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SOCIO-ECONOMIC INEQUALITIES IN HEALTH – MEASUREMENT PROBLEMS AND THE RESULTS OF ANALYSES FOR POLAND

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Abstract

Population health status has improved in the EU in the recent years, but health inequalities continue to be considerable, both within individual Member States and among them. Reducing human potential, the inequalities seriously burden the Member States and their health care systems. Policies aimed at removing the inequalities could help increase productivity, constrained by diseases and premature mortality. The article presents the results of an empirical investigation into the magnitude of the socio-economic health inequality in Poland. The inequality was measured with the health concentration index indicating the inequality of health status distribution caused by economic status. A valuable property of the health concentration index is that it can be decomposed, thus allowing the identification of the sources of the inequality. The investigation took account of the fact that gender causes variations in the values of health indicators.

Keywords: socioeconomic inequality in health, concentration index, econometric analysis.

JEL classification: I12, I21, C50.

Introduction

In October 2009 the European Commission issued the communication „*Solidarity in health: reducing health inequalities in EU*", where the elimination of health inequalities is treated as part of the general process of social and economic development. Health inequalities that still exist both within individual Member States and among them[1], despite generally improving population health status in the Community, greatly burden Member States' budgets and healthcare systems. Health inequalities cause losses to human capital. They should be reduced not only for moral reasons, but also for the economic ones, because measures removing health inequalities may increase productivity curbed by diseases and untimely deaths**.**

Poland's transition and the unemployment and social exclusion problems have resulted in considerable health inequalities, both geographical and social. In addition to securing general improvement in population's health, the Polish healthcare system is also responsible for making the inequalities less marked.

For policies improving population health and reducing health inequalities to be implemented, the magnitude of the latter should be estimated. This article presents the empirical findings about the extent of socio-economic health inequalities in Poland. Because gender is a factor differentiating many indicators of health, it will be addressed in the course of the analysis.

The methodology employed to carry out this research has already been used by other world studies dealing with the same subject[2].

1. Measurement problems of socio-economic inequalities in health

Studies investigating health inequalities use a number of health determinants, because the inequalities are not purely incidental. They are caused by non-random irregularities in the distribution of factors determining the health of individuals and populations[3].

One of the major hypotheses dealing with individuals' health refers to economic and social determinants, among which the level of income is treated as one of the most important factors determining human health. Higher incomes have both direct and indirect influence on the health status[4], as they allow, respectively, better satisfaction of health needs and secure the availability of housing and food, which are central to staying in good health[5]. Low incomes and poor health may show correlation even in developed countries.

The world literature presents attempts at systematizing the methods for measuring health inequalities, including those caused by socio-economic circumstances. The systematization is necessary, because the inequalities can be presented as the differences among health indicators

for countries, regions within countries, or demographic groups; as the differences among health indicators characterising the poorest group and other groups in society; or as a social gradient, i.e. as changes in health indicators calculated for successive social groups ordered by wealth. The third approach is generally recognised as particularly valuable[6].

One method for estimating the magnitude of health inequalities makes use of the health concentration index C which measures the inequality in health distribution caused by economic status, thus showing the social health gradient[7]. For individual data, the index can be calculated using the following formula:

$$C = \frac{2}{\mu}\operatorname{cov}(H_i, r_i) \tag{1}$$

where H_i and $r_i = i/N$ are, respectively, the health status of the i-th individual and the rank he/or she has (expressed as a fraction) in the distribution of the socio-economic status. For the lowest status individual $r_i = 1/N$, and for the highest status individual $r_i = N/N$. μ denotes an average health status in the population.

For the continuous health status variables the index C lies in the interval [–1;1], while for the binary variable (satisfaction with health, low self-assessment of health) the lower and upper limit values of the index depend on the average value of the examined variable. The range of values that C may take is, respectively, $\mu - 1 + 1/N$ and $1 - \mu + 1/N$. For the binary variable case, the concentration index may be written as[8]:

$$C = \frac{2}{N\mu}\sum_{i=1}^{n} H_i r_i - 1 - 1/N \tag{2}$$

The health concentration index C should not be used when health status is a variable indicated on an ordinal scale. One way to solve this problem is to transform such a variable into a binary form, e.g. by dividing the respondents dichotomously into those who have a good opinion about their health and those thinking otherwise[9].

According to Kakwani, Wagstaff, van Doorslaer (1997), the standard error of the health concentration index can be calculated using the following formula:

$$\operatorname{var}(\hat{C}) = \frac{1}{N}\left[\frac{1}{N}\sum_{i=1}^{n} a_i^2 - (1+C)^2\right] \tag{3}$$

where:

$$a_i = \frac{H_i}{\mu}(2r_i - 1 - C) + 2 - q_{i-1} - q_i, \quad q_i = \frac{1}{\mu N}\sum_{j=1}^{i} H_j \quad \text{i} \quad q_0 = 0.$$

A valuable property of the health concentration index C is that it can be decomposed to identify the source of inequality. To carry out the decomposition procedure, the appropriate health status model must be specified and estimated. Most models of individual health status draw on the concept of 'latent' variables, because individual health status is not directly observable. The object of econometric modelling is a directly unobservable variable representing health status, H, which is a function of model $\boldsymbol{x}_i$ explanatory variables (incomes, age, gender, educational attainment) describing a given individual and of other factors affecting the assessment of health:

$$H_i = f(\mathrm{x}_i^T \beta) + \varepsilon_i \tag{4}$$

ε is an error term, β is the vector of the model's structural parameters. The health concentration index C for H can be written as:

$$C = \sum_k (\beta_k \bar{x}_k / \mu) C_k + (\bar{\varepsilon} / \mu) C_\varepsilon \tag{5}$$

where: $\bar{x}_k$ is the average value of the variable x_k, C_k is the health concentration index for x_k (constructed in the same way as C), C_ε is the health concentration index for the error term ε.

C is equal to the weighted sum of concentration indices for k regressors, where the weight of the variable x_k is the elasticity of the variable H with respect to x_k:

$$\eta_k = \beta_k \frac{\bar{x}_k}{\mu} \tag{6}$$

This type of decomposition applies to the linear models of health status. As far as the non-linear models are concerned, the most popular approach utilizes marginal effects, which are calculated for the average values of the explanatory variables. The concentration index C for the variable H is then written as:

$$C = \sum_k (\beta_k^m \bar{x}_k / \mu) C_k + (\bar{\varepsilon} / \mu) C_u \tag{7}$$

where β_k^m are the marginal effects for particular explanatory variables[10]. The contribution of a given explanatory variable to health inequality is given by $\eta_k C_k / C$, where: $\eta_k = \beta_k^m \frac{\bar{x}_k}{\mu}$.

Qualitative variables used as regressors induce the problem of relativity of some model parameter estimates with respect to the accepted reference category. It must be remembered, though, that this methodology is mainly used to analyse relationships between incomes and health inequalities.

The contribution of each health determinant to income-related health inequality can be decomposed into two parts: its impact on health measured by the elasticity η_k and its degree of unequal distribution across income (C_k).

2. The results of the empirical analysis for Poland

The most objective way of capturing health inequalities is one using official statistics. Aggregate data on the objective measures of health status (mortality, morbidity) are rarely shown in Polish statistical reports according to their socio-economic characteristics. The methodology described above could be applied to estimate health inequality understood as unequal distribution of the selected health measures caused by the socio-economic status variable because of the availability of survey data presenting typically subjective assessments of health.

The analysis presented in this paper uses individual data (concerning particular respondents) that were made available by the authors of the project *Social Diagnosis 2009*[11]. The database of the project contains information derived from questionnaires distributed among all household members aged 17 years and older, but this analysis uses only data characterising the adult population, i.e. individuals aged 18 years and older. The final size of the sample was $N = 10732$ and $N = 8883$ for females and males, respectively.

The respondents in the Social Diagnosis survey self-assessed their health with a six-point scale, the highest level being 'very satisfied' and the lowest 'very dissatisfied'. The ordinal character of self-assessments poses a problem for calculating health inequality measures, which are typically constructed either for a binary variable or for a continuous variable. For the sake of this analysis, the health self-assessment variable H_i is presented as a dichotomous variable taking value 1 for the respondents who were very satisfied, satisfied and rather satisfied with their health, or 0, when they were very dissatisfied, dissatisfied or rather dissatisfied.

In the world literature income is the most popular measure of individuals' socio-economic status. In this analysis, the status is determined by respondents' personal incomes (in zlotys).

It is generally known that health deteriorates with age, but the world research also proves that among the low-income groups the process is faster and more persistent[12]. This analysis shows that Poland is not different in this respect (see Figure 1).

The percentage of the respondents who have a good opinion on their health is declining fast with decreasing economic status. It is definitely the lowest among those whose financial situation is the most difficult (quartile I), and the differences grow with respondent's age. This finding holds true for both males and females.

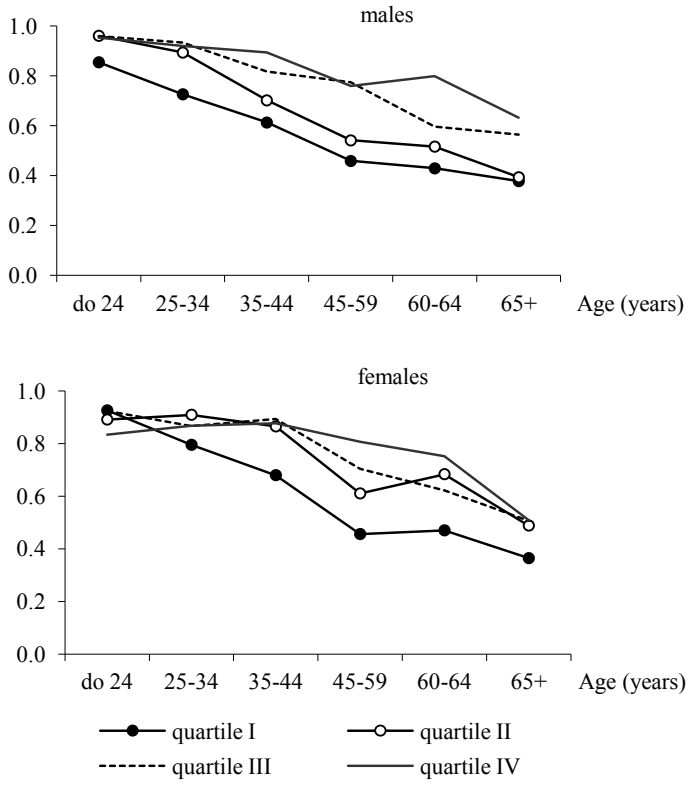

Fig. 1. Fractions of the respondents giving positive assessments of their health by level of income

Source: calculated by the Author.

Health inequalities as measured by the health concentration index *C* also change according to respondents' age (see Table 1).

Table 1. Health concentration indices for the self- assessments of health status by age and gender

Age	Males		Females	
	index *C*	*t*-statistics	index *C*	*t*-statistics
to 24	0.006	0.891	–0.011	–1.277
25–34	0.009	1.815	0.014	2.275
35–44	0.035	4.462	0.028	3.593
45–59	0.062	8.013	0.086	11.013
60–64	0.117	6.594	0.116	7.453
65+	0.114	7.414	0.139	9.191

Source: calculated by the Author[13].

The income-related health inequalities concerning young people to 34 years of age, most of whom still enjoy good health, are relatively small and statistically insignificant. The statistically significant health concentration indices C in the age group 35 years and older reveal unequal distribution of health caused by different levels of incomes. This unfavourable phenomenon is particularly intense in the age group 60 years and older. The value of the index C is slightly greater for females than for males. The positive values of the index show that the analysed variable (positive self-assessment of health) takes higher values in groups whose socio-economic status is higher.

In order to decompose the health concentration index C the health status model must be estimated first. The individual self-assessment of health status H_i was modelled with a logit model:

$$P(H_i = 1) = \frac{\exp\left(x_i^T \beta\right)}{1 + \exp\left(x_i^T \beta\right)} \tag{8}$$

where:

$H_i = 1$ – when the i-th individual is satisfied with his/her health (very satisfied, satisfied, rather satisfied),

$H_i = 0$ – when the i-th individual is not satisfied with his/her health (very dissatisfied, dissatisfied, rather dissatisfied).

The model of the individual health status was specified using explanatory factors available in the literature[14]. In addition to incomes, the following factors were assumed to determine health:

- the size-class of the locality of residence: towns with populations exceeding 500,000, with 200,000–500,000, 100,000–200,000, and 20,000–100,000 residents, and those populated by less than 20,000 people. The size-class of the locality of residence (introduced to approximate the accessibility of health services) is represented in the model by binary variables corresponding to the particular sizes of the localities (the rural area being the reference category),
- education – binary variables denoting the following levels of education: basic vocational/junior secondary, secondary, post-secondary and tertiary (primary education and without education being the reference category),
- disability – a binary variable taking value 1 for the holders of disability certificates or 0 for the non-holders.

Other binary variables introduced into the model represent widowed persons, divorcees, those aged 65 years and older, as well as involvement in physical activity. Some of the variables considered in the first stage turned out to be statistically insignificant. The accepted estimates of the logit model of health status and the characteristics necessary to decompose health concentration indices for females and males are presented, respectively, in Tables 2 and 3. The statistical data used to estimate the logit model's parameters and to decompose the health concentration index *C* concerned only individuals in the age group 35 years and older, where statistically significant health inequalities start to emerge (see Table 1).

Table 2. Decomposition of the health concentration index – females ($N = 8271$)

Variable	$\hat{\beta}$ parameter estimate	Z statistics [p value]	Marginal effect β_k^m	Concentration index Ck	Contribution to health inequality (%)
Incomes (a logarithm)	0.543	10.36 [0.000]	0.129	0.043	55.54
Towns with populations exceeding 500,000	–0.351	–4.14 [0.000]	–0.086	0.218	–2.11
Tertiary education	0.679	8.50 [0.000]	0.150	0.539	16.60
Post-secondary education	0.706	6.24 [0.000]	0.152	0.232	2.07
Secondary education	0.415	8.36 [0.000]	0.096	0.104	4.37
Vocational education	0.469	9.46 [0.000]	0.108	–0.156	–5.31
Age 65+	–0.487	–8.02 [0.000]	–0.117	–0.104	5.63
Widow	–0.313	–5.04 [0.000]	–0.076	–0.045	1.27
Physical activity	0.308	4.68 [0.000]	0.073	0.225	3.01
Disability	–1.563	–20.48 [0.000]	–0.371	–0.261	18.92
R^2McFaddena (pseudo-R^2) = 0.12		McKelvey and Zavoina's $R^2 = 0.202$		Count $R^2 = 0.69$	

Source: calculated by the Author.

Income is the factor that contributes to health inequalities the most strongly. The second important factor is tertiary education. The income-related inequalities in health are caused by the strong dependence of health status on incomes expressed by the coefficient η_k, rather than by the unequal distribution of incomes. It is worth noting that the dependence is not considerably different between males and females.

Table 3. Decomposition of the health concentration index–males (N = 6758)

Variable	$\hat{\beta}$ parameter estimate	Z statistics [p value]	Marginal effect β_k^m	Concentration index C_k	Contribution to health inequality (%)
Incomes (a logarithm)	0.619	11.54 [0.000]	0.138	0.047	56.20
Towns with populations exceeding 500,000	–0.416	–3.75 [0.000]	–0.096	0.309	–2.50
Tertiary education	0.577	4.73 [0.000]	0.115	0.496	7.93
Post-secondary education	0.972	3.83 [0.000]	0.174	0.352	1.53
Secondary education	0.314	3.52 [0.000]	0.066	0.117	2.28
Vocational education	0.195	2.45 [0.014]	0.042	–0.052	–1.10
Age 65+	–0.623	–8.95 [0.000]	–0.140	–0.141	5.67
Physical activity	0.367	4.85 [0.000]	0.082	0.301	4.68
Disability	1.566	–22.08 [0.000]	–0.369	–0.302	25.31
R^2McFaddena (pseudo-R^2 = 0.14		McKelvey and Zavoina's R^2 = 0.198		Count R^2 = 0.68	

Source: calculated by the Author.

Conclusions

The main purpose of this article was to spotlight the rather important problem of health status inequalities arising from economic status. The research has found socio-economic health inequalities affecting both males and females in the age group 35 years and older. In Poland the magnitude of the inequalities as measured by the health concentration index is definitely greater than in most European countries[15].

The research offers conclusions providing guidance to health policy. If the health status of the population with low economic status is to improve, effective solutions must be worked out that will let people stay in good health irrespective of their incomes.

In the analyses of the relationship between health and income the complexity of the relationship still remains a problem. Incomes are known to influence health, but a different situation is also possible – health may determine individuals' economic success. This interplay makes the specification and estimation of the binomial models of health status more difficult.

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Notes

[1] European Commission (2010), p. 7.

[2] See, for instance, van Doorslaer, Wagstaff, Bleichrodt (1997), Cavelaars, Kunst, Geurt (1998), Jones, Wildman (2005), Gundgaard, Lauridsen (2006), Yiengprugsawan et al. (2007), Allanson (2010).

[3] European Commission (2010), p. 9.

[4] A broader discussion on the financing and accessibility of medical services can be found, *inter alia*, in Laskowska (2000).

[5] Tobiasz-Adamczyk (2000), *Health policy and the accessibility...* (2007).

[6] *The material status of a family...* (2007).

[7] Wagstaff et al. (1991).

[8] Wagstaff (2005).

[9] O'Donell et al. (2008).

[10] Marginal effects for a continuous explanatory variable are usually *calculated* for its average value. The marginal effect for a binary variable is the difference between the probabilities of an event taking place when the variable is 1 and when it is 0, assuming that the other variables take values equal to their average values.

[11] *Social Diagnosis 2009. The Conditions and Quality...* (2009); databases: The Council for Social Monitoring (2009), *Social Diagnosis*: integrated database, www.diagnoza.com (3.12.2009).

[12] Chandola et al. (2007).

[13] Individual health concentration indices were calculated with the STATA v.10 package.

[14] van Doorslaer, Koolman (2004), Jones, Wildman (2005).

[15] See, for instance, van Doorslaer, Koolman (2004).

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