EFFECTIVENESS OF ALLOCATION OF HEALTH SYSTEM NON-FINANCIAL RESOURCES

Paulina UCIEKLAK-JEŻ
Jan Dlugosz University in Czestochowa
4-8 Waszyngtona St., Czestochowa, Poland
p.ucieklak-jez@ajd.czest.pl

Agnieszka BEM
Wroclaw University of Economics
118-120 Komandorska St., Wroclaw, Poland
bemagnieszka@gmail.com

Paweł PRĘDKIEWICZ
Wroclaw University of Economics
118-120 Komandorska St., Wroclaw, Poland
pawel.predkiewicz@ue.wroc.pl

Abstract. *The aim of this study is the analysis of the efficiency of regional distribution of non-financial resources' in Polish health care system. We have assumed, that the redistribution of financial resources is of secondary character, because the existence of human and fixed resources determines the potential to provide services and affect the distribution of funds among the regions. We have used the least squares method, the weighted least squares method and selected measures of model' fitting, like Akaike Information Criterion, Hannan-Quinn Criterion, Schwarz'Bayes-Criterion. The results of empirical studies indicate, that there is a significant relationship between health resources and women's state of health, at the age of 45 and 60 years, and only some of the benefits have a strong impact on the population's health. Cross-sectional data for women at the age of 60, analysed in the period of 2009-2013 show, that women in some voivodeships live shorter or longer than, on average, in the other voivodeships, comparing to the same volume of resources.*

Keywords: *health; non-financial resources; health state.*

Introduction

Functioning of the health system has enormous importance for the well-being of a society and its economic development. Health needs are, due to their nature, varied and require a wide range of resources, including human, financial and infrastructural ones (Asante, Zwi & Ho, 2006). Health resources in every country are limited and the treatment options are infinite, which means the need for tough decisions on allocation of scarce resources (Sweatman & Woollard, 2002). Analysis of health care resources is generally based on three dimensions: restraint of resources, inequity of distribution and inefficiency of resource-use (Saxena et al., 2007). The main purpose of each resource allocation model is to maximize the health of the population (Flessa, 2003), (Emanuel, 2000). Inappropriate resource allocation can lead to inequalities in health (Asante, Zwi & Ho, 2006), that can have also a regional dimension.

Resources are allocated efficiently, if its redistribution meets the needs of local communities. If the allocation is ineffective more people do not have sufficient access to health benefits (Saxena et al., 2007), without regional disparities (Kreng & Yang, 2011). If resources are allocated equitably, it should be reflected in health outcomes (Rice & Smith, 1999).Literature suggests a variety of measures of health status, also known as health outcomes. They include: life expectancy (LE), healthy life years (HLY), potential years life lost (PYLL), quality adjusted life years (QALY) (Ryć & Skrzypczak, 2011). Many studies also use negative indicators, such as morbidity and mortality. All-cause mortality is among the most commonly used health status indicators, especially in studies concerning health inequality (Starfield et al., 2005).

Traditional health needs-based allocation mechanisms assume, that regions with greater health needs get more resources (Mooney & Houston, 2004, Donaldson & Gerard, 1993, Asthana et al., 2004, Asante & Zwi, 2009). Diagnosed health needs often are analysed in relation to the socio-economic factors, characterising local communities (Bellanger & Jourdain, 2004).

Research on allocative efficiency are linked to the availability of public health care services. In the case of primary care services, financed from the public health insurance, services are generally available, according to Włodarczyk (2007), and this availability is not dependent on residence in the voivodeship, while the availability of more specialised services depends on the place of residence and wealth.

The aim of this study is to analyse the efficiency of the regional non-financial distribution of resources in Polish health care system. We have assumed, that the redistribution of financial resources is of secondary character, because the existence of human and fixed resources determines the potential to provide services and affects the distribution of funds between the regions.

We have posed the following research hypotheses:
H1:non-financial resources affect significantly women's state of health;
H2: non-financial health resources are redistributed inefficiently.

The H1 hypothesis assumes, that there is a significant relationship between health resources and women's health at the age between 45 and 60. Confirmation of the H1 hypothesis leads not only to existence of such a connection, but may also indicate health benefits, which have the strongest impact on the health status of the population.

The construction of the H2 hypothesis bases between regional distribution of non-financial resources and selected health indicators. This hypothesis assumes, that the inequality in the distribution of resources between regions potentially generate health inequalities reflected in the health indicators. In Poland, self-government entities, particularly at the regional level, are committed to formulation of a local development strategy, which also includes the aspect of health (Fyderek, 2007). Voivideship – as a local government unit - creates, among other things, coverage plans for health benefits, ensuring health services for the voivodeship's population. This also applies to the geographical distribution of health infrastructure.

Many studies confirmed the relationship between the number, or density of doctors and mortality rates and life expectancies, even if income inequalities occurred (Horev, Pesis-Katz & Mukamel, 2004; Anand & Bärnighausen, 2004; Chen et al., 2004) and between fixed health resources (e.g., the number of hospital beds) and consumption of health benefits (Litaker & Love, 2005).

This survey covers the geographical distribution of health resources. It is important, however, that gender and social position (income, education) are relevant health factors of the health status. In fact, voivodeship populations show a diversity in terms of education and income, not only between voivodeships, but also between women and men. Inequalities in the morbidity of men and women may be associated with the fact, that women serve different social functions and use more extensively social support, including health benefits. According to previous research, women aged 45, are more likely than men to use healthcare resources.

We have used data covering the regional distribution of infrastructure and human resources from The Centre of Health Information Systems (CSIOZ) and data from The Main Statistical Office (GUS) for the years 2009-2013.

The presented study differs from prior literature in several aspects. First, we have examined empirically the impact of non-financial resources on the population's health status, which provides an important contribution to the current research. What is important, this study concentrates on the population of elderly women, who have often much worse access to health care services.

Methodology and data

The research concept is based on the study of the relationship between non-financial health resources and the population's health state, assuming that this is a consequence of the existing resources. The data have been analysed in the territory division, corresponding to the level of the NTS2 (Nomenclature of Territorial Units for Statistics). In the case of Poland, it implies the analysis for the 16 voivodeships.

The dependent variable is life expectancy for women aged 45 (LEF_45) and 60 (LEF_60). Life expectancy is one of the basic measures of population health status' improvement. It allows the analysis of the health status' diversification between the sexes, depending on place of residence. Life expectancy for a newborn baby is largely affected by perinatal mortality (inter alia caused by malformations and genetic disorders), which significantly impairs total life expectancy. We have assumed, that the state of health of the elderly, which is expressed by LE45, to a large extent influences the availability or access to health services.

We selected a number of potential explanatory variables, related to the existing human resources and health infrastructure (Table 1). The analysis was made for the 2009 to 2013 data. The data on infrastructure and human resources have been transformed into relative values - in relation to the population of a voivodeship.

Table 1. Potential explanatory variables (based on CSIOZ data)

Variable	Definition
Doctors in hospitals(DOC)	The number of doctors in hospitals, regardless of the form of employment
Specialists (DOC_SPEC)	Specialists, regardless of the form of employment, working in hospitals and outpatient specialist care
Nurses (NURS)	Nurses working in hospitals, regardless of the form of employment
Midwives(MIDS)	Midwives working in hospitals, regardless of the form of employment
Primary care doctors (GP_DOC)	Doctors in primary health care, regardless of the form of employment
Primary care nurses (GP_NURS)	Nurses working in primary health care, regardless of the form of employment
Hospital beds (BEDS)	Overall number of hospital's beds
Operation rooms (O_ROOM)	Overall number of operating rooms in hospitals
Echocardiography (ECHO)	The number of echocardiography's machines
X-ray diagnostics (XRAY)	The number of X-ray machines
Ultrasonography (USG)	The number of ultrasound's machines
Electromyography (ELMIO)	The number of electromyography's machines
Isotope Diagnostics (PET)	The number of Positron Emission Tomography's machines
Computer tomography (CTG)	The number of computer tomography's machines
Magnetic resonance imaging (MAG_RES)	The number of magnetic resonance imaging's machines

We analysed several explanatory variables: LE for women aged 45 and 60, respectively for the years 2009 and 2013. We started our analysis with the presentation of changes in non-financial resources between 2009 and 2013. Then, we estimated the econometric models, basing on the Classic Method of Least Squares. We also applied the weighted least-squares method and model fit measures, such as: Akaike Information Criterion, Hannan-Quinn Criterion, Schwarz'Bayes-Criterion. The analysis was carried out with the use of Statistica 10 software.

Results and discussion

In Poland, there have been changes in terms of the number of hospitals and the number of hospital's beds. Earlier, hospitals were, generally, larger, and had more beds. After the reform of the healthcare system, hospitals are much smaller and the number of beds was declining systematically during the period 2000-2005 (Sowa, 2007).

The analysis of changes in human resources for primary health care has shown considerable variation in the number of doctors and nurses in voivodeships. Besides, the direction of changes in the years 2009-2013, was not homogeneous, in some of the voivodeships human resources decreased, but increased in others (Table 2).

Table 2. Changes in primary care human resources in voivodeships, 2009-2013, per 10.000 of residents (based on CSIOZ data)

Voivodeship	GP_DOC (2009)	GP_DOC (2013)	2009=100	GP_NURS (2009)	GP_NURS (2013)	2009=100
Dolnośląskie	6,97	7,75	111,19	7,64	7,93	103,80
Kujawsko-Pomorskie	8,25	8,91	108,00	9,62	9,45	98,23
Lubelskie	7,22	17,33	240,03	9,76	20,77	212,81
Lubuskie	5,69	2,76	48,51	8,64	3,68	42,59
Łódzkie	9,19	10,01	108,92	9,63	10,05	104,36
Małopolskie	7,35	8,16	111,02	10,31	10,49	101,75
Mazowieckie	8,64	6,76	78,24	10,95	6,95	63,47
Opolskie	6,04	5,53	91,56	11,3	9,21	81,50
Podkarpackie	6,15	6,72	109,27	10,62	10,49	98,78
Podlaskie	6,83	7,36	107,76	9,42	9,29	98,62
Pomorskie	6,15	6,84	111,22	7,48	7,13	95,32
Śląskie	8,16	8,86	108,58	10,84	9,68	89,30
Świętokrzyskie	7,5	8,61	114,80	10,69	11,42	106,83
Warmińsko-Mazurskie	5,92	5,72	96,62	8,11	7,82	96,42
Wielkopolskie	2,21	8,61	389,59	3,44	4,53	131,69
Zachodniopomorskie	5,55	5,28	95,14	8,61	6,95	80,72

In the case of inpatient care resources an increase in the total number of physicians and nurses in almost all provinces was observed. On the other hand, the number of specialists decreased in all regions (Table 3).

Table 3. Changes in hospital resources in voivodeships, 2009-2013, per 10.000 of residents (based on CSIOZ data)

Voivodeship	DOC (2009)	DOC (2013)	2009 =100	DOC _SPEC (2009)	DOC _SPEC (2013)	2009 =100	NURS (2009)	NURS (2013)	2009 =100
Dolnośląskie	16,23	21,65	133,39	16,42	15,33	93,36	32,43	34,65	106,85
Kujawsko-Pomorskie	15,13	18,53	122,47	15,3	13,03	85,16	29,53	32,71	110,77
Lubelskie	41,41	43,67	105,46	19,61	32,96	168,08	36,74	78,33	213,20
Lubuskie	5,70	7,42	130,18	12,16	5,67	46,63	27,28	14,22	52,13
Łódzkie	21,05	25,96	123,33	20,81	18,52	89,00	34,19	36,39	106,43
Małopolskie	17,19	19,95	116,06	17,51	14	79,95	32,14	33,25	103,45
Mazowieckie	21,08	26,26	124,57	21,46	19,58	91,24	33,6	37,56	111,79
Opolskie	12,41	14,52	117,00	12,08	10,87	89,98	27,06	29,13	107,65
Podkarpackie	12,00	15,21	126,75	12,16	12,53	103,04	31,97	34,59	108,20
Podlaskie	19,96	22,97	115,08	20,05	17,41	86,83	36,32	34,74	95,65
Pomorskie	16,68	20,21	121,16	17,17	14,19	82,64	28,42	30,11	105,95

Śląskie	19,19	23,12	120,48	19,02	17,88	94,01	36,47	37,83	103,73
Świętokrzyskie	14,61	17,39	119,03	14,59	13,59	93,15	33,74	34,17	101,27
Warmińsko-Mazurskie	13,40	16,23	121,12	13,59	12,34	90,80	27,88	29,72	106,60
Wielkopolskie	16,12	13,57	84,18	16,4	9,23	56,28	30,46	30,2	99,15
Zachodniopomorskie	14,66	19,94	136,02	14,88	13,61	91,47	28,6	31,5	110,14

Distribution of medical equipment is also very patchy, but certain changes can be observed – in every voivodeship the number of medical equipment (per 10.000 population) improved (Table 4).

The number of beds requires broader analysis. During the analysed period the number of beds in some voivodeships increased, while in other – it decreased, but still some variation in the number of beds could be observed (Table 4). What is important, in some voivodeships the relative number of hospital beds grew during analysed period, and in others – dropped and it is difficult to find any pattern in these changes.

Table 4. Changes in infrastructural resources in voivodeships, 2009-2013, per 10.000 of residents (based on CSIOZ data and Main Statistics Office data)

Voivodeship	**BEDS (2009)**	**BEDS (2013)**	**2009 =100**	**ECHO (2009)**	**ECHO (2013)**	**2009 =100**	**O_ROOM (2009)**	**O_ROOM (2013)**	**2009 =100**
Dolnośląskie	48,34	50,74	104,96	0,19	0,24	126,32	0,8	2,4	300,00
Kujawsko-Pomorskie	43,68	45,55	104,28	0,27	0,31	114,81	0,8	2,6	325,00
Lubelskie	53,2	52,20	204,81	0,26	0,56	215,38	0,9	6,9	766,67
Lubuskie	43,14	40,62	47,80	0,22	0,10	45,45	0,8	1,5	187,50
Łódzkie	53,6	52,64	98,21	0,31	0,32	103,23	0,9	3,1	344,44
Małopolskie	43,62	43,60	99,95	0,25	0,30	120,00	0,8	2,4	300,00
Mazowieckie	46,17	48,00	103,96	0,25	0,28	112,00	0,8	2,3	287,50
Opolskie	43,17	45,50	105,40	0,26	0,26	100,00	0,6	2,1	350,00
Podkarpackie	46,23	47,18	102,05	0,28	0,25	89,29	0,7	2,3	328,57
Podlaskie	52,36	47,14	90,03	0,25	0,28	112,00	0,9	2,1	233,33
Pomorskie	39,8	40,07	100,68	0,28	0,3	107,14	0,7	2,7	385,71
Śląskie	57,37	56,09	97,77	0,36	0,35	97,22	0,8	2,7	337,50
Świętokrzyskie	49,7	49,66	99,92	0,27	0,28	103,70	0,8	1,6	200,00
Warmińsko-Mazurskie	42,44	42,67	100,54	0,25	0,25	100,00	0,6	2,0	333,33
Wielkopolskie	46,72	40,93	87,61	0,21	0,25	119,05	0,7	1,9	271,43
Zachodniopomorskie	46,96	47,63	101,43	0,27	0,35	129,63	0,8	2,0	250,00

During the main part of this research we estimated several econometric models, which allowed us to indicate resources that affect further lifespan to a greater extent. In order to confirm the H1 hypothesis, we tested four models, assuming, that the explanatory variable is women's life expectancy at the age of 45 and 60 years. In each model statistically irrelevant variables were removed. The determination coefficients for constructed models ranged from 83,34% to 91,37%, which meant a very good fit.

Model 1

In the first model, the dependent variable was the average LE of women 45 years of age. The model indicated that the number of primary care nurses and the diagnostic equipment (the number of echocardiograph and MMR) explained the state of health of women aged 45 years in 83,34%, whereas the other 16,66% were other factors not included in the model (Table 5 and 6).

Table 5. The estimation results – dependent variable (Yi): LEF$_{2009}$_45

Variable	Coefficient	Standard error	t-Student test	p-value
const	34,9583	0,891675	39,2052	<0,0001 ***
GP_NURS	4,41882	0,615759	7,1762	<0,0001 ***
ECHO	52,8581	27,9225	1,8930	0,0849 *
MAG_RES	2,74414	0,424455	6,4651	<0,0001 ***
* significance level α = 0.1, ** significance level α = 0.05 *** significance level α = 0.01				

Table 6. Measure of the model fitting

Average value of dependent variable	36,44938	Standard deviation of the dependent variable	0,660782
Residual sum of squares	1,091373	Final prediction error	0,314985
Coefficient of determination R-squared	0,833365	Adjusted R-squared	0,772771
F(6, 9)	13,75316	p value for test F	0,000293
Credible interval	1,221801	Akaike Information Criterion	12,44360
Schwarz'Bayes- Criterion	16,30655	Hannan-Quinn Criterion	12,64142

Test for normality of residuals –
Null hypothesis: the random component has a normal distribution.
The test statistics: Chi-square (2) = 4,69575, p-value = 0,0955718.

Model 2
In Model 2, the dependent variable is the average LE for women aged 60, in 2009 (LEF$_{2009}$_60). The model 2, indicates that the state of health of women, at the age of 60, is explained in 89,51% by six variables– the number of primary care nurses, the number of hospital beds, the number of operating rooms and the number of diagnostic equipment (echocardiographs, PETs, MRIs), and the remaining 10,49% are other factors not included in the model (Table 7 and 8).

Results show, that non-financial resources affect women's health, and the observed impact of such resources as hospital beds, PET or the number operating rooms, increases with age.

Table 7. The estimation results – dependent variable (Y_i): LEF$_{2009}$_60

Variable	Coefficient	Standard error	t-Student test	p-value
const	20,9127	0,724026	28,8840	<0,0001 ***
GP_NURS	3,18556	0,395676	8,0509	<0,0001 ***
BEDS	2,25327	0,296709	7,5942	<0,0001 ***
ECHO	62,1487	19,1527	3,2449	0,0101 **
PET	271,524	147,928	1,8355	0,0996 *
MAG_RES	556,309	91,5339	6,0776	0,0002 ***
O_ROOM	26,122	9,65624	2,7052	0,0242 **
* significance level α = 0.1, ** significance level α = 0.05 *** significance level α = 0.01				

Table 8. Measure of the model fitting

Average value of dependent variable	23,17938	*Standard deviation of the dependent variable*	0,483494
Residual sum of squares	0,367994	Final prediction error	0,202208
Coefficient of determination R-squared	0,895053	*Adjusted R-squared*	0,825089
F(6, 9)	12,79299	p value for test F	0,000587
Credible interval	7,475192	Akaike Information Criterion	0,950384
Schwarz'Bayes- Criterion	4,457737	Hannan-Quinn Criterion	0,673444

Test for normality of residuals –
Null hypothesis: the random component has a normal distribution.
The test's statistics: Chi-square (2) = 0,252594, p-value = 0,881353.

Model 3

In Model 3, the dependent variable is the average LE for women aged 45, in 2013 (LEF_{2013}_45). The coefficient of determination, R2 of approximately 93,40%, shows, that the model explain women's health state using the seven variables -human resources: the number of primary care doctors and nurses in hospitals and primary health care, the number of medical specialists in hospitals, and infrastructure: the number of beds and operating rooms in hospitals and the number of CTs. The remaining 6.6% of volatility must be explained by others factors not included in the model (Table 9 and 10).

Table 9. The estimation's results – dependent variable(Y_i): LEF_{2013}_45

Variable	Coefficient	Standard error	t-Student test	p-value
const	36,2939	0,215671	168,2838	<0,0001***
GP_DOC	2,52329	0,561547	4,4935	0,0020***
NURSE	1,74942	0,418721	4,1780	0,0031***
DOC_SPEC	0,96619	0,380887	2,5367	0,0349**
GP_NURS	4,3818	0,570284	7,6835	<0,0001***
BEDS	1,98677	0,261035	7,6111	<0,0001***
CTG	161,129	56,0374	2,8754	0,0207**
O_ROOM	4,59701	1,44985	3,1707	0,0132**
* significance level α = 0.1, ** significance level α = 0.05 *** significance level α = 0.01				

Table 10. Measure of the model' fitting

Average value of dependent variable	**37,20313**	***Standard deviation of the dependent variable***	**0,671364**
Residual sum of squares	0,445958	Final prediction error	0,236103
Coefficient of determination R-squared	0,934039	*Adjusted R-squared*	0,876323
F (6, 9)	16,18343	p value for test F	0,000388
Credible interval	5,937941	Akaike Information Criterion	4,124119
Schwarz'Bayes- Criterion	10,30483	Hannan-Quinn Criterion	4,440622

Test for normality of residuals –
Null hypothesis: the random component has a normal distribution.
The test statistics: Chi-square (2) = 1,35256, p-value = 0,508505.

Model 4

In Model 4 the explanatory variable is the average LE of women aged 60, in 2013 (LEF_{2013}_60). The determination coefficient (R^2) shows, that the model explains 89.68% of volatility, using six explanatory variables – the number of primary care doctors and nurses, the number of hospital's nurses, the number of hospital beds, CTs and operating rooms). The other 6.6% are other factors not included in the model (Table 11 and 12).

Table 11. The estimation's results – dependent variable(Y_i): LEF_{2013}_60

Variable	Coefficient	Standard error	t-Student test	p-value
const	23,1886	0,186931	124,0488	<0,0001***
GP_DOC	1,72431	0,476583	3,6181	0,0056***
NURSE	1,37061	0,360472	3,8023	0,0042***
GP_NURS	2,74045	0,380582	7,2007	<0,0001***
BEDS	1,48233	0,225272	6,5802	0,0001***
CTG	81,8991	42,5386	1,9253	0,0863*
O_ROOM	3,1067	1,25902	2,4676	0,0357**
* significance level α = 0.1, ** significance level α = 0.05 *** significance level α = 0.01				

Table 12. Measure of the model' fitting

Average value of dependent variable	**23,75688**	***Standard deviation of the dependent variable***	**0,501899**
Residual sum of squares	0,390070	Final prediction error	0,208185
Coefficient of determination R-squared	0,896767	*Adjusted R-squared*	0,827945
F (6, 9)	13,03025p	p value for test F	0,000547

Credible interval	7,009124	Akaike Information Criterion	0,018247
Schwarz'Bayes- Criterion	5,389874	Hannan-Quinn Criterion	0,258693

Test for normality of residuals –
Null hypothesis: the random component has a normal distribution.
The test's statistics: Chi-square (2) = 3,51251, p-value = 0,17269.

The results of this study indicate, that there is a statistically significant relationship between non-financial resources of the health system and health indicators for the female population. Basing on the models 1 and 2 we can conclude that, from the point of view of LE, the availability of diagnostic equipment (echocardiograph and MRI) is crucial, and so is the density of primary care nurses. With increasing age acquisition of hospital service resources plays also an important role - the number of hospital beds and operating rooms. Models 3 and 4 suggest a stronger connection between human resources (primary care's doctors and nurses), the number of hospital beds and operating rooms and diagnostic equipment (CT) and the LE for women aged 45 and 60. In any case, this relationship is statistically significant at the level of $\alpha = 0.01$. All models have confirmed the relationship between the distribution of resources and the life expectancy for women, which allows the adoption of the H1 hypothesis, although the results do not provide any consistent interpretation.

In the second stage of the study we tried to determine the differences in LE, generated by the distribution of resources. The results of the estimation, carried out with the use of the WLS method for cross-sectional data for women at the age of 60, in the period of 2009-2013, show, that women in Kujawsko-Pomorskie voivodeship, live about 0.59 year shorter than, on average, women in the other voivodeships with the same resources. On the other hand, in Podkarpackie voivodeship, women live 0.85 year longer than in the other provinces. The typical voivodeships, characterised by equal levels of employed resources are Dolnośląskie, Lubelskie Lubuskie, Małopolskie, Opolskie, Warmińsko-Mazurskie and Wielkopolskie voivodeships (Table 13). Those results have allowed us to confirm the H2 hypothesis, concerning unequal distribution of non-financial resources.

Table 13. WLS estimation, using 80 observations – dependent variable (Y_i): LEF_60

Variable	Coefficient	Standard error	t-Student test	p-value
const	23,2615	0,106242	218,9495	<0,0001***
NURSE	0,655653	0,0956168	6,8571	<0,0001***
GP_DOC	1,14738	0,111383	10,3011	<0,0001***
BEDS	- 0,650915	0,0412007	- 15,7986	<0,0001***
ECHO	18,6974	5,24264	3,5664	0,0007***
CTG	32,515	13,776	2,3603	0,0213***
MAG_RES	- 26,5585	11,9746	- 2,2179	0,0301***
Kujawsko-Pomorskie	- 0,595936	0,0665969	- 8,9484	<0,0001***
Łódzkie	- 1,0929	0,0563057	- 19,4101	<0,0001***
Mazowieckie	- 0,371348	0,092903	- 3,9972	0,0002***
Podkarpackie	0,846137	0,115684	7,3142	<0,0001***
Podlaskie	0,740503	0,123581	5,9921	<0,0001***
Podlaskie	- 0,590817	0,0862879	- 6,8470	<0,0001***
Pomorskie	- 0,701863	0,0936243	- 7,4966	<0,0001***
Śląskie	0,515053	0,0690193	7,4624	<0,0001***
Wielkopolskie	- 0,214381	0,0614423	- 3,4891	0,0009***

* significance level $\alpha = 0.1$, ** significance level $\alpha = 0.05$ *** significance level $\alpha = 0.01$

Table 14. Basic statistics for weighted data

Residual sum of squares	23,75688	Final prediction error	1,101880
Coefficient of determination R-squared	0,390070	*Adjusted R-squared*	0,945279
F (15, 64)	0,896767	p value for test F	2,46e-37
Credible interval	13,03025p	Akaike Information Criterion	256,7015
Schwarz'Bayes- Criterion	7,009124	Hannan-Quinn Criterion	271,9818

Table 15. Basic statistic for non-weighted data

Average value of dependent variable	23,75688	Final prediction error	1,101880
Residual sum of squares	0,390070	*Adjusted R-squared*	0,945279

Test for normality of residuals –
Null hypothesis: the random component has a normal distribution.
The test's statistic: Chi-square (2) = 0,244947, p-value = 0,884729

Results have proved a statistically significant (at the level of α= 0.01) positive relationship between the number of primary care's doctors and nurses and LE for women aged 60. Similarly, a positive correlation can be observed between the number of diagnostic equipment and LE. The results indicate the importance of primary care resources, including diagnostics, from the point of view of population's health indicators.

All these considerations relate to the impact of the level of health care resources on the population's health in the region. Using the same amount of the non-financial health resources, women aged 60, on average, live longer or shorter depending on the voivodeship.

The research has confirmed, partly, the relationships, indicated in the literature, between the number or density of doctors and mortality rates and life expectancies (Ricketts & Holmes, 2011; Horev, Pesis-Katz & Mukamel, 2004; Chen et al., 2004). Also the study carried out by Anand and Bärnighausen (2004) proved, that the cross-country results strongly confirmed the importance of human resources for health in affecting health outcomes in attaining health-system goals. Starfield et al. (2005) showed, that an increase of one primary care physician per 10,000 population was associated with a 6 percent decrease in all-cause mortality. For total mortality, an increase of one primary care physician per 10,000 population was associated with a reduction of 34.6 deaths per 100,000 population at the state level (Starfield et al., 2005).

A broader analysis, however, require the negative relationship between number of hospital beds and LE. A simplified interpretation could lead to the false conclusion that reducing of the number of beds in hospitals would lead to an improvement of population's health status. Such results are the result of the processes, which have taken place in Polish health care system – in recent years, the number of hospital beds has decreased, accompanied by a systematic extension of LE. The analysis of this relationship requires, definitely, further research, due to the importance of the intensity of use of the beds, expressed by the number of benefits per one bed or the average length of hospitalization.

Conclusions

We have verified two research hypotheses. The results of these empirical studies indicate, that there is a significant relationship between non-financial health resources and health of women at the age of 45 and 60. Basing on estimated models, we can conclude that the benefits that have the strongest impact on the state of health are: the number of primary care doctors, the number of nurses in hospitals and primary health care, and infrastructure, especially the number of beds and diagnostic equipment. On the other hand, it is difficult to conclude, that the inequality in the distribution of resources between regions generate health inequalities.

This research is a part of the global assessment of the allocative efficiency of non-financial resources of Polish health care system. The next step will aim to build an econometric model estimate using panel data from the years 2009-2013 that will provide an improvement of results, in several following ways, such as - an increase in the number of degrees of freedom and a reduction of the problem of collinear constraints data, facilitation of identification of econometric model parameters and selection of competing economic assumptions, allowableness of elimination or reduction of the burden on estimators, provision of basics evidence in micro analysis carried out on the basis of aggregated data.

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