role in certain areas and other factors have stronger influences elsewhere. These non-ubiquitous factor influences imply that separate, local factors influence health as well as other, non-typical determinants, and should be taken into consideration in further, more detailed studies. Therefore, the multiplicity and various distributions of factors shaping health across a region provide a large research field for geographers.

A methodical finding of this research highlights the need to distinguish suburban gminas as a separate group, alongside urban and rural ones. A regression residuals analysis showed great differences in hospitalization determinants of suburban areas adjacent to larger and multifunctional cities. Further research is necessary to estimate health outcomes in suburban gminas, as they are contemporarily shaped by intensive housing, economic development and population movements, but still remain in a rural environment. A separate group could be also created for small towns, as they show certain socio-demographic characteristics, hence the designation of the factor concerning small-town demography.

As this study was constrained to use the public running records and census data collected per each gmina, some important variables contributing to health outcomes may have been overlooked. Small gmina areas may have prevented the acquisition of more information, e.g., from age groups. Older people are undoubtedly more likely to suffer from a disease and end up in hospital, but small differences between age groups may have thwarted any significant finding. This problem results from the contextual character of this research.

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