Assessment of the impact of socio-economic situation on health status of inhabitants in the European Union countries

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Abstract

Good health status is a priority for citizens of each country and a precondition for economic prosperity. Significant differences in health status exist between European countries and regions. Health status and its supposed determinants are multidimensional categories, specified by a number of indicators. Health indicators based on reliable and mutually comparable data are a prerequisite for establishing and monitoring the implementation of strategies and policies aimed at improving Europeans' health. The European Commission is currently publishing various sets of health indicators that are, and will continue to be, used and disseminated in order to achieve the targets set under the Europe 2020 Strategy.

There is a number of major studies which have demonstrated a clear link between socio-economic background (such as income or occupation) and health. The goal of this article is to assess and quantify inequalities in health status of inhabitants depending on socio-economic situation in European union countries based on selected health, social and economic indicators by using multidimensional methods, namely factor and cluster analysis.

Keywords: *health status, socio-economic situation, inequalities, multidimensional statistical methods*

JEL Classification: *C38, I14, I15*

1. Introduction

Health is important for the wellbeing of individuals and society, but a healthy population is also a prerequisite for economic productivity and prosperity. Our aim was to analyse the socio-demographic and economic factors associated with different levels of health status in European Union countries.

Diseases of the heart and circulatory system (CVD) are the leading cause of mortality in Europe as a whole, responsible for over 3.9 million deaths a year, or 45% of all deaths. CVD is also the leading cause of mortality in the EU, where it causes just over 1.8 million deaths each year – around 800,000 deaths in men and 1 million deaths in women. The main forms of CVD are ischaemic heart disease (IHD) and stroke. As in Europe, IHD and stroke are the first and second most common single causes of death in the EU (Wilkins et al., 2017).

Comparing the CVD mortality burden across individual European countries reveals substantial variation, with a higher burden typically found in Central and Eastern European countries compared to that in Northern, Southern and Western countries (Jindrová and Kopecká, 2017; Pacáková et al., 2016). The incidence of a disease describes the number of new cases that develop within a population over a specified period of time. In 2015, there were just fewer than 11.3 million new cases of CVD in Europe. In the EU there were 6.1 million new cases of CVD

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in 2015. Half of these new CVD cases were due to IHD, while around 10% of new CVD cases were due to stroke (OECD/EU, 2018). CVD has major economic costs as well as human costs for Europe. Overall CVD is estimated to cost the EU economy €210 billion a year. Of the total cost of CVD in the EU, 53% (€111 billion) is due to direct health care costs, 26% (€54 billion) to productivity losses and 21% (€45 billion) to the informal care of people with CVD (Wilkins et al., 2017).

By comparison, cancer – the next most common cause of death – accounts for just fewer than 1.1 million deaths (24%) in men and just fewer than 900,000 deaths (20%) in women. Large variations exist in cancer incidence across EU countries. These variations in incidence rates reflect not only variations in the real number of new cancers occurring each year, but also differences in national policies regarding cancer screening to detect different types of cancer as early as possible, as well as differences in the quality of cancer surveillance and reporting (ECIS, 2019).

There is a large literature examining socio-economics determinants and income inequality in relation to health (Marmot, 2002; Pacáková and Kopecká, 2018; Pickett and Wilkinson, 2015). The social determinants of health are closely inter-linked. Indeed, it makes it hard to empirically disentangle the individual effects of different factors on health. But what is evident is that these factors will, in general, reinforce each other. For example, the better educated are also likely to be richer, live in healthier environments, and be less likely to smoke. Furthermore, some researchers argue that large income differences not only cause health inequalities, but may also be detrimental to population health (Pickett and Wilkinson, 2015).

The goal of this article is to assess and quantify inequalities in health status of inhabitants depending on socio-economic situation in European union countries based on selected health, social and economic indicators by using multidimensional methods, namely factor and cluster analysis. Unlike the most publications for assessing the health status, indicators of incidence were used instead of indicators of mortality due to serious illnesses.

2. Indicators, data and methods

The most of publications in assessing the impact of socio-economic situation on the health status of the population use indicators of mortality of selected diseases. In our opinion, the values of mortality indicators are the result of the impact not only of the socio-economic situation and the quality of life in individual countries but also depend on the level of health expenditure and health care quality. Therefore, to achieve the goal of the article, indicators of incidence of cardiovascular and oncological diseases have been used instead of mortality indicators in line with the Introduction. These indicators are complemented by indicators of the healthy life expectancy of men and women in EU countries.

The used indicators of the socio-economic situation in the EU countries were selected using pairwise Spearman rank correlation coefficients with the selected health indicators. Surprisingly, low dependence of health indicators with unemployment, income inequality indicators and health risk indicators such as alcohol consumption and obesity has been demonstrated, although these indicators are clearly seen as important determinants of health in healthcare publications. The significant impact of risk factors on health may arise if the statistical units are directly people – the inhabitants of countries and not the countries. Unfortunately, indicators of this type are currently not available, the hope for the future can be e-health.

In accordance with the objectives 15 indicators have been selected. The first 8 indicators together characterise the state of health and the last 7 indicators characterize socio-economics situation in EU countries. The values of the indicators have been taken from ECIS (2019), Eurostat (2018), OECD (2016, 2017 and 2018), OECD/EU (2018) and Wilkins et al. (2017).

List of selected indicators:

CVD_I	Incidence of cardiovascular disease, per 100 000, both sexes, 2015
IHD_T	Incidence of ischaemic heart disease, per 100 000, both sexes, 2015
Stroke_T	Incidence of stroke, per 100 000, both sexes, 2015
Cancer_I	Estimated cancer incidence, per 100 000, both sexes, all sites but non-melanoma skin, all ages, 2018
HLY_W	Healthy life years, women, 2016 (or nearest year)
HLY_M	Healthy life years, men, 2016 (or nearest year)
HLY_65_W	Healthy life years at 65, women, 2016 (or nearest year)
HLY_65_M	Healthy life years at 65, men, 2016 (or nearest year)
GDP	GDP per capita in EUR PPP, 2017
Mean	Mean equivalised net income, 2017 or latest available year, Euro
Median	Median equivalised net income, 2017 or latest available year, Euro
Poverty	At risk of poverty rate, 2016
Deprivation	Material deprivation, 2016
Smoking	% of population who smokes daily
Edu_high	Share of the population (%) age 25–54 with tertiary educational attainment

Two multidimensional methods were used to achieve the goal of the article, Factor and Cluster Analysis.

Factor analysis is a statistical approach that can be used to analyse interrelationships among a large number of variables and to explain these variables in terms of their common underlying factors. The general purpose of factor analytic techniques is to find a way of condensing (summarising) the information contained in a number of original variables into a smaller set of new composite factors with a minimum loss of information. Numerous variations of the general factor model are available. The component model is used when the objective is to summarise most of the original information (variance) in a minimum number of factors. An important concept in factor analysis is the rotation of factors. In practice, the objective of all methods of rotation is to simplify the rows and columns of the factor matrix to facilitate interpretation. The *Varimax* criterion centres on simplifying the columns of the factor matrix. With the Varimax rotation approach, there tend to be some high loadings (i.e., close to –1 or +1) and some loadings near 0 in each column of the matrix. The *factor loadings* show the correlation between the original variables and the factors and they are the key to understanding the nature of a particular factor. The *Factor Scores* in output of Factor analyse procedure display the values of the rotated factor scores for each of n cases, in our analysis for each of 28 European Union countries (Hair et al., 2007).

Cluster Analysis procedure is designed to group observations (countries) into clusters based upon similarities between them. A number of different algorithms is provided for generating clusters and are described in detail in many statistical publications. We used the agglomerative algorithm, starting with separate clusters for each observation and then joining clusters together based upon their similarity. To form the clusters, the procedure began with each observation in a separate group. It then combined the two observations which were closest together to form a new group. After re-computing the distance between the groups, the two groups then closest together are combined. This process is repeated until only one group remained. The results of the analysis are displayed in a *dendogram* (Hair et al., 2007).

3. Results and discussion

To assess the suitability of indicators for the factor analysis, we applied the Kaiser-Meyer-Olkin measure (KMO). The KMO = 0.709747 shows suitability of the source variables for factor analysis. In this case, 3 factors were extracted, since 3 factors had eigenvalues greater than or equal to 1. Together they account more than 78 % of the variability in the original data (Table 1).

Table 1. Factor analysis – number of factor extracted

Factor number	Eigenvalue	Percent of Variance	Cumulative Percentage
1	8.21701	54.780	54.780
2	2.57545	17.170	71.950
3	1.03643	6.910	**78.859**
4	0.955858	6.372	85.232
⋮	⋮	⋮	⋮
15	0.00094131	0.006	100.000

Factor loadings present the correlation between the original variables and the extracted factors and they are the key to understanding the nature of a particular factor. After varimax rotation factor loadings shown in Table 2 have been obtained. Rotation is performed in order to simplify the explanation and naming of the factors.

Based on Factor loadings in Table 2 we found out that the *Factor 1* has the strong negative correlation with the indicators of CVD incidence and strong positive correlation with income indicators. The *Factor* 2 demonstrates strong positive correlation with the indicators of healthy life years. The *Factor* 3 shows strong positive correlation with the indicators of poverty, material deprivation and smoking and significant negative correlation with incidence of cancer. So the extracted factors were interpreted as follows: Factor 1 – *factor of CVD incidence and income level*, Factor 2 – *factor of healthy life years* and Factor 3 – *factor of social exclusion and cancer incidence*.

Table 2. Factor loading matrix after Varimax Rotation

Variables	Factor 1	Factor 2	Factor 3
CVD_I	**–0.8589**	–0.3604	0.1395
IHD_T	**–0.8675**	–0.3410	0.0906
Stroke_T	**–0.7209**	–0.4165	0.3555
Cancer_I	0.1439	–0.0415	**–0.7179**
HLY_W	0.0319	**0.95255**	0.1174
HLY_M	0.2224	**0.9566**	0.0349
HLY_65_W	0.3021	**0.8682**	–0.3021
HLY_65_M	0.4319	**0.8461**	–0.2402
GDP	**0.7705**	0.1152	–0.3083
Mean	**0.8121**	0.2282	–0.4401
Median	**0.7972**	0.2301	–0.4620
Poverty	–0.4724	–0.0668	**0.7321**
Deprivation	–0.2259	–0.0246	**0.7796**
Smoking	–0.3279	–0.2841	**0.6045**
Edu_high	**0.6076**	–0.0099	–0.2603

Table 3 shows the factor scores for each monitored country. The Factor Scores displays the values of the rotated factors for each country. Graphical display of countries in a two-dimensional coordinate system with the axes of the extracted factors allows us to quickly assess the observed situation in each country and also to compare the situation in different countries.

In the coordinate system of the factors *Factor 1* and *Factor 2* (Fig. 1) three main groups of countries were created. The first one with high values of both factors, including all the old EU member countries, the second one with low values of both factors, including the new EU countries and the third one with the middle level of the first and the low to medium level of the second factor. In countries with a high level of income and education and a low incidence of CVD there is a high level of healthy life years.

Fig. 2 illustrates the high inequalities in social inclusion and incidence of cancer and healthy life in EU countries. This inequality can also be caused by the fact that high values of *Factor 3* indicate high social exclusion and a high proportion of smokers, and paradoxically a relatively low incidence of cancer. Unfortunately, the Fig. 2 shows again a low level of healthy years of life and a high level of social exclusion in former socialist countries.

Table 3. Table of factor scores

Country	Code	Factor 1	Factor 2	Factor 3
Austria	AT	2.619	–1.802	–0.979
Belgium	BE	4.542	2.783	–3.274
Bulgaria	BG	–10.076	–1.715	8.572
Croatia	HR	–7.947	–6.363	4.415
Cyprus	CY	3.238	2.685	0.992
Czech Republic	CZ	–3.021	–0.751	–0.699
Denmark	DK	6.796	2.691	–5.980
Estonia	EE	–4.394	–5.200	1.939
Finland	FI	4.262	–0.147	–3.879
France	FR	4.788	2.399	–3.164
Germany	DE	2.667	3.994	–2.221
Greece	EL	–3.512	–0.809	4.525
Hungary	HU	–6.668	–4.574	2.139
Ireland	IE	8.872	6.791	–4.883
Italy	IT	–0.032	3.119	1.114
Latvia	LV	–8.507	–8.932	4.475
Lithuania	LT	–7.345	–6.303	4.049
Luxembourg	LU	12.081	3.840	–6.339
Malta	MT	3.484	7.977	–0.754
Netherlands	NL	5.554	1.583	–4.365
Poland	PL	–4.575	–1.529	2.453
Portugal	PT	–1.912	–2.346	1.697
Romania	RO	–9.923	–5.353	7.836
Slovakia	SK	–4.433	–5.832	1.329
Slovenia	SI	–1.241	–2.298	–1.166
Spain	ES	2.343	3.131	0.989
Sweden	SE	7.193	10.027	–5.061
United Kingdom	UK	5.144	2.936	–3.761

The factor analysis based on principal component method resulted in 3 mutually independent factors. These factors are appropriate for the cluster analysis.

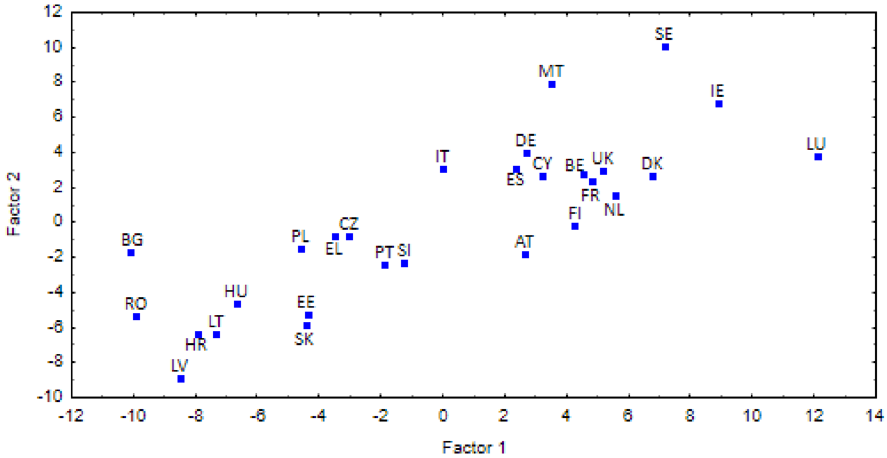

Fig. 1. Location of EU countries according to Factor 1 and Factor 2

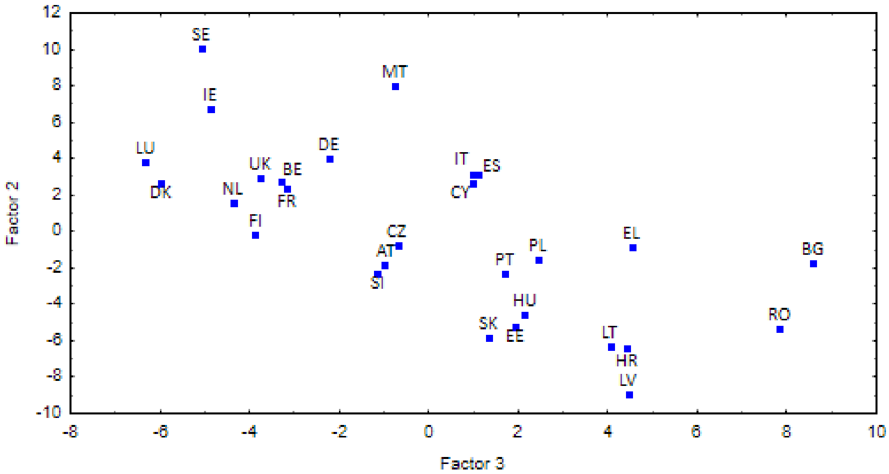

Fig. 2. Location of EU countries according to Factor 3 and Factor 2

The cluster analysis results presented by the dendrogram in Fig. 3 are consistent with the results of factor analysis. In particular, it presents a very large gap between Western EU countries and EU countries in Central, Eastern and Southern Europe by selected health and socio-economic indicators.

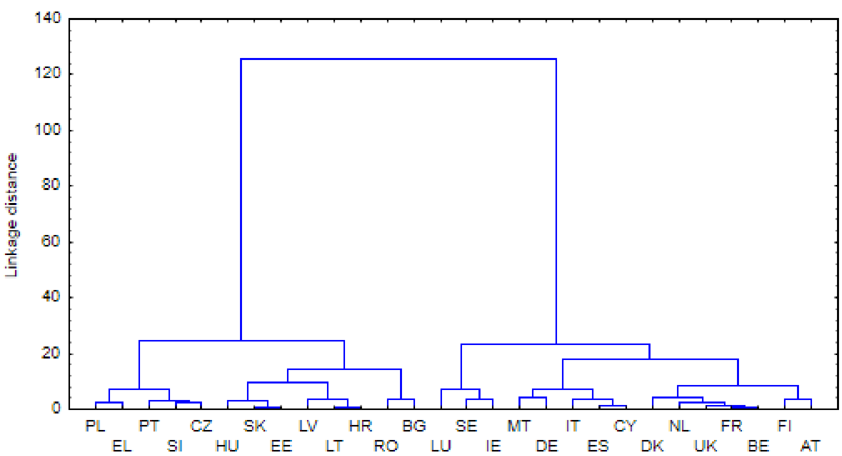

Fig. 3. Cluster analysis results

Conclusions

Large disparities exist between countries in CVD and cancer incidence and healthy life years and their significant dependence on the social and economic situation in the EU countries has been confirmed. The results of factor and cluster analysis showed significant health and social disparities in the EU countries, mainly a large gap between Western EU countries and EU countries in Central, Eastern and Southern Europe. The objectives of the European Commission concerning the gradual reduction of these inequalities, which have been declared in European Commission (2013) and OECD (2015), apparently not successful.

A wide range of policies is required to reduce inequalities. These include greater efforts to prevent health problems starting early in life, promote equal access to care for the whole population, and better manage chronic health problems when they occur to reduce their disabling effects (OECD, 2017).

Reducing inequalities in health in the EU countries necessarily requires reducing inequality in income levels and social exclusion of the population.

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