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The self-perceived high level of health quality of Europeans: Spatial analysis of determinants

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The self-perceived high level of health guality of Europeans – spatial analysis of determinants

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ABSTRACT

The aim of this article is to provide a quantification of the territorially varied relation between socioeconomic factors and share of people perceived their own health as good or very good in European countries in years 2005-2018. The preliminary data analysis shows that, to model health status at the country level, it is necessary to consider the age structure of inhabitants, country specifics and spatial interactions. For the purpose of the research, several causes were identified depending on age category, e.g., crime rate, self-reported unmet needs for medical examination by main reason declared, households with access to the Internet at home, pure alcohol consumption, hospital beds and population by educational attainment level. To increase the explained variability of phenomena and emphasize country-specific differences in the phenomena, geographically weighted regression was applied.

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Self-perceived health; different age categories; socioeconomic factors; European countries; spatial analysis; geographically weighted regression

1. Introduction

Many factors affect our health. They can be divided into several different categories, e.g., economic, psycho-physical, sociological environmental, demographic or social. The health condition may also be evaluated from various points of view. We perceive it differently and it is assessed differently by doctors, on the basis of their professional knowledge and experience. Hence, self-perceived health is one of the most commonly used health measures in surveys (Freidoony, Chhabi, Kim, Park, & Kim, 2015; Shields, 2008). This may be due to the fact that it expresses subjective assessment by the respondents' health (Maniscalco, Miceli, Bono, & Matranga, 2020). As Bombak (2013) underlines, self-perceived health indicator is regarded as a popular measure not only in health surveys but also in clinical studies because it provides information that cannot be reached by other health measurements. It reflects respondents' holistic perception of general health status, which is obtained by answering questions such as - How is your health status? on a four or five-point scale (Freidoony et al., 2015). What is more, this complex measure represents subjective and objective aspects of health in a form of each respondents' summary statement (Machón, Vergara, Dorronsoro, Vrotsou, & Larrañaga, 2016). Nevertheless, some of the limitations of using a self-perceived health index should

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also be considered. The Organisation for Economic Cooperation and Development-OECD (2016) and Levi (2017) provided that the health-measure suffers from some methodological difficulties related to data collection. In technical documents that accompany the OECD database, the OECD notes it has still not achieved full uniformity of this indicator among non-European members and indeed, several countries use differently phrased questionnaires, i.e., Australia, Canada, Chile, Israel, New Zealand and the the United States. Demetriou, Ozer, and Essau (2015) recall also some issues that can affect the validity and reliability of the questionnaires, i.e., the possibility of providing invalid answers, response bias or the clarity of the items, which brings the risk of obtaining different interpretations of questions. Some limitations of the self-perceived health measure also include reporting bias and difficulties interpreting this measure across varying age ranges and cultural groups (Mcdonald, 2008).

Although there are weaknesses of self-assessed health indicator, most of the studies suggest that this measurement is one of these metrics that is of particular importance when it comes to perceive the health status of populations. It is also becoming increasingly more predictive of objective health and mortality due to the widespread availability of health information in developed countries (Bonner et al., 2017; Schnittker & Bacak, 2014). Moreover, self-perceived health, and in particular its determinants, are increasingly appearing in scientific research. This gives quite a large field for interpretation and research, because indicators based on this concept can be used to assess the health status, health inequalities or healthcare needs (Eurostat, 2020a). Analysis of the literature on the subject indicates a huge variety of factors affecting self-perceived health status.

Self-perceived health, and in particular its determinants, are increasingly appearing in scientific research. This gives quite a large field for interpretation and research, because indicators based on this concept can be used to assess the health status, health inequalities or healthcare needs (Eurostat, 2020a). Analysis of the literature on the subject indicates a huge variety of factors affecting self-perceived health status. Self-perceived health was analyzed from various points of view and in connection with, e.g., future health, use of healthcare services and corresponding costs, mortality patterns, recovery from illness and quality of life (Baruth, Becofsky, Wilcox, & Goodrich, 2014; Bath, 1999; Heistaro, Jousilahti, Lahelma, Vartiainen, & Puska, 2001; Idler & Benyamini, 1997; Maniscalco et al., 2020; Su, Richardson, Wen, & Pagán, 2011). It is widely underlined in the literature that self-perceived health status is connected with morbidity and mortality (Ferraro & Kelley-Moore, 2001; Ganna & Ingelsson, 2015; Jylha, 2009; Kaplan et al., 1996; Saravia & Chau, 2017), physical functioning (Menec & Chipperfield, 1997; Roos, Lahelma, Saastamoinen, & Elstad, 2005), and utilization of health services (Best, Souders, Charness, Mitzner, & Rogers, 2015; Miilunpalo, Vuori, Oja, Pasanen, & Urponen, 1997). A self-perceived health status analysis was also carried out for alcohol consumption (Lange, Quere, Shield, Rehm, & Popova, 2016; Salonsalmi, Rahkonen, Lahelma, & Laaksonen, 2017; Yao et al., 2019) and crime occurrence (Mendes, Silva, Hallal, & Tomasi, 2014). Furthermore, self-perceived health status ratings are highly correlated to physician assessments of health conditions (Brown, 2016; Larue, Bank, Jarvik, & Hetland, 1979). Undisputed factors affecting self-perceived health status are also significantly associated with age (Eurostat, 2020b; Bonner et al., 2017). The distinctions between gender are not significant or unclear (Bonner et al., 2017; Machón et al., 2016). In addition, Shields and Shooshtari (2002) pointed out a number of other factors

such as: burdening with various diseases, functional decline (Farmer & Ferraro, 1997), recovery from illness (Kaplan et al., 1996), marital status, level of education, physical activity (Arrivillaga, Salazar, & Correa, 2003) household's income, perceived life stress or mental health symptoms (Barraza & Silerio, 2007; Caballero, Abello, & Palacio, 2007). Furthermore, self-perceived health tends also to be a good screening tool in general practice (Jylha, 2009). As Freidoony et al. (2015) underlines, "identification of the main components of self-perceived health in a specific context has several public health benefits such as the ability to better address cultural and specific characteristics of the population in public health policies and to implement more targeted interventions for that population."

All of the above-exposed literature neglects the possible impact of spatial processes on the quality of self-perceived health status. However, Verropoulou (2009), Zhang, Cook, Jarman, and Lisboa (2011), Livingston and Lee (2014) and Dearden, Lloyd, and Catney (2019) observed that the self-assessed health status is not uniform across geographical units and may be correlated with a certain tendency towards the spatial autocorrelation of the process causes.

In this paper we identify the regionally divergent relation between selected socioeconomic determinants and the proportion of people perceived their own health as good or very good in four age categories: 16-24, 25-44, 45-64, 65 or over. We used data for 32 European countries from the period 2005-2018. Our study contributes to the current literature in several ways. We performed our analysis separately for four age categories, which enabled us to identify differences in the health status of Europeans related to age. Moreover, our study focuses on the unstudied cases of the high quality of self-assessed health, but can be useful when formulating health policy recommendations and identifying strategies for health promotion across different age groups of individuals. We also noted that across Europe, about 70% of the 16 or over population say their health is "good" or "very good." This has remained constant over the last 15 years. Furthermore, we observed that the self-perceived health status is inextricably linked to "geography" (locality) and European countries have specific determinants of self-perceived health, which results in the lack of a generalized model of determinants for all of Europe. By examining health inequalities through an area classification framework, we obtained new insights into health inequalities in different demographic and socioeconomic contexts and, correspondingly, the potential causes of local health inequalities. We also found that the share of people perceived their health as very good or good in Europe is spatially dependent. The results discussed so far are aspatial. Therefore, this analysis was extended further by examining the spatial aspects of territorially varied relationships between health status and selected factors. We indicated that geographical differences should be considered when investigating empirical relations between the selected factors and health status in different age categories. This evidence of the spatial non-stationarity and spatial of health status at that autocorrelation aggregate level warrants using a geographically weighted regression (GWR) for this dataset. Finally, we examined the impact of a wide range of possible determinants (socio-demographic, socioeconomic, health conditions, health behaviors, geographical and psychosocial). This approach represents a novelty way of modeling the quality of health in Europe; that is, such an analysis has not been performed previously.

2. Data and methodology

2.1. Preliminary data analysis

The analysis of self-perceived high level of health quality in Europe was carried out on the basis of statistical data obtained from Eurostat on the share of people with good or very good perceived health in total population in cross-sections: age and space in the years 2005–2018. The research was conducted for four age categories: 16–24, 25–44, 45–64, 65 or over and 32 European countries (the data concern the countries, as these are the geographical units for which the self-perceived indicators are available). In addition to countries belonging to the European Union, i.e., Austria (AT), Belgium (BE), Bulgaria (BG), Croatia (HR), Cyprus (CY), the Czech Republic (CZ), Denmark (DK), Estonia (EE), Finland (FI), France (FR), Germany (DE), Greece (EL), Hungary (HU), Ireland (IE), Italy (IT), Latvia (LV), Lithuania (LT), Luxembourg (LU), Malta (MT), the Netherlands (NL), Poland (PL), Portugal (PT), Romania (RO), Slovakia (SK), Slovenia (SI), Spain (ES), Sweden (SE), and the United Kingdom (UK), the analysis also included: Iceland (IS), Turkey (TU), Norway (NO), and Switzerland (CH).Table 1 displays the summary statistics of the data.

Self-perceived health status is strongly related to age. In the years 2005–2018 66.8% of European people perceived their health as very good or good on average. The younger people tended to rate their health better than older (92% of the people aged 16–24, 85% of the people aged 25–44). However, the analyzed phenomena had large relative variation. The distribution of variables in all age categories was left-skewed. Values were visibly below mean (leptokurticity), especially in higher age groups.

From a regional perspective, European countries were characterized by large distortions in the share of people who received their health as very good or good. People aged 45 or over provided the most significant territorial variation in the declared quality of health (Coefficient of Variation₄₅₋₆₄ = 23%, Coefficient of Variation_{65_or_over} = 54%), Figure 1.

In 2005–2018, a noticeably higher proportion of people aged 16–24 perceived their own health as good or very good in Romania, Greece and Cyprus than in Latvia and Portugal. It can be clearly seen on the maps in Figure 1 that the number of people with very good or good health status aged 25–44 was less spatially diversified than the number of people in others age categories in Europe. For individuals aged 45–64, the highest values of the variable characterized the northern part of Europe, as well as Spain, Cyprus,

Share of people with good or v	ery good perceived he	alth [as % of populat	ion]	
Age category	16–24	25–44	45–64	65 or over
Mean	92,0	84,6	60,0	34,5
Median	91,9	85,6	64,2	34,7
Min	84,3	68,9	31,6	5,4
Max	98,3	93,8	78,4	65,2
Standard Deviation, SD	7,0	8,8	14,0	18,8
Coefficient of Variation	9%	11%	23%	54%
Skewness	-0,4	-0,9	-0,6	-0,2
Range [in p.p.]	14,0	24,9	46,8	59,9

 Table 1. Summary statistics (mean values, 2005–2018) of the share of people with good or very good perceived health in five age categories.

n = 32, t = 19, N = 608, p.p. – percentage points.

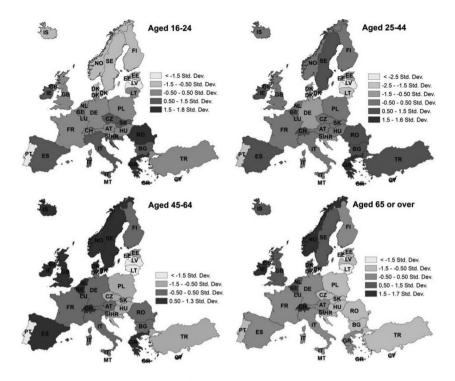


Figure 1. Standard deviations in share of people perceived their health as very good or good in particular age categories in European countries in selected years (mean values, 2005–2018). Note: we also investigated the differences between the self-assessed health quality for men and women, but the results did not reveal statistically significant gender differences (the outcomes are available via Author's e-mail).

Greece and Switzerland, whereas the lowest were reported for Latvia, Lithuania and Portugal. Over the analyzed period, Norway, Ireland and Switzerland were characterized by the largest number of people perceived their health as very good or good. A clear division of continental Europe into the "healthier" western part and the less healthy eastern part can easily be seen in that age category.

In general, the share of the population with very good or good health status in the analyzed countries was characterized by a steady increase over the study period (an average annual growth of about 0.3% people). The fastest dynamics of increase in the share of people perceived their health as very good or good was noticed for individuals aged 65 or over (an increase of 1.7% people from year to year). However, throughout the analyzed period, there was marked an annual decrease of about 0.1% of people for individuals aged 16–24 who perceived their own health as good or very good, Figure 2.

Data presented on maps in Figure 1 show that European countries are grouped into homogeneous, compact areas of the share of people perceived their own health as good or very good in particular age categories. Dearden et al. (2019), Livingston and Lee (2014) and Zhang et al. (2011) concluded that the regionalized health status of the European population may be associated with a certain tendency towards spatial concentration of the process determinants. The global spatial autocorrelation measure (Moran's I) has been applied to explore oflocal variations in the health status of European people

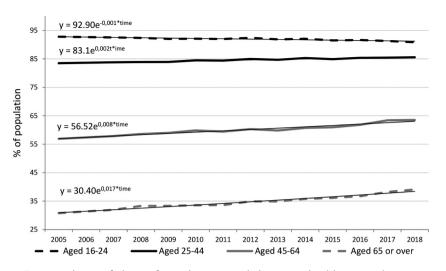


Figure 2. Time tendency of share of people perceived their own health as good or very good in particular age categories in 32 European countries in the years 2005–2018 [in %].

(Anselin & Florax, 1995). We used the first order of contiguity row standardized matrix **W** based on the queen criterion (the neighbors have at least one point in common, including borders and corners). The dimension of the binary matrix **W** is equal to the number of units and the value of the matrix is one when countries i and j are neighbors, and is otherwise zero (the diagonal elements of the matrix are set to zero, by assumption). The elements of the row standardized matrix take values between zero and one. The sum of the row values is always one (Antczak, Gałecka-Burdziak, & Pater, 2018).

The results presented in Table 2 demonstrate that health varies spatially, highlighting how health is inextricably linked to geography.

The Moran's I indices (Table 2) showed that adjacent countries tended to cluster according to the share of people perceived their own health as good or very good aged 25 or over, but that the polarisation could have occurred in terms of the share of people aged 16–24. Certain values fluctuated over time, and the changes had no clear pattern in that

or very gu	Du measured by Mu	ian's i statistic, in ye		
Years	Aged 16-24	Aged 25-44	Aged 45-64	Aged 65 or over
2005	0.13	0.57***	0.58***	0.59***
2006	0.16	0.56***	0.58***	0.60***
2007	0.19	0.54***	0.58***	0.61***
2008	0.22*	0.42**	0.57***	0.62***
2009	0.32**	0.42**	0.56***	0.62***
2010	0.16	0.46***	0.56***	0.62***
2011	0.28*	0.44**	0.55***	0.65***
2012	0.20	0.38**	0.55***	0.65***
2103	0.21	0.33**	0.54***	0.65***
2014	0.08	0.31**	0.54***	0.64***
2015	0.18	0.28*	0.49***	0.67***
2016	0.16	0.28*	0.49***	0.67***
2017	0.20	0.19	0.51***	0.71***
2018	0.32**	0.16	0.47***	0.67***

Table 2. Spatial autocorrelation of the share of people perceived their own health as good or very good measured by Moran's I statistic, in years 2005–2018.

Significance levels: $\alpha = 0.10^*$, 0.05^{**} , 0.01^{***} .

age category. The further analysis of GWR explores and explains why this spatial structuring is observed.

2.2. Potential determinants of high-level health status

Many variables can be possible predictors of the self-perceived high level of health status in European countries. Health status is not one-dimensional; the health and well-being of individuals are influenced by a range of factors, both within and outside of individual control (Brown et al., 2012), consequently, assessing health change over time is complex. Taking into account the availability and comparability of data and those variables defined in the literature, this paper suggests a wide range of country-specific determinants of the phenomena, Table 3. The data were collected from \Eurostat, WHO (World Health Organization) and OECD (the Organization for Economic Co-operation and Development).

2.3. Methodology

The conventional approach to the empirical analysis of spatial data is to build a global model (OLS, Ordinary Least Square) that assumes stationary cross-regional relationships between dependent and independent variables. It means that the same stimulus provokes the same response in all parts of the studied geographical area (1):

$$y_i = \beta_0 + \sum_{k=1}^{\beta_k} x_{ik} + \varepsilon_i \tag{1}$$

where y_i is the dependent variable at location *i*, x_{ik} is the *k*-th independent variable at location *i*, β_{i0} is the intercept for location *i*, β_{ik} is the local regression coefficient for the *k*-th independent variable at location *i* and ε_i is the random error at location *i* (Antczak, 2020).

However, in practice, the relationship between variables may vary geographically (Matthews & Yang, 2016). The GWR is a technique that models non-stationary relationships (over space). Compared with the basic regression (1), the coefficients in GWR are functions of spatially-varying location. Thus, the coefficient β_k takes different values for each region (here for each European country). This method generates a separate regression equation for each location (Fotheringham, Brunsdon, & Charlton, 2002):

$$y_i = \beta_0(u_i, v_i) + \sum_{k=1}^{\beta_k} (u_i, v_i) x_{ik} + \varepsilon_i$$
(2)

where (u_i, v_i) are the location coordinates.

The model parameter estimation is achieved by using the weighted least square method and assigning different weights to each unit. The parameter estimates obtained for each location is:

$$\mathbf{\hat{y}} = (\mathbf{X}^T \mathbf{W}(u_i, v_i) \mathbf{X})^{-1} \mathbf{X}^T \mathbf{W}(u_i, v_i) \mathbf{Y}$$
(3)

where $\mathbf{\hat{\gamma}}$ is the vector of elements k, $\mathbf{X}^{\mathrm{T}}\mathbf{W}(u_i, v_i)\mathbf{X}$ is the geographically weighted variancecovariance matrix, $\mathbf{W}(u_i, v_i)$ is the diagonal matrix $(n \times n)$ of spatial weights with non-

Table 3. Potent	T <mark>able 3.</mark> Potential determinants of the share of people with good or very good perceived health.	
Potential		
determinants	Description [units]	Time span
EXP	Private households out-of-pocket on health as percentage of total health expenditure [%]	2005-2017
DIPR	The ratio of total income (as equivalised disposable income received) by the 20% of the population with the highest income (top quintile) to that received by	2005-2018
		0100 1000
		8102-5002
HB	Hospital beds [per 100,000 inhabitants]	2005–2018
MD	Medical doctors [per 100,000 inhabitants]	2005-2018
INT	Households with access to the Internet at home [%]	2007-2018
CP	Consultations with physicians [per capita]	2005-2018
GDP	Gross domestic product [PPS per capita]	2005-2018
UNTE	Self-reported unmet needs for medical examination by main reason declared (too expensive) [%]	2008-2018
UNTF	Self-reported unmet needs for medical examination by main reason declared (too far) [%]	2008-2018
AI	Ageing index -the ratio of the number of elderly persons of an age when they are generally economically inactive (aged 65 and over) to the number of	2005-2017
	young persons (from 0 to 14) [%]	
UNE	Unemployment of total labor force [%]	2005-2018
LUNE	Long-term unemployment rate [%]	2005-2018
EAP	Exposure to air pollution by particulate matter (particulates < 2.5 µm) of urban population [%]	2005-2017
GHG	Greenhouse gas emissions [tones of CO ₂ equivalent per capita]	2005-2017
CR	Intentional homicide – crime rate [per 100, 000 inhabitants]	2008–2017
MAWCH	Mean age of women at childbirth and at birth of first child [years]	2006–2018
CHE	Current health expenditure [% of GDP]	2005–2017
DPHE	Domestic private health expenditure [PPS per capita]	2005-2017
PAC	Pure alcohol consumption of age 15+, [litres per capita]	2005–2016
ANR	Average number of rooms [per capita]	2005-2018
HD	Hospital discharges [per 100,000 inhabitants]	2006–2017
EDU	Population by upper secondary, post-secondary non-tertiary and tertiary education (levels 3–8) [%]	2005–2018
FV	Daily consumption of fruit and vegetables of 18 years or over [kg per capita]	2014
ACT	Performing health-enhancing physical activity of 18 years or over [%]	2014
NW	Body mass index (BMI), normal weight of 18 years or over [%]	2014
OW	Body mass index (BMI), overweight of 18 years or over [%]	2014
we are aware that	we are aware that more factors on self-reported, clinical and local data of health of Europeans are also relevant in this analysis. However, the poor availability of regional statistics determined us	etermined us

Table 3. Potential determinants of the share of people with good or very good perceived health.

5 to prepare of a survey to obtain this information in the future.

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zero diagonal elements and w_{ij} is the geographical weight, referring to the surroundings of location *i*defined by coordinates (u_i, v_i) . Most commonly, the coordinates (u_i, v_i) indicate location *i*'s geographic center and the location of each point where an observation was made, so that $\mathbf{W}(u_i, v_i) = diag$ elements $(w_{i1}, w_{i2}, \dots, w_{in})$.

Here, the weighting scheme W is calculated with a kernel function based on the proximities between regression point *i* and the *N* data points around it. Several options are possible for the estimation of the bandwidth in GWR models (Charlton & Fotheringham, 2009). For this study, used to explore local relations, the fixed Gaussian kernel weighting function was employed because it best fits the model:

$$w_{ij} = exp\left[-\frac{1}{2}\left(\frac{d_{ij}}{b}\right)^2\right] \tag{4}$$

where d_{ij} is the Euclidean distance between locations *i* and *j* in geographical space and *b* is the bandwidth; that is, the radius of the circle containing points that are considered still influential in the formation of the model parameters. An optimum bandwidth can be found by minimizing a model goodness-of-fit diagnostic (Loader, 1999), such as the cross-validation (CV) score (Fingleton, 1999), which accounts for model prediction accuracy only, or the Akaike information criterion (AIC) (Akaike, 1973). Thus, for a GWR model with a bandwidth *b*, its CV of bandwidth can be found by minimizing the following expression (Brunsdon, Fotheringham, & Charlton, 2000):

$$CV = \sum_{i=1}^{n} \sum_{j=1}^{n} [y_i - \hat{y}_{j\neq i}(b)]^2$$
(5)

where $\hat{y}_{i\neq i}$ is a theoretical (estimated) value of the observation y_i .

As with any GWR study, it is important to estimate the parameters of the global nonspatial regression (1), so that this benchmark model can be compared to its GWR counterpart. However, as there is no single agreed upon the functional form in modeling, several statistical tests were conducted, using a pseudo-stepwise procedure, to explore the data with a limited number of OLS regression analyses (Fotheringham et al., 2002). To test for multicollinearity, the variance inflation factor (VIF) measure was used (Gollini, Lu, Charlton, Brunsdon, & Harris, 2015). To test the spatial dependency on the residuals, Moran's I and the Lagrange multiplier tests for both dependence error and missing spatially lagged dependent variable were used (Leung, Mei, & Zhang, 2000). To identify the spatial non-stationarity, Koenker's statistic (Koenker's studentized Bruesch-Pagan test) was applied (Andy, 2005).

3. Results and discussion

As previously noted, self-perceived health status is strongly related to age and had large relative country-level variability (is spatial non-stationary). Moreover, it can be clearly seen, that the data set (Table 3) is not complete because of gaps with some variables for the period 2005–2018 and the panel estimates are not possible to our dataset. We averaged the values of all variables and expressed them in natural logarithms. We conducted several stepwise regressions to identify predictive variables of the self-

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perceived very good or good health status in Europe over the years 2005–2018. Finally, to overcome all the problems, we estimated each GWR function model – for each age category – to model the phenomena properly. We used ArcGIS and GWR4 software. Regression results (6)–(9) indicated the statistically significant relationship between the share of people with good or very good perceived health in total population in European countries and seven factors – depends on the age groups of individuals (Table 4):

$$SHP_{16-24,i} = \gamma_0(u_i, v_i) + \gamma_1(u_i, v_i)CR_i + \gamma_2(u_i, v_i)PAC_i + \gamma_3(u_i, v_i)INT_i + \gamma_4(u_i, v_i)HB_i + \varepsilon_i$$

$$SHP_{25-44,i} = \gamma_0(u_i, v_i) + \gamma_1(u_i, v_i)CR_i + \gamma_2(u_i, v_i)PAC_i + \varepsilon_i$$
(7)

$$SHP_{45-64,i} = \gamma_0(u_i, v_i) + \gamma_1(u_i, v_i)CR_i + \gamma_2(u_i, v_i)PAC_i + \gamma_3(u_i, v_i)UNTF_i + \gamma_4(u_i, v_i)EDU_i + \varepsilon_i$$
(8)

$$SHP_{65+,i} = \gamma_0(u_i, v_i) + \gamma_1(u_i, v_i)CR_i + \gamma_2(u_i, v_i)ANR_i + \gamma_3(u_i, v_i)PAC_i + \varepsilon_i$$
(9)

where (u_i, v_i) denotes the coordinates (longitude, latitude) of the destination location *i*, for i = 1, 2, ..., 32 countries, $\gamma_k(u_i, v_i)$ are structural parameters of the weighted regression model and ε_i is the random error at location *i*, $SPH_{16-24,i}$ is the share of people with good or very good perceived health as a % of population aged 16–24, $SPH_{25-44,i}$ is the share of people with good or very good perceived health as a % of population aged 25–44, $SPH_{45-64,i}$ is the share of people with good or very good perceived health as a % of population aged 45–64, $SPH_{65+,i}$ is the share of people with good or very good perceived health as a % of population aged 65 or over, CR_i intentional homicide-crime rate per 100,000 inhabitants, PAC_i -pure alcohol consumption in litres per capita, $UNTF_i$ -self-reported unmet needs for medical examination by main reason declared (too far), share of people in total population in %, EDU_i - share of people with upper secondary, post-secondary non-tertiary and tertiary education (levels 3–8) in total population in %, ANR_i - average number of rooms per capita, HB_i -hospital beds per 100,000 inhabitants and INT_i - share of households with access to the Internet at home in %.

Table 4 contains the results of GWR modeling of the share of people with good or very good perceived health in total population in European countries for each age category with some diagnostic statistics of the models.

The first empirical finding suggests that a 1% increase in the number of rooms per capita raises the share of people with good or very good perceived health aged 16–24 from 0.058% (in Greece, Poland, Bulgaria, Romania) to 0.066% in Norway, Sweden and Finland, *ceteris paribus*. It is worth emphasizing that the increase in housing comfort has a statistically significant impact on the quality of health in about 50% of the analyzed countries in the group of people aged 16–24 and in all countries in the group of older people. In the group of people aged 65+, an increase in the average number of rooms per inhabitant by 1% causes an increase in the share of people with good or very good perceived health in that age category from 1.43% (in Greece and Bulgaria) to app. About

INT HB CR PAC CR PAI 0.11 -0.035 -0.067 -0.17 -0.2 0.13 -0.035 -0.067 -0.17 -0.2 0.13 -0.035 -0.067 -0.16 -0.4 0.13 -0.041 -0.051 -0.16 -0.16 0.15 -0.041 -0.053 -0.16 -0.17 -0.3 0.15 -0.038 -0.067 -0.17 -0.3 -0.3 0.17 -0.038 -0.067 -0.17 -0.3 -0.3 0.16 -0.038 -0.067 -0.17 -0.3 -0.17 -0.3 0.17 0.03 -0.044 -0.071 -0.17 -0.3 0.17 0.03 -0.044 -0.065 -0.18 -0.3 0.13 -0.044 -0.051 -0.17 -0.3 0.15 -0.044 -0.066 -0.17 -0.3 0.18 -0.046 -0.067 -0.18 -0.3			SPH ₁₆₋₂₄	24		SPH ₂₅₋₄₄	5-44		SPH ₄₅₋₆₄	5-64			SPH ₆₅₊	
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$		ß	ANR		HB	CR	PAC	ß	PAC	UNTF	EDU	CR	ANR	PAC
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	AT	-0.021		-0.14		-0.035	-0.067	-0.17	-0.26	-0.053		-0.32	1.92	
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	BE			-0.13			-0.070	-0.16	-0.40	-0.048		-0.29	2.05	-0.61
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	BG	-0.022	0.059	-0.16		-0.041	-0.051	-0.19		-0.054		-0.44	1.43	-0.34
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	£			-0.13			-0.073	-0.16	-0.34	-0.052		-0.27	1.93	
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	ç	-0.021	0.06	-0.16		-0.041		-0.20		-0.057		-0.42	1.52	-0.35
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	D	-0.019		-0.15		-0.038	-0.068	-0.18		-0.053		-0.36	1.94	-0.68
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	DE	-0.017		-0.14		-0.035	-0.071	-0.17	-0.31	-0.052		-0.32	2.07	-0.82
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	DK	-0.018	0.063	-0.15		-0.038		-0.18	-0.32	-0.051		-0.33	2.13	-0.61
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	E	-0.022	0.064	-0.17		-0.046	-0.050	-0.22		-0.058		-0.42	1.92	-0.49
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	ES			-0.12	0.03		-0.071	-0.17	-0.37	-0.053	0.53	-0.26	1.84	-0.48
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	H	-0.021	0.066	-0.17		-0.044		-0.22		-0.057		-0.40	1.91	-0.47
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	FR			-0.12			-0.079	-0.15	-0.42	-0.049	0.46	-0.25	1.95	
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	8			-0.13			-0.065	-0.18	-0.36	-0.049	0.41	-0.30	2.07	-0.60
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	GR	-0.021	0.058	-0.15		-0.039	-0.051	-0.19		-0.056		-0.41	1.43	-0.33
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	HR	-0.019		-0.15		-0.036	-0.060	-0.17		-0.052		-0.36	1.66	-0.41
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	H	-0.021		-0.15		-0.040	-0.059	-0.18		-0.052		-0.40	1.72	-0.46
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	Ш			-0.13			-0.064	-0.18	-0.37	-0.048	0.46	-0.30	2.05	-0.59
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	IS		0.063	-0.15		-0.036	-0.054	-0.20	-0.31	-0.051	0.42	-0.35	1.99	-0.52
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	F	-0.018		-0.14			-0.061	-0.16	-0.27	-0.053		-0.32	1.61	
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	Z	-0.022	0.064	-0.17		-0.046	-0.051	-0.22		-0.059		-0.43	1.92	-0.51
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	5	-0.023	0.063	-0.17		-0.047	-0.052	-0.21		-0.059		-0.43	1.90	-0.52
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	В			-0.13			-0.071	-0.16	-0.38	-0.049		-0.29	2.04	-0.68
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	MT	-0.018		-0.14			-0.057	-0.17	-0.26	-0.056		-0.35	1.51	-0.34
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	NL			-0.13			-0.072	-0.17	-0.37	-0.049		-0.29	2.10	-0.74
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	NO	-0.02	0.066	-0.16		-0.042		-0.21		-0.055		-0.39	1.99	-0.51
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	РL	-0.022	0.059	-0.16		-0.044	-0.059	-0.19		-0.056		-0.41	1.91	-0.63
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	РТ			-0.12	0.03		-0.067	-0.18	-0.36	-0.053	0.54	-0.29	1.85	-0.49
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	RO	-0.023	0.059	-0.16		-0.043	-0.052	-0.19		-0.054		-0.44	1.59	-0.39
-0.019 −0.14 −0.035 −0.064 −0.17 −0.052 −0.35 1.77 -0.021 −0.16 −0.041 −0.059 −0.19 −0.054 −0.41 1.78 -0.022 0.061 −0.16 −0.042 −0.042 −0.44 1.52 -0.44 1.52 −0.44 1.52 GWR R ² : 0.47−0.52 GWR R ² : 0.42−0.56 GWR R ² : 0.50−0.69 GWR R ² : 0.50−0.87	SE	-0.021	0.066	-0.16		-0.043		-0.21		-0.056		-0.39	1.99	-0.52
−0.021 −0.16 −0.041 −0.19 −0.054 −0.41 1.78 −0.022 0.061 −0.16 −0.042 −0.21 −0.21 −0.057 −0.44 1.52 GWR R ² : 0.47−0.52 GWR R ² : 0.42−0.56 GWR R ² : 0.50−0.69 GWR R ² : 0.65−0.87	SI	-0.019		-0.14		-0.035	-0.064	-0.17		-0.052		-0.35	1.77	-0.47
−0.022 0.061 −0.16 −0.042 −0.21 −0.057 −0.44 1.52 −0.21 −0.057 −0.44 1.52 GWR R² : 0.47−0.52 GWR R² : 0.42−0.56 −0.87	SK	-0.021		-0.16		-0.041	-0.059	-0.19		-0.054		-0.41	1.78	-0.51
7–0.52 GWR R ² : 0.42–0.56 GWR R ² : 0.50–0.69	TR	-0.022	0.061			-0.042		-0.21		-0.057		-0.44	1.52	
			GWR R²: 0. 4	\sim		GWR R ² : (.42–0.56		GWR R ² : (0.50-0.69		GW	R R²: 0.65–(.87
													-	(00000000)

		SPH ₁₆₋₂₄	24		SPH ₂₅₋₄₄	15-44		SPH ₄₅₋₆₄	15-64			SPH ₆₅₊	
	CR	ANR	INT	HB	CR	PAC	ß	PAC	PAC UNTF	EDU	CR	ANR	PAC
GWR diagnosis		OLS R²:0.39).39		OLS R²:0.390.45	.390.45		OLS R ² :0.390.41	0.390.41		0	OLS R ² :0.390.60	
		OLS AIC:-1	171.7		OLS AIC: -130.5	-130.5		OLS AIC	DLS AIC: -51.1		0	DLS AIC: -20.8	
		gwr aic: -	-190.7		GWR AIC: -140.9	: -140.9		GWR AIC: -57.3	<u>:</u> –57.3		6	GWR AIC: -23.4	
		Moran's I of	l of		Moran's I of	's I of		Moran's I of	's I of			Moran's I of	
		OLS residuals: 0.38*	als: 0.38*		OLS resid	OLS residuals: 0.18*		OLS resid	<pre>DLS residuals: 0.26*</pre>		O	DLS residuals: 0.25*	25*
		Moran's I of	l of		Moran's I of	's I of		Moran's I of	's I of			Moran's I of	
		GWR residuals: 0.06	als: 0.06		GWR resi	GWR residuals: 0.08		GWR resi	GWR residuals: 0.20		0	GWR residuals: 0.19	.19
All coefficients presented in the table are statistically significant at the significance level: $\alpha > 0.10$; significance level of residuals: $\alpha = 0.10^{*}$, 0.05**, 0.01***; in the modeling, we selected the	ted in the t	able are statis	tically signifi	cant at the s	significance leve	el: α > 0.10; sigr	nificance level	l of residuals	:: α = 0.10*, 0	.05**, 0.01**	*;in the mo	deling, we seld	ected the

Table 4. (Continued).

statistically significant determinants with VIF values that did notexceed2.5 and for which local multicollinearity problem was subsequently solved with principal components method (PCA) (Hervé & Williams, 2010); the correlation matrix, all results of VIF and principal components analysis are available by Author's e-mail.

2.13% in Belgium, the Netherlands, Luxembourg, Ireland, Denmark, Germany and the United Kingdom.

The results of the conducted analysis indicate the spatial polarization of the impact of this factor on the quality of young people's health. The average number of rooms per person has an impact on improving the self-assessment of health in highly developed Scandinavian countries, and on the other hand in developing and middle-developed countries of Eastern Europe. Eurostat data also shows that in the years 2005–2018 there was a significant increase in housing comfort in Eastern Europe. In 2018, compared to 2005, the average number of rooms per capita in Lithuania, Latvia, Romania, Slovenia, the Czech Republic, Poland and Hungary increased by 30% on average (Eurostat, 2019). Recent studies indicate that improvements in living standards outdo the link between housing and health as well as positive effects of lifelong exposure to higher living standards of each new generation (Bonnefoy, Braubach, Moissonnier, Monolbaev, & Röbbel, 2003; Mackenbach et al., 2018). Moreover, Fernández-Carro, Módenes, and Spijker (2015) proved that living conditions are a predictor of elderly residential satisfaction in most European countries.

In the group of young people (aged 16–24), the increase in hospital beds per 100,000 inhabitants also has a positive impact on the quality of health. The increase of 1% of this variable resulted in a 0.03% increase in the share of people with good or very good perceived health status only in Spain and Portugal (*ceteris paribus*). According to Matos et al. studies (Matos, Tomé, Gaspar, Cicognani, & Moreno Rodríguez, 2016), in Spain and Portugal, youth showed signs of mental distress with an increase in: psychological symptoms, self-mutilation, feelings of hopelessness and despair that include less positive expectations toward the future, less intention to go to college and less attraction to school.

In the years 2005–2018, for individuals aged 16–24, there were two considerable variables that decreased the share of people with good or very good perceived health status: crime rate and Internet access. A notable factor is the share of households with access to the Internet at home. An 1% increase in the share of households with access to the Internet at home led to a decrease in the quality of health in all analyzed countries. The highest decline was recorded in Latvia, Lithuania, Estonia and Finland (by 0.17% on average, *ceteris paribus*). Machimbarrena et al. (2019) emphasized the possible dysfunctions entailed by the consumption of the Internet in the individual's life.

In turn, the crime factor turned out to have a statistically significant and negative impact on the level of health quality in all age groups. Nevertheless, in the younger group (aged 16–24 and 25–44) this impact is weaker than in the group of people over 45 and incidental (it did not apply to all analyzed countries). For people aged 16–24, 69% of European countries reported a decrease in the share of people with good or very good perceived health status under the influence of a 1% increase in intentional homicide per 100,000 inhabitants (from 0.017% in Germany to 0.023% in Romania and Lithuania). In turn, in the group of people from 25 to 44 years of age, a 1% increase in crime rate caused a decrease in the quality of health by 0.035% in Austria, Germany and Slovenia to 0.047% in Lithuania, *ceteris paribus*. In the group of people aged 45–64, the highest decrease in the share of people with good or very good perceived health status was recorded in Finland, Estonia and Lithuania (by 0.22%), and in the group of people over 65 Bulgaria, Turkey and Sweden (about 0.44%). According to Robinson and Keithley (2000) crime

poses substantial risks to the health of victims and, consequently, generates additional demand for health services.

In terms of its regional range alcohol consumption was the factor that most considerably affected the quality of health in a group of individuals aged 25–44 and 65 or over (in 86% of the countries this impact was noted). This factor also had a significant impact on the share of people with good or very good perceived health status aged 45–64; nevertheless, it concerned 47% of the countries surveyed (in the group of young people pure alcohol consumption in liters per capita did not affect the quality of health). An increase of 1% in alcohol consumption generated an average decrease in the share of people with good or very good perceived health status aged 25–44 from around 0.05% in Estonia to as much as 0.073% in Switzerland (*ceteris paribus*). In a group of 45–64 the highest negative impact of this factor on the high quality of health was noticed in France (-0.42%). Finally, the increase of 1% of the pure alcohol consumption in liters per capita resulted in a drop in the share of people with good or very good perceived health status from 0.33% in Greece to 0.82% in Germany, Table 4. The results of our analysis correspond positively with research conducted even in Greece by Vozikis, Drivas, and Milioris (2014) on health literacy.

The group of people aged 45–64 is differentiated by the impact of two factors on the share of people with good or very good perceived health status, not affecting the quality of health in the other age groups studied: share of people with upper secondary, post-secondary non-tertiary and tertiary education (levels 3–8) in total population and share of people who self-reported unmet needs for medical examination because of there were too far from the place of living. In 19% of the analyzed countries, an increase of 1% in the share of people with upper secondary, post-secondary non-tertiary, and tertiary education (levels 3–8) in total population generated an average increase from around 0.41% in the share of people with good or very good perceived health status in Great Britain to as much as 0.54% in Portugal (*ceteris paribus*).This relationship is undoubtedly associated with a higher level of health awareness and the possibility of using the latest technologies in diagnostics. A higher level of education also positively affects the possibility of finding a better job, thanks to which access to specialist health care and sports activities enabling maintaining a healthy body condition is easier.

In the years 2005–2018, in the group of people aged 45–64, a statistically significant and negative impact of self-reported unmet needs for medical examination due to distance from the place of living was recorded in all countries. Ireland and Bulgaria noted the lowest drop of the share of people with good or very good perceived health status within (–0.048%) and Latvia and Lithuania the highest (–0.059%) as the consequence of a 1% increase in the share of people self-reported unmet needs for medical examination due to distance, Table 4. This result corresponds to the conducted scientific research. Difficulty in accessing medical services, caused by a considerable distance from medical centers, translates into the deterioration of health, and thus a worse self-assessment of health.

4. Conclusions

In this study, we provided a quantification of the relation between socioeconomic factors and the share of people perceived their own health as good or very good in European countries in the years 2005–2018.We used geographically weighted regression to overcome the spatial non-stationarity and spatial autocorrelation of health status at the analyzed aggregated level. Based on the modeling we have indicated that the proportion of people self-perceived health as good or very good differs across Europe (is not spatially stable) and is spatial dependent. What is more, the relation between selected socio-economic determinants and the proportion of people perceived their own health as good or very good is regionally divergent (territorially varied at a country level). Thus, the self-perceived health status was strongly related to age and was inextricably linked to geography. However, a clear division of continental Europe into the "healthier" western part and the less healthy eastern part was observed in the 45–64 age groups.

Very interesting research results are also applied to the age group of older people. The study showed that the sense of security in older people has a greater impact on health quality than in younger age groups. What is more, as the age progresses, the comfort of life plays a greater role in shaping the higher quality of health.

The negative impact of the Internet on self-perceived health status in the 16–24 age category is also interpretatively interesting. This result may indicate that better and better access to information, including on educational, traveling, social as well as medical topics does not translate into better well-being. From the outcomes of our analysis it can be concluded that with so many social media and communication channels that are used collectively, the Internet can cause various problems. Our study provides that further research is needed, focusing on increasing Internet abuse or addiction among young people and taking into account the purposes of Internet use.

Finally, GWR proved to be an extremely effective instrument for identifying and modeling spatially varying relationships between health status and its determinants. Local models were characterized by considerably better fit to empirical data than global ones. As to their merits, using GWR in relationship modeling increased the quality of the assessments considerably over using global OLS regression (R^2 and AIC, see in Table 4). Moreover, the residuals of the GWR model were free from spatial autocorrelation.

A review of published studies on the subject revealed the worldwide interest of scientists in health status modeling. In this research, we focused on the understudied case of the self-perceived high level of health quality of Europeans. The objectives of health policies are created at national levels. Hence, the results of this study may be relevant to institutional and national policy-makers that make an effort to search for solutions tailored to the challenges of the health situation they are faced with and will face in the future. To the best of our knowledge, a study adopting such a broad approach has never been carried out before, but should be applicable as it makes health status fairly predictable in a practical way, which may allow preparing countries for changes.

Nonetheless, there are still analysis limitations and unexplained variations that must be addressed in future studies. Accounting for the determinants of health status by taking into account level of education, place of living, economic aspects such as: expenditure on health protection, economic development of the country or income of residents could enrich the analysis. Looking to the future, we plan to explore how the Internet as a widely used medium and a popular source of health-related information for patients influences the self-perceived health status; and how this trend and patterns of health-related Internet use vary over the European countries. Predicting the bad and very bad selfperceived health statuses of Europeans also remain some possibilities to extend this analysis in the future. Moreover, the preparation of a survey to obtain the local-level data and clinical aspects will be an opportunity to enrich future studies. Finally, we are currently dealing with the COVID-19 epidemic worldwide, including Europe. Thus, we can expect changes in health quality after 2019. For this reason, the continuation of research on self-perceived health in the European population is fully justified.

Disclosure statement

No potential conflict of interest was reported by the authors.

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References

- Akaike, H. (1973). Information theory and the maximum likelihood principle. In B. N. Petrov & F. Csaki (Eds.), *Selected papers of hirotugu akaike* (pp. 199–213). New York: Springer Series in Statistics (Perspectives in Statistics).
- Andy, M. (2005). The ESRI guide to GIS analysis. In Volume 2: Spatial measurements and statistics and zeroing, geographic information systems at work in the community. Boston: ESRI.
- Anselin, L., & Florax, R. J. (1995). New directions in spatial econometrics. Berlin: Springer-Verlag.
- Antczak, E. (2020). Municipal waste in Poland: Analysis of the spatial dimensions of determinants using geographically weighted regression. European Spatial Research and Policy, 26(2), 177–197.
- Antczak, E., Gałecka-Burdziak, E., & Pater, R. (2018). Unemployment and vacancy flows in spatial labour market matching at the regional level. The case of a transition country. *Journal of Applied Economics*, 21(1), 25–43.
- Arrivillaga, M., Salazar, I., & Correa, D. (2003). Creenciassobre la salud y surelación con las prácticas de riesgo o de protección en jóvenes universitarios. *Colombia Médica*, 34(4), 186–195.
- Barraza, A., & Silerio, J. (2007). El estrésac adémico en alumnos de educación media superior: Un studio comparativo. *INED*, *7*, 48–65.
- Baruth, M., Becofsky, K., Wilcox, S., & Goodrich, K. (2014). Health characteristics and health behaviors of African American adults according to self-rated health status. *Ethnicity & Disease*, 24, 97–103.
- Bath, P. A. (1999). Self-rated health as a risk factor for prescribed drug use and future health and social service use in older people. *The Journals of Gerontology: Series A*, 54(11), 565–570.
- Best, R., Souders, D. J., Charness, N., Mitzner, T. L., & Rogers, W. A. (2015). The role of health status in older adults' perceptions of the usefulness of eHealth technology. In J. Zhou &

G. Salvendy (Eds.), *Human aspects of IT for the aged population. Design for everyday life. ITAP. Lecture notes in computer science.* Cham: Springer.

- Bombak, A. E. (2013). Self-rated health and public health: A critical perspective. *Frontiers in Public Health*, *1*, 15.
- Bonnefoy, X. R., Braubach, M., Moissonnier, B., Monolbaev, K., & Röbbel, N. (2003). Housing and health in Europe: Preliminary results of a pan-European study. *American Journal of Public Health*, 93(9), 1559–1563.
- Bonner, W., Weiler, R., Orisatoki, R., Lu, X., Andkhoie, M., Ramsay, D., ... Farag, M. (2017). Determinants of self-perceived health for Canadians aged 40 and older and policy implications. *International Journal for Equity in Health*, 16(1), 94.
- Brown, D., O'Reilly, D., Gayle, V., Macintyre, S., Benzeval, M., & Leyland, A. (2012). Sociodemographic and health characteristics of individuals left behind in deprived and declining areas in Scotland. *Health & Place*, 18(2), 440–444.
- Brown, T. N. (2016). Turner The multidimensionality of health: Associations between allostatic load and self-report health measures in a community epidemiologic study. *Health Sociology Review*, 25(3), 272–287.
- Brunsdon, C., Fotheringham, S., & Charlton, M. (2000). *Geographically weighted regressionas a statistical model, spatial analysis research group, department of geography.* UK: University of Newcastle-upon-Tyne.
- Caballero, C., Abello, R., & Palacio, J. (2007). Relación del burnout y el rendimiento académico con la satisfacción frente a los estudios en estudiantes universitarios. *Avancesen Psicología Latinoamericana*, 25, 98–111.
- Charlton, M., & Fotheringham, A. S. (2009). Geographically Weighted Regression. In *National centre for geocomputation: Maynooth.* Ireland.
- Dearden, E. K., Lloyd, D. C., & Catney, G. (2019). A spatial analysis of health status in Britain, 1991–2011. Social Science & Medicine, 220, 340–352.
- Demetriou, C., Ozer, B. U., & Essau, C. A. (2015). Self-Report Questionnaires. In Eds. (R. L. Cautin & S. O. Lilienfeld), *The encyclopedia of clinical psychology*. doi:10.1002/9781118625392. wbecp507
- Eurostat (2019). htps://webcache.googleusercontent.com/search?q=cache:qx5tWmm4UMAJ: https://ec.europa.eu/eurostat/statistics-explained/pdfscache/67027.pdf+&cd=10&hl=pl&ct= clnk&gl=pl&client=firefox-b-d
- Eurostat. (2020a), https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Self-perceived_health
- Eurostat (2020b), https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Health_statis tics_at_regional_level#Health_status
- Farmer, M. M., & Ferraro, K. F. (1997). Distress and perceived health: Mechanisms of health decline. *Journal of Health and Social Behavior*, 39(3), 298–311.
- Fernández-Carro, C., Módenes, J. A., & Spijker, J. (2015). Living conditions as predictor of elderly residential satisfaction. A cross-European view by poverty status. *European Journal of Ageing*, 12 (3), 187–202.
- Ferraro, K., & Kelley-Moore, J. (2001). Self-rated health and mortality among black and white adults: Examining the dynamic evaluation thesis. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, 56(4), 195–205.
- Fingleton, B. (1999). Spurious spatial regression: Some monte carlo results with a spatial unit root and spatial cointegration. *Journal of Regional Science*, 39(1), 1–19.
- Fotheringham, A. S., Brunsdon, C., & Charlton, M. E. (2002). *Geographically weighted regression: The analysis of spatially varying relationships.* Wiley: Chichester.
- Freidoony, L., Chhabi, R., Kim, C. S., Park, M. B., & Kim, C. B. (2015). The components of self-perceived health in the Kailali district of Nepal: A cross-sectional survey. *International Journal of Environmental Research and Public Health*, *12*(3), 3215–3231.
- Ganna, A., & Ingelsson, E. (2015). 5-year mortality predictors in 498 103 UK Biobank participants: A prospective population-based study. *Lancet*, *386*(9993), 533–540.

- Gollini, I., Lu, B., Charlton, M., Brunsdon, C., & Harris, P. (2015). GWmodel: An R package for exploring spatial heterogeneity using geographically weighted models. *Journal of Statistical Software*, 63(17). doi:10.18637/jss.v063.i17
- Heistaro, S., Jousilahti, P., Lahelma, E., Vartiainen, E., & Puska, P. (2001). Self rated health and mortality: A long term prospective study in eastern Finland. *Journal of Epidemiological Community Health*, 55(4), 227–232.
- Hervé, A. L., & Williams, J. L. (2010). Principal component analysis. In *Wiley interdisciplinary reviews: Computational statistics* (Vol. 2, ppp.433–459). Hoboken, NJ: John Wiley and Sons, Inc..
- Idler, E., & Benyamini, Y. (1997). Self-rated health and mortality: A review of twenty-seven community studies. *Journal of Health and Social Behavior*. 38(1), 21–37. www.jstor.org/stable/ 2955359
- Jylha, M. (2009). What is self-rated health and why does it predict mortality? Towards a unified conceptual model. *Social Science & Medicine*, 69(3), 307–316.
- Kaplan, G. A., Goldberg, D. E., Everson, S. A., Cohen, R. D., Salonen, R., Tuomilehto, J., & Salonen, J. (1996). Perceived health status and morbidity and mortality: Evidence from the Kuopio Ischaemic heart disease risk factor study. *International Journal of Epidemiology*, 25(2), 259–265.
- Lange, S., Quere, M., Shield, K., Rehm, J., & Popova, S. (2016). Alcohol use and self-perceived mental health status among pregnant and breastfeeding women in Canada: A secondary data analysis. *BJOG*, *123*(6), 900–909.
- Larue, A., Bank, L., Jarvik, L. F., & Hetland, M. D. (1979). Health in old age: How do physicians' ratings and self-ratings compare? *Journal of Gerontology*, 34(5), 687–691.
- Leung, Y., Mei, C. L., & Zhang, W. X. (2000). Statistical tests for spatial nonstationarity based on the geographically weighted regression model. *Environment and Planning A: Economy and Space*, 32(1), 9–32.
- Levi, B. (2017). Perceived health status in a comparative perspective: Methodological limitations and policy implications for Israel. *Israel Journal of Health Policy Research*, 6(2). doi:10.1186/s13584-016-0128-x
- Livingston, M., & Lee, D. (2014). The Glasgow effect?"- the result of the geographical patterning of deprived areas? *Health & Place*, 29, 1–9.
- Loader, C. R. (1999). Bandwidth selection: Classical or plug-in? *The Annals of Statistics*, 27(2), 415-438.
- Machimbarrena, J. M., González-Cabrera, J., Ortega-Barón, J., Beranuy-Fargues, M., Álvarez-Bardón, A., & Tejero, B. (2019). Profiles of problematic internet use and its impact on adolescents' health-related quality of life. *International Journal of Environmental Research and Public Health*, 16(20), 3877.
- Machón, M., Vergara, I., Dorronsoro, M., Vrotsou, K., & Larrañaga, I. (2016). Self-perceived health in functionally independent older people: Associated factors. *BMC Geriatrics*, *16*(1), 66.
- Mackenbach, J. P., Valverde, J. R., Artnik, B., Bopp, M., Brønnum-Hansen, H., Deboosere, P., ... Nusselder, W. J. (2018). Trends in health inequalities in 27 European countries. *Proceedings of the National Academy of Sciences of the United States of America*, 115(25), 6440–6445.
- Maniscalco, L., Miceli, S., Bono, F., & Matranga, D. (2020). Self-perceived health, objective health, and quality of life among people aged 50 and over: interrelationship among health indicators in Italy, Spain, and Greece. *International Journal of Environmental Research and Public Health*, 17 (7), 2414.
- Matos, M. G. D., Tomé, G., Gaspar, T., Cicognani, E., & Moreno Rodríguez, M. D. C. (2016). Youth mental health in Portugal, Italy and Spain: Key challenges for improving well-being. *European Health Psychologist*, 18(3), 128–133.
- Matthews, S. A., & Yang, T. C. (2016). Mapping the results of local statistics: Using geographically weighted regression. *Demographic Research*, *26*, 151–166.
- Mcdonald, J. (2008). Measuring personality constructs: The advantages and disadvantages of self-reports, informant reports and behavioural assessments. *Enquire*, 1.

- Mendes, M., Silva, I. C., Hallal, P. C., & Tomasi, E. (2014). Physical activity and perceived insecurity from crime in adults: A population-based study. *PloS One*, *9*(9), e108136.
- Menec, V. H., & Chipperfield, J. G. (1997). The interactive effect of perceived control and functional status on health and mortality among young-old and old-old adults. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, 52(3), 118–126.
- Miilunpalo, S. I., Vuori, I. M., Oja, P., Pasanen, M. E., & Urponen, H. (1997). Self-rated health status as a health measure: The predictive value of self-reported health status on the use of physician services and on mortality in the working-age population. *Journal of Clinical Epidemiology*, 50(5), 517–528.
- OECD. (2016). Health statistics 2016 definitions, sources and methods.
- Robinson, F., & Keithley, J. (2000). The impacts of crime on health and health services: A literature review. *Health, Risk & Society*, 2(3), 253–266.
- Roos, E., Lahelma, E., Saastamoinen, P., & Elstad, J. I. (2005). The association of employment status and family status with health among women and men in four Nordic countries. *Scandinavian Journal of Public Health*, 33(4), 250–260.
- Salonsalmi, A., Rahkonen, O., Lahelma, E., & Laaksonen, M. (2017). The association between alcohol drinking and self-reported mental and physical functioning: A prospective cohort study among City of Helsinki employees. *BMJ*, 7. doi:10.1136/bmjopen-2016-014368
- Saravia, J. C., & Chau, C. (2017). What factors are related to self-perceived health? The relationship between Sense of Coherence, behaviors and health on Peruvian emerging adults. *Journal of Behavior, Health & Social*, 9(2), 111–116.
- Schnittker, J., & Bacak, V. (2014). The increasing predictive validity of self-rated health. *PLoS ONE*, *9*(1), e84933.
- Shields, M. (2008). Community belonging and self-perceived health. *Health Reports*, 19(2), (Statistics Canada, Catalogue 82-003), 51-60.
- Shields, M., & Shooshtari, S. (2002). Determinants of self-rated health. Health reports/Statistics Canada, Canadian Centre for Health Information = Rapports sur la santé/Statistique Canada. *Centre Canadien D'information Sur La Santé*, 13, 35–52.
- Su, D., Richardson, C., Wen, M., & Pagán, J. A. (2011). Cross-border utilization of health care: Evidence from a population-based study in south Texas. *Health Services Research*, 46(3), 859–876.
- Verropoulou, G. (2009). Key elements composing self-rated health in older adults: A comparative study of 11 European countries. *European Journal of Ageing*, 6(3), 213–226.
- Vozikis, A., Drivas, K., & Milioris, K. (2014). Health literacy among university students in Greece: Determinants and association with self-perceived health, health behaviours and health risks. *Archives of Public Health*, 72(72), 15.
- Yao, X. I., Ni, M. Y., Cheung, F., Wu, J. T., Schooling, M., Leung, G. M., & Pang, H. (2019). Change in moderate alcohol consumption and quality of life: Evidence from 2 population-based cohorts. CMAJ, 191(27), 753–760.
- Zhang, X., Cook, P. A., Jarman, I., & Lisboa, P. (2011). Area effects on health inequalities: The impact of neighbouring deprivation in mortality. *Health & Place*, 17(6), 1266–1273.