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Comparison of Selected European Countries in Terms of the Number of In-patient Days per Inhabitant

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Abstract

The aim of the paper is to determine the influence of particular factors on the diversity of European countries in terms of the number of hospital bed-days per one inhabitant. Two factors affecting the discussed variable have been analysed in the paper: the in-patient average length of stay and the proportion of the number of in-patients to the population size of a given country. To assess the impacts of these factors on the deviation of the variable considered, the logarithmic method was used. The causal analysis allowed to answer the question, how in the selected European countries the analysed factors affect the dependent variable, namely, what the directions and strengths of their impacts are. The values referring to Poland were compared with the results obtained for each of the examined countries and final conclusions were drawn on those grounds.

Key words: *number of hospital bed-days, in-patient average length of stay, frequency of hospitalisation.*

Introduction

Better health means a fuller use of the potential accumulated in human capital. However, it should be strongly emphasised that healthy life benefits not only a given person, but also translates into better functioning of the entire society. Moreover, the positive impact of health is multidimensional [1]. Good health gives a chance for greater professional and non-professional activity, which facilitates life self-fulfilment. Good health also enhances the sense of security and makes it possible to undertake actions aimed at improving the material conditions of one's existence. In contrast, disease is related to losses and these are losses not only in the individual dimension, but also in the general economic and social dimension. The increase in the number of sick citizens means a decrease in productivity in the economy of a given country, with a simultaneous increase in the burden on the state budget. Thus, health is undoubtedly one of the key determinants of economic growth and development [2].

Research confirms that those countries that spend more on health are more effective in treating most diseases and therefore have a healthier society. It is also worth adding that a clear correlation has been proven between the amount of healthcare expenditure in a given country and the average healthy life expectancy of inhabitants [3]. This means that expenditure on healthcare should be perceived not as a cost, but as an investment in human capital, which returns in the form of greater productivity and activity of citizens. Healthy citizens are not only able to work more efficiently, but also enjoy opportunities to participate more extensively in cultural and social life.

In European countries, a clear tendency to allocate increasing amounts to healthcare can be observed. Undoubtedly, this is a consequence of the ongoing demographic processes (mainly related to the aging society), changes in the degree of advancement of medical procedures implemented, and faster and faster progress in the field of technologies applied. Obviously, the appearance of new, improved therapeutic products and technical means in medicine ensures more effective treatment of

known diseases, as well as enables to fight diseases previously considered very difficult or impossible to cure. At the same time, it entails the necessity of incurring constantly increasing expenses on healthcare sector, as a result of which growing public spending on healthcare is becoming an important problem of modern economies [3].

Based on the available data, it can be seen that European countries vary greatly in terms of the amount of expenditure on healthcare *per capita*, and this is due to significant differences in the level of economic development between these countries [4]. Higher amounts on healthcare are allocated by those which can simply afford it (that is, those with higher GDP *per capita*).

There are various institutional solutions for the healthcare system in European countries. The structure of financing from public and private sources is also diverse [5]. The diversity is the result of many different factors, including historical determinants, ideological considerations and economic conditions of individual societies [6]. Regardless of the system solutions used, the main objectives of the health service always include the provision of high-quality health services with ensuring their comprehensiveness, continuity and the widest possible availability [7].

As a consequence of the high dynamics of health expenditure growth observed in Europe, the issue of not only effectiveness, but also efficiency of service delivery is increasingly being raised. An action is effective when it allows to obtain a positive health effect. But, in order to answer the question whether such action is efficient, this effect has to be confronted with the quantity of material, labour and financial inputs consumed [8]. However, measuring efficiency in the healthcare sector is quite a challenging task, as the achieved results in the form of a healthier population are at least difficult to quantify. While it is possible to precisely calculate the expenses incurred, presenting the whole bundle of effects in monetary units is a truly complicated task. Nevertheless, this does not undermine the necessity to make efforts to seek the best possible allocations for state funds assigned to health purposes of the society and to undertake actions aimed at identifying hidden

reserves. It seems that constant improvement of management and streamlining processes carried out in healthcare entities is the best way to boost their efficiency. Hence, no matter how much the measurement of efficiency in healthcare is a problematic issue, there is a real need to develop such methods and select such measures that would facilitate analyses and assessments. Continuous and comprehensive control of processes is the basis for their proper selection and enables appropriate changes to be made to optimise the methods and techniques applied. Evaluation of processes is also a good tool to increase transparency and strengthen the sense of responsibility not only for the results achieved, but also for the inputs consumed.

The most important position in the healthcare system – both in respect of sums of money involved and the functions performed – is occupied by stationary treatment. It includes various types of healthcare institutions whose task is to provide services related to the treatment and organisation of 24-hour care for patients [9]. Hospitals play a key role among these establishments. A medical facility may be considered a hospital if it is characterised by a constant readiness to admit and accommodate patients, provides the patients staying there with round-the-clock, comprehensive and qualified medical care consisting of observation, diagnosis, nursing and treatment [10]. Hospital treatment is very expensive and, in most countries, it absorbs a significant and growing part of funds allocated for meeting the health needs of the society [11].

It can be noticed that European countries vary greatly in terms of the annual number of in-patient days *per capita*. Thus, the question is: what is the reason? Is it because the in-patient average length of stay varies greatly in these countries? Or is it because, in some countries, inhabitants are hospitalised much more often, and in some countries much less often? Or maybe it results from both of those factors? If so, then another question arises: what is the weight of each of the aforementioned factors? Consequently, the determination of impacts of individual factors on the diversity of European countries with regard to the number of in-patient days *per capita* has become the aim of the research carried out in the

further part of this article. As stated earlier, the study covered two factors shaping the value of the dependent variable, namely the in-patient average[1] length of stay and the proportion of the number of in-patients to the population size of a given country. The results for Poland were compared with those obtained for eighteen selected European countries, and on this basis, final conclusions were drawn.

The difference between the value of the measure under consideration for a given country and the value of this measure for Poland was defined as a deviation for the purposes of this study. Such a deviation may be positive or negative. Therefore, wherever in this article a deviation is mentioned, it should be understood as a positive or negative deviation from the value characteristic for Poland. The structure of the deviation can be known thanks to the causal analysis. In this paper the logarithmic method was proposed as the most attractive method of the causal analysis.

Material and methods

In order to build an appropriate ratio equality, it was assumed that the examined variable α could be presented as a product of factors β and γ. The value of variable α for Poland is the reference basis and has been denoted as α_{PL}. In turn, the value of this variable calculated for the i-th country (i = 1, ..., 18) is marked by α_i. The ratio $w_{i;\alpha}$ – constructed for variable

$$\alpha - \text{is } \frac{\alpha_i}{\alpha_{\text{PL}}}.$$

Since $\alpha_i = \beta_i \gamma_i$ and $\alpha_{PL} = \beta_{PL}\gamma_{PL}$ dividing α_i by α_{PL}, one can get:

$$\frac{\alpha_i}{\alpha_{\text{PL}}} = \frac{\beta_i \gamma_i}{\beta_{\text{PL}}\gamma_{\text{PL}}}, \qquad (1)$$

[1] The average used in this article is the arithmetic mean.

where:
$\alpha_i, \beta_i, \gamma_i$ – the values of variables α, β and γ referring to the i-th country;
$\alpha_{PL}, \beta_{PL}, \gamma_{PL}$ – the values of variables α, β and γ referring to Poland.

The same can be written differently, namely:

$$\frac{\alpha_i}{\alpha_{PL}} = \frac{\beta_i}{\beta_{PL}} \cdot \frac{\gamma_i}{\gamma_{PL}}, \quad (2)$$

or:

$$w_{i;\alpha} = w_{i;\beta} \cdot w_{i;\gamma}, \quad (3)$$

where $w_{i;\alpha} = \frac{\alpha_i}{\alpha_{PL}}$, $w_{i;\beta} = \frac{\beta_i}{\beta_{PL}}$, $w_{i;\gamma} = \frac{\gamma_i}{\gamma_{PL}}$.

Thus, if a variable α is the product of variables β and γ affecting the discussed variable α, the ratio computed for α is the product of ratios computed for factors β and γ.

From a mathematical point of view, logarithms with any base can be taken of both sides of an equation, provided that the numbers that the logarithms have been taken of are positive. The values of ratios $w_{i;\alpha}$, $w_{i;\beta}$ and $w_{i;\gamma}$ are always greater than zero, hence the logarithms can be taken of both sides of the equation (3). Obviously, the base of the logarithm must be > 0 and ≠ 1. The choice of the base, however, has no bearing on the final results of the causal analysis, but only on its partial results. The logarithm with base 10 (i.e. the common logarithm) will be used in further computations.

Taking the logarithms of both sides of the equation (3), the following expression can be obtained:

$$\log (w_{i;\alpha}) = \log (w_{i;\beta} \cdot w_{i;\gamma}) \quad (4)$$

Then, using the logarithm property stipulating that the logarithm of a product of two numbers is equal to the sum of the logarithms of these numbers, the equation presented below can be derived:

$$\log (w_{i;\alpha}) = \log (w_{i;\beta}) + \log (w_{i;\gamma}) \quad (5)$$

The next step is to divide both sides of this equation by the term . This results in the expression:

$$1 = \frac{\log(w_{i;\beta})}{\log(w_{i;\alpha})} + \frac{\log(w_{i;\gamma})}{\log(w_{i;\alpha})}, \quad (6)$$

where:

$\frac{\log(w_{i;\beta})}{\log(w_{i;\alpha})}$ – the impact of factor β on the deviation of variable α,

$\frac{\log(w_{i;\gamma})}{\log(w_{i;\alpha})}$ – the impact of factor γ on the deviation of variable α.

The final step is to multiply both sides of the equation (6) by the deviation calculated for variable α. The result is:

$$\alpha_i - \alpha_{\mathrm{PL}} = (\alpha_i - \alpha_{\mathrm{PL}}) \cdot \frac{\log(w_{i;\beta})}{\log(w_{i;\alpha})} + (\alpha_i - \alpha_{\mathrm{PL}}) \cdot \frac{\log(w_{i;\gamma})}{\log(w_{i;\alpha})}, \quad (7)$$

where:

$(\alpha_i - \alpha_{\mathrm{PL}}) \cdot \frac{\log(w_{i;\beta})}{\log(w_{i;\alpha})}$ – the deviation of variable α caused by factor β;

$(\alpha_i - \alpha_{\mathrm{PL}}) \cdot \frac{\log(w_{i;\gamma})}{\log(w_{i;\alpha})}$ – the deviation of variable α caused by factor γ.

In this paper, the causal analysis has been used to answer the question of what are – in eighteen European countries – the impacts of individual factors on the deviation of the annual number of hospital bed-days per inhabitant from the value characteristic for Poland. It was assumed that variable α is the number of hospital bed-days per inhabitant, variable β –

the in-patient average length of stay, and variable y – the proportion of the number of in-patients to the population size. The analysis was based on the data for 2018 collected in Table 1.

Table 1. In-patients, hospital bed-days and the population size in selected European countries

Country	In-patients (total in 2018)	Hospital bed-days (total in 2018)	Population size (average in 2018)
Symbols	P	D	L
France	12,424,193	109,344,157	66,965,912
Italy	6,896,911	54,568,449	60,421,760
Poland	**6,570,185**	**46,230,794**	**37,974,750**
Spain	4,899,954	40,563,057	46,797,754
Romania	4,113,449	29,845,498	19,472,545
Bulgaria	2,401,759	12,552,904	7,025,037
Czechia	2,082,385	19,503,165	10,629,928
Belgium	1,923,554	11,847,879	11,427,054
Hungary	1,882,253	18,127,868	9,775,564
Netherlands	1,546,635	6,923,765	17,231,624
Switzerland	1,443,857	11,781,040	8,514,329
Sweden	1,411,756	7,937,132	10,175,214
Slovakia	1,040,010	7,435,175	5,446,771
Finland	891,384	6,870,543	5,515,525
Norway	868,436	4,650,800	5,311,916
Croatia	661,745	5,723,162	4,090,870
Slovenia	362,834	2,538,839	2,073,894
Cyprus	69,435	421,970	870,068
Liechtenstein	1,566	7,699	38,246

Source: own compilation based on the Eurostat database [16].

Analysis of the ratio constructed for the average number of hospital bed-days

The first task to be performed is to assess the number of in-patient days *per capita* in each of the eighteen countries considered against the value of this measure in Poland.

Ratio $w_{i;\beta}$ was constructed by dividing the value computed for the i-th country by the value referring to Poland. Table 2 contains results of the relevant calculations.

Table 2. Ratios referring to the average number of hospital bed-days

Country	Number of in-patient days per inhabitant	Ratio based on the values of variable α	Country	Number of in-patient days per inhabitant	Ratio based on the values of variable α
Symbols	$\alpha = \frac{D}{L}$	$w_{i;\alpha} = \frac{\alpha_i}{\alpha_{PL}}$	Slovenia	$122.4 \cdot 10^{-2}$	1.006
Hungary	$185.4 \cdot 10^{-2}$	1.523	**Poland**	$\mathbf{121.7 \cdot 10^{-2}}$	**1.000**
Czechia	$183.5 \cdot 10^{-2}$	1.507	Belgium	$103.7 \cdot 10^{-2}$	0.852
Bulgaria	$178.7 \cdot 10^{-2}$	1.468	Italy	$90.3 \cdot 10^{-2}$	0.742
France	$163.3 \cdot 10^{-2}$	1.341	Norway	$87.6 \cdot 10^{-2}$	0.719
Romania	$153.3 \cdot 10^{-2}$	1.259	Spain	$86.7 \cdot 10^{-2}$	0.712
Croatia	$139.9 \cdot 10^{-2}$	1.149	Sweden	$78.0 \cdot 10^{-2}$	0.641
Switzerland	$138.4 \cdot 10^{-2}$	1.137	Cyprus	$48.5 \cdot 10^{-2}$	0.398
Slovakia	$136.5 \cdot 10^{-2}$	1.121	Netherlands	$40.2 \cdot 10^{-2}$	0.330
Finland	$124.6 \cdot 10^{-2}$	1.023	Liechtenstein	$20.1 \cdot 10^{-2}$	0.165

Source: own calculations based on Table 1.

Table 3. Ratios referring to the in-patient average length of stay

Country	In-patient average length of stay	Ratio based on the values of variable β	Country	In-patient average length of stay	Ratio based on the values of variable β
Symbols	$\beta = \frac{D}{P}$	$w_{i;\beta} = \frac{\beta_i}{\beta_{PL}}$	Slovakia	7.15	1.016
Hungary	9.63	1.369	**Poland**	**7.04**	**1.000**
Czechia	9.37	1.331	Slovenia	7.00	0.994
France	8.80	1.251	Belgium	6.16	0.875
Croatia	8.65	1.229	Cyprus	6.08	0.864
Spain	8.28	1.176	Sweden	5.62	0.799
Switzerland	8.16	1.160	Norway	5.36	0.761
Italy	7.91	1.124	Bulgaria	5.23	0.743
Finland	7.71	1.095	Liechtenstein	4.92	0.699
Romania	7.26	1.031	Netherlands	4.48	0.636

Source: own calculations based on Table 1.

The highest number of hospital bed-days in relation to the population size was recorded in Hungary – in this country in 2018 the number of in-patient days *per capita* was over 1.5 times higher than the analogous value calculated for Poland. In turn, the lowest number of in-patient days per inhabitant was registered in Liechtenstein – the average number of hospital bed-days in this country was only 16.5% of the quantity relating to Poland.

Analysis of the ratio constructed for the in-patient average length of stay

The second task is to evaluate the in-patient average length of stay in each of the countries considered in relation to the value calculated for Poland.

Ratio $w_{i;\beta}$ was constructed by dividing the value β_i computed for the i-th country by the value β_{PL} referring to Poland. The obtained results are presented in Table 3.

In 2018, the longest in-patient stays were recorded in Hungary – in this country the average length of stay in a hospital was nearly 137% of the average length of stay in a hospital in Poland. The shortest in-patient stays were noted in the Netherlands – in 2018 in this region, the discussed quantity was 36.4% lower than in Poland.

Analysis of the ratio constructed for the frequency of hospitalisation

The third task is to compare all the countries with regard to the frequencies of hospitalisation.

Ratio $w_{i;\beta}$ was constructed by dividing the value computed for the i-th country by the value referring to Poland. The results of the calculations are collected in Table 4.

Table 4. Ratios referring to the frequency of hospitalisation

Country	Quotient of in-patients and citizens	Ratio based on the values of variable γ	Country	Quotient of in-patients and citizens	Ratio based on the values of variable γ
Symbols	$\gamma = \frac{P}{L}$	$w_{i;\gamma} = \frac{\gamma_i}{\gamma_{PL}}$	Belgium	$16.8 \cdot 10^{-2}$	0.973
Bulgaria	$34.2 \cdot 10^{-2}$	1.976	Norway	$16.3 \cdot 10^{-2}$	0.945
Romania	$21.1 \cdot 10^{-2}$	1.221	Croatia	$16.2 \cdot 10^{-2}$	0.935
Czechia	$19.6 \cdot 10^{-2}$	1.132	Finland	$16.2 \cdot 10^{-2}$	0.934
Hungary	$19.3 \cdot 10^{-2}$	1.113	Sweden	$13.9 \cdot 10^{-2}$	0.802
Slovakia	$19.1 \cdot 10^{-2}$	1.104	Italy	$11.4 \cdot 10^{-2}$	0.660
France	$18.6 \cdot 10^{-2}$	1.072	Spain	$10.5 \cdot 10^{-2}$	0.605
Slovenia	$17.5 \cdot 10^{-2}$	1.011	Netherlands	$9.0 \cdot 10^{-2}$	0.519
Poland	$\mathbf{17.3 \cdot 10^{-2}}$	**1.000**	Cyprus	$8.0 \cdot 10^{-2}$	0.461
Switzerland	$17.0 \cdot 10^{-2}$	0.980	Liechtenstein	$4.1 \cdot 10^{-2}$	0.237

Source: own calculations based on Table 1.

The highest proportion of the number of in-patients to the number of inhabitants was registered in Bulgaria – in the year examined the frequency of hospitalisation in Bulgaria was 97.6% higher than in Poland. In turn, Liechtenstein had the lowest number of in-patients in relation to the population size – in Liechtenstein the considered quotient was less than 1/4 of the value relevant to Poland.

Determination of impacts of the factors covered by the study

The last task to be carried out is to determine the influences of the two factors considered on the deviation of the number of hospital bed-days *per capita* in each of the European countries analysed from the level specified for Poland.

It was established in this paper that the number of hospital bed-days per inhabitant may be presented as a product, where the first multiplier is the in-patient average length of stay, and the second multiplier is the quotient of the number of in-patients and the number of inhabitants. The aforementioned relationship is as follows:

$$\frac{D}{L} = \frac{D}{P} \cdot \frac{P}{L}. \tag{8}$$

The ratio equality (3) was derived from this relationship.

Table 5 presents the values of ratios calculated for the eighteen studied countries. In the upper right corner of Table 5 are located those countries for which the ratios $w_{i;\beta}$ and $w_{i;\gamma}$ have values greater than 1. In the lower right corner of Table 5 are placed those countries for which the ratios $w_{i;\beta}$ have values greater than 1, but the ratios $w_{i;\gamma}$ – less than 1. In the upper left corner of Table 5 are put those countries for which the ratios $w_{i;\beta}$ have values less than 1, but the ratios $w_{i;\gamma}$ – greater than 1. And finally, in the lower left corner of Table 5 one can find those countries for which both ratios have values lower than 1.

Table 5. Ratio equalities derived

Higher frequency of hospitalisation	Bulgaria:	**1.468** = 0.743 · 1.976	Hungary:	**1.523** = 1.369 · 1.113
	Slovenia:	**1.006** = 0.994 · 1.011	Czechia:	**1.507** = 1.331 · 1.132
			France:	**1.341** = 1.251 · 1.072
			Romania:	**1.259** = 1.031 · 1.221
			Slovakia:	**1.121** = 1.016 · 1.104
	Poland			
	1.000 = 1.000 · 1.000			
Lower frequency of hospitalisation	Belgium:	0.852 = 0.875 · 0.973		
	Norway:	0.719 = 0.761 · 0.945	Croatia:	**1.149** = 1.229 · 0.935
	Sweden:	0.641 = 0.799 · 0.802	Switzerland:	**1.137** = 1.160 · 0.980
	Cyprus:	0.398 = 0.864 · 0.461	Finland:	**1.023** = 1.095 · 0.934
	Netherlands:	0.330 = 0.636 · 0.519	Italy:	0.742 = 1.124 · 0.660
	Liechtenstein:	0.165 = 0.699 · 0.237	Spain:	0.712 = 1.176 · 0.605
	← **Shorter** stays of patients in hospitals		**Longer** stays of patients in hospitals →	

Source: own compilation based on Tables 2, 3 and 4.

In the next stage of the research, further steps of the logarithmic method were performed. Thanks to the method, it was possible to find out to what extent the deviation of the dependent variable can be explained by the influence of the first factor and to what extent by the second factor. The impacts and related effects are shown in Table 6.

As an example, the values obtained for Hungary will be interpreted. In 2018, the number of hospital bed-days *per capita* in Hungary was 52.3% higher than in Poland. In Hungary, it was 185.4 days of hospitalisation per 100 inhabitants, while in Poland it was 121.7 in-patient days per 100 inhabitants (i.e. the difference amounted to 63.7 days for every 100 inhabitants). This difference in 74.6 p.p. was due to the fact that Hungarians were discharged from hospitals after – on average – 9.63 days after admissions, and Poles – after 7.04 days (thus, in Hungary the average stay was 36.9% longer than in Poland). In the remaining 25.4 p.p., the difference of 63.7 days can be explained by relatively more frequent hospitalisation of patients in Hungary than in Poland (11.3% more frequent). In 2018 in Hungary, the proportion of the number of hospitalisa-

tions to the number of inhabitants was equal to 1/5, while in Poland this proportion mentioned was approximately 1/6. Had a Hungarian been hospitalised as rarely as a Pole, the number of hospital bed-days per one Hungarian would have been higher than the corresponding number in Poland by only 47.5 days for every 100 inhabitants, and this deviation could have been attributed solely to the fact that sick Hungarians stay in hospitals longer than sick Poles. If, however, the in-patient average length of stay of Hungarians had been the same as the in-patient average length of stay of Poles, the number of hospital bed-days per one inhabitant in Hungary would have been higher than in Poland by 16.2 days for every 100 inhabitants, and this would have been caused by the fact that a Hungarian is hospitalised more often than a Pole.

Table 6. Weights that may be assigned to the causes of the deviations identified

Country	Deviation in the number of in-patient days per inhabitant	because of:		Weight of the in-patient average length of stay	Weight of the frequency of hospitalisation
		longer / shorter stays of patients in hospitals	higher / lower frequencies of hospitalisation		
Symbols	$\alpha_i - \alpha_{\mathrm{PL}}$			$\frac{\log(w_{i;\beta})}{\log(w_{i;\alpha})}$	$\frac{\log(w_{i;\gamma})}{\log(w_{i;\alpha})}$
Hungary	$63.7 \cdot 10^{-2}$	$47.5 \cdot 10^{-2}$	$16.2 \cdot 10^{-2}$	74.6 p.p.	25.4 p.p.
Czechia	$61.7 \cdot 10^{-2}$	$43.0 \cdot 10^{-2}$	$18.7 \cdot 10^{-2}$	69.7 p.p.	30.3 p.p.
Bulgaria	$56.9 \cdot 10^{-2}$	$-44.1 \cdot 10^{-2}$	$101.1 \cdot 10^{-2}$	−77.5 p.p.	177.5 p.p.
France	$41.5 \cdot 10^{-2}$	$31.7 \cdot 10^{-2}$	$9.9 \cdot 10^{-2}$	76.2 p.p.	23.8 p.p.
Romania	$31.5 \cdot 10^{-2}$	$4.2 \cdot 10^{-2}$	$27.3 \cdot 10^{-2}$	13.3 p.p.	86.7 p.p.
Croatia	$18.2 \cdot 10^{-2}$	$26.9 \cdot 10^{-2}$	$-8.8 \cdot 10^{-2}$	148.4 p.p.	−48.4 p.p.
Switzerland	$16.6 \cdot 10^{-2}$	$19.2 \cdot 10^{-2}$	$-2.6 \cdot 10^{-2}$	115.7 p.p.	−15.7 p.p.
Slovakia	$14.8 \cdot 10^{-2}$	$2.0 \cdot 10^{-2}$	$12.7 \cdot 10^{-2}$	13.9 p.p.	86.1 p.p.
Finland	$2.8 \cdot 10^{-2}$	$11.2 \cdot 10^{-2}$	$-8.4 \cdot 10^{-2}$	397.0 p.p.	−297.0 p.p.
Slovenia	$0.7 \cdot 10^{-2}$	$-0.7 \cdot 10^{-2}$	$1.4 \cdot 10^{-2}$	−100.6 p.p.	200.6 p.p.
Belgium	$-18.1 \cdot 10^{-2}$	$-15.0 \cdot 10^{-2}$	$-3.1 \cdot 10^{-2}$	82.9 p.p.	17.1 p.p.
Italy	$-31.4 \cdot 10^{-2}$	$12.3 \cdot 10^{-2}$	$-43.8 \cdot 10^{-2}$	−39.3 p.p.	139.3 p.p.
Norway	$-34.2 \cdot 10^{-2}$	$-28.3 \cdot 10^{-2}$	$-5.9 \cdot 10^{-2}$	82.8 p.p.	17.2 p.p.
Spain	$-35.1 \cdot 10^{-2}$	$16.8 \cdot 10^{-2}$	$-51.8 \cdot 10^{-2}$	−47.8 p.p.	147.8 p.p.
Sweden	$-43.7 \cdot 10^{-2}$	$-22.0 \cdot 10^{-2}$	$-21.7 \cdot 10^{-2}$	50.4 p.p.	49.6 p.p.
Cyprus	$-73.2 \cdot 10^{-2}$	$-11.7 \cdot 10^{-2}$	$-61.6 \cdot 10^{-2}$	15.9 p.p.	84.1 p.p.
Netherlands	$-81.6 \cdot 10^{-2}$	$-33.3 \cdot 10^{-2}$	$-48.3 \cdot 10^{-2}$	40.8 p.p.	59.2 p.p.
Liechtenstein	$-101.6 \cdot 10^{-2}$	$-20.2 \cdot 10^{-2}$	$-81.4 \cdot 10^{-2}$	19.9 p.p.	80.1 p.p.

Source: own calculations based on Tables 2 and 5.

Discussion

On the one hand, the governments of European countries strive to achieve the fullest possible implementation of social goals, and one of such goals is undoubtedly concern for the health of citizens. On the other hand, they want to achieve and maintain a budget balance. Therefore, simultaneously with satisfying social needs by providing more and more effective health services of higher and higher quality, there is a need to constantly improve the efficiency of the services provided [12].

In the case of the business sector, efficiency means comparing the output produced with the outlay made, while both – outlay and output – can usually be easily identified and expressed in monetary terms. In the case of the healthcare sector, it would rather not be possible to construct the efficiency ratio in exactly the same way, as the benefits to society resulting from better health are multidimensional and difficult to quantify. Nevertheless, irrespective of these methodological difficulties, the need to base the conducted activity on the economic calculation in the area where funds from the state budget are used, is an undisputed issue. In the healthcare sector, however, the efficiency should be understood much broader than the relation of the outlay to the output expressed in monetary units. In addition to the direct benefits that a healthy society brings to the state, there are a number of indirect benefits, many of which are noticeable only in the long run. Despite the fact that the positive effects of health are difficult to clearly identify and precisely measure, their existence is obvious, as investment in health is an investment in human capital [13].

The best recommendation seems to be the introduction of elements of process management to healthcare entities, and some good practices in this area can be taken from the business sector. Of course, the implementation of solutions used in commercial enterprises would require adapting them to the specificity of processes taking place in entities pro-

viding health services [14]. However, measuring processes in the health-care sector is not an option, but a necessity. This necessity results, inter alia, from the permanent shortage of resources essential for meeting the constantly growing social needs at the higher and higher costs of the procedures applied, from the need for more rational management of limited public funds, as well as from the increased requirements of "patients/clients" regarding the standards and quality of services provided [15]. Hospital treatment is the one that absorbs the largest part of financial flows allocated to satisfying the health needs of the society. The in-patient average length of stay and the frequency of hospitalisation are the two variables that affect the number of hospital bed-days per inhabitant of a given country. In this paper, the impacts of these two factors on the variation in the number of hospital bed-days *per capita* were indicated for eighteen selected European countries.

Figure 1 depicts the diversity of the countries covered by the study with respect to the deviation of the variable inspected from the value computed for Poland. The horizontal axis of the two-dimensional coordinate system exhibits the impact effect of the first factor, and the vertical axis – the impact effect of the second factor.

In conclusion, it is worth mentioning that in 2018:

- in ten countries the number of days spent in hospital beds *per capita* was higher than in Poland, and in the remaining eight states the number of days spent in hospital beds *per capita* was lower than in Poland;
- in ten countries the in-patient average length of stay was bigger than in Poland, and in the remaining eight states the in-patient average length of stay was smaller than in Poland;
- in seven countries the quotient of the number of hospitalisations and the number of inhabitants was higher than in Poland, and in the remaining eleven states the frequency of hospitalisations was lower than in Poland.

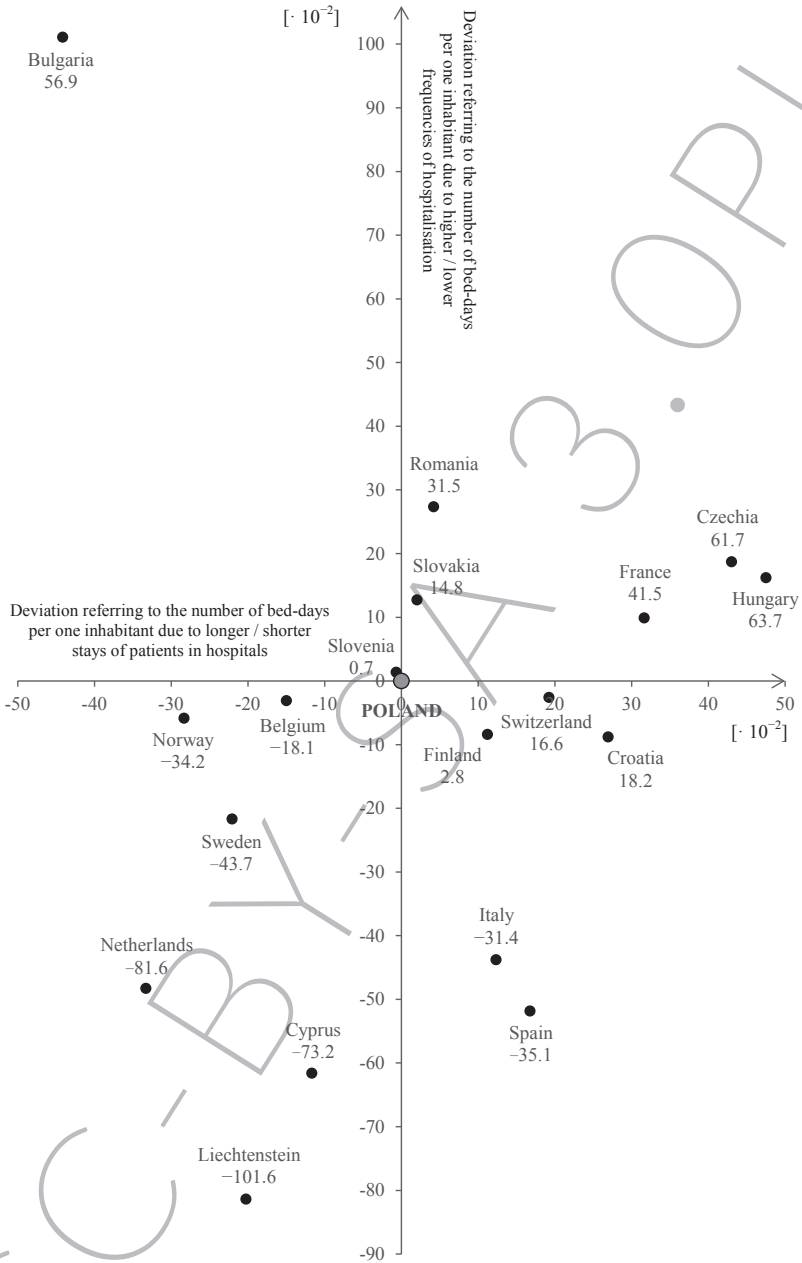

Figure 1. Causes of the observed deviations of the number of hospital bed-days *per capita* in selected European countries from the value calculated for Poland (data for 2018)

Source: own compilation based on Table 6.

It should be strongly emphasised that the research conducted in this article is only a contribution to a further search for the causes of the heterogeneity in the group of European countries with regard to the number of days of hospitalisation per one inhabitant. In this piece of work, the author analysed two factors that have a direct impact on the variable under consideration. Nonetheless, these two factors are influenced by a set of other variables which also – but indirectly – shape the number of hospital bed-days *per capita*. In further studies, the author will try to answer the question whether any associations between the structure of financing from public and private sources and the length and frequency of hospitalisation exist, as well as what the nature of such possible relationships is. In particular, the differences in the structure by disease types and the impact of these differences on the diversity of European countries in terms of the number of in-patient days *per capita* will be the subject of the author's further investigations.

References

1. Czyżewski B, Hnatyszyn-Dzikowska A, Polcyn J. Problems of quantifying public goods in the healthcare sector. Gospodarka Narodowa 2016; 3(283): 105–125.

2. Hnatyszyn-Dzikowska A, Polcyn J. Regional differences in dilivery of public services – selected methodological aspects. In: Polcyn J, Głowski P, eds. Regional development and its determinants. Piła: Stanisław Staszic University of Applied Sciences; 2015, pp. 249–267.

3. Skrzypczak Z, Rogoś E. Healthcare outlays and societies' health condition in the European Union. Studies in European Affairs 2007; 2: 167–197.

4. Reeves A, McKee M, Basu S et al. The political economy of austerity and healthcare: cross-national analysis of expenditure changes in 27 European nations 1995–2011. Health Policy 2014; 115(1): 1–8. https://doi.org/ 10.1016/j.healthpol.2013.11.008.

5. Urbanowicz U, Wronka M. Ocena efektywności wybranych działań podejmowanych w systemie ochrony zdrowia i jego podmiotach. In: Frączkiewicz-Wronka A, ed. Pomiar efektywności organizacji publicznych na przykładzie ochrony zdrowia. Katowice: Akademia Ekonomiczna w Katowicach; 2010, pp. 132–165.

6. Donev D, Kovacic L, Laaser U. The Role and Organization of Health Care Systems. In: Burazeri G, Zaletel-Kragelj L, eds. Health: Systems – Lifestyles – Policies (Volume I). 2nd ed. Lage: Jacobs Publishing Company; 2013, pp. 3–14.

7. Moscelli G, Siciliani L, Gutacker N et al. Socioeconomic inequality of access to healthcare: Does choice explain the gradient? Journal of Health Economics 2018; 57: 290–314. https://doi.org/10.1016/j.jhealeco.2017.06.005.

8. McLaughlin N, Ong M, Tabbush V et al. Contemporary health care economics: an overview. Neurosurgical Focus 2014; 37(5)/E2: 1–7. https://doi.org/ 10.3171/2014.8.FOCUS14455.

9. Hass-Symotiuk M. Szpital jako podmiot oceny przez różnych interesariuszy. In: Hass-Symotiuk M, ed. System pomiaru i oceny dokonań szpitala. Warszawa: Wolters Kluwer; 2011, pp. 11–62.

10. Jachowicz R. Zarys technologii współczesnego szpitala. Warszawa: Państwowy Zakład Wydawnictw Lekarskich; 1970.

11. Golinowska S, Czepulis-Rutkowska Z, Sitek M et al. Opieka zdrowotna w Polsce po reformie. Warszawa: Raport Centrum Analiz Społeczno-Ekonomicznych; 2002, p. 53.

12. Spika SB, Zweifel P. Buying efficiency: Optimal hospital payment in the presence of double upcoding. Health Economics Review 2019; 9(1): 1–14. https://doi.org/ 10.1186/s13561-019-0256-4.

13. Frączkiewicz-Wronka A. Nowoczesna koncepcja świadczenia usług publicznych – zmiana w kierunku nowego zarządzania publicznego. In: Frączkiewicz-Wronka A, ed. Pomiar efektywności organizacji publicznych na przykładzie ochrony zdrowia. Katowice: Akademia Ekonomiczna w Katowicach; 2010, pp. 15–62.

14. Krakowiak J, Burzyńska M, Pikala M. Evaluation of the impact of the transformation of a public hospital into a commercial company on the level of patient satisfaction with services provided. Journal of Health Study and Medicine 2017; 4: 5–19.

15. Guo KL. Entrepreneurship management in health services: an integrative model. Journal of Health and Human Services Administration 2006; 4(28): 504–530.

16. Eurostat database [Internet]. Available from: https://ec.euroopa.eu/eurostat [cited 11.07.2020].

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The Importance of Selenium (Se) in the Prevention and Treatment of Diseases

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Abstract

Introduction: *Numerous studies have proven the hypothesis put forward in the '70s that some human diseases are connected with selenium deficiency. Significantly lower concentration of selenium in the blood is found in patients with coronary thrombosis, diabetes, asthma, fatty liver disease and cirrhosis, malignant tumors, rheumatoid arthritis, skin conditions, neurological diseases, childhood diseases, alcoholism and nicotinism.*

Aim: *The aim of this paper is to indicate the importance of selenium (Se) in the prevention and treatment of human diseases in the light of the literature on the subject.*

Description: *Numerous studies conducted in the world concerning the role of selenium in the prevention and treatment of diseases have confirmed that selenium has the following health effects: it fights mutagenic free radicals, stimulates the immune system, increases the production of IgG and IgA antibodies, inhibits the division of cancer cells and limits their hematogenous spread due to its anticoagulant properties, and decreases the toxicity of chemotherapeutics. The recommended daily intake of selenium for adults is 50–100 µg and should not exceed 200 µg. Its maximum safe dose should not exceed 400 µg per day. In Poland, the average content of selenium in foods is too low.*

Summary: *Appropriate concentration of selenium in a human body has prophylactic and preventive effects. The results of numerous prospective studies in Poland and abroad indicate that a low intake of selenium and/or its low concentration in serum/plasma/nails are markers of high risk of developing most cancers as well as cardiovascular diseases, rheumatic diseases and psoriasis.*

Key words: *selenium (Se), prevention, disease, treatment, epidemiology.*

Introduction

Due to its essential biological functions and a thin line between the dose human organisms need to function correctly and one that is already toxic, selenium has become a research subject of great interest among toxicologists and researchers from various disciplines over recent years [1, 2, 3, 4].

Selenium, discovered in 1817 by a Swedish chemist Jöns Jacob Berzelius, was considered a toxic element for a long time. Areas of high concentration of selenium in the soil contributed to even fatal poisoning in cattle, and people suffered from hair loss, cracking nails and skin conditions. Now, several dozen of years after the Chinese publications revealed that selenium supplementation is vital in order not to develop cardiomyopathy (Kesham disease), our knowledge about this microelement is much broader [5, 6].

It was only in the middle of the 20th century that scientists presented beneficial effects of selenium in people and animals (despite the fact that the line between beneficial and toxic effects of selenium is narrow) [5].

We currently know that selenium is an essential element for life and a key component of selenoproteins, which perform diverse functions in living organisms [7, 8].

Selenium has been arousing more and more interest over recent years both as a microelement and as a natural component with a potential ability to inhibit processes of carcinogenesis [4].

The importance of this trace element needs to be emphasized in maintaining health, prolonging longevity, maintaining visual acuity or increasing potency. It is also of great significance in the prevention of cancer, cardiovascular diseases (coronary artery disease in a form of a myocardial infarction, hypertension), X-ray damage. Its beneficial therapeutic effects are noticed in the treatment of rheumatism, psoriasis, and others [9, 10].

Dietary intake of selenium is an important factor modifying the action of many drugs, including cytostatic drugs and toxic compounds.

Selenium is an essential microelement for the proper growth and development of living organisms. It acts by means of proteins, in which it is built in a form of selenocysteine. Being a component of seleloproteins, selenium occupies both enzymatic and structural roles [9].

The biological effect of this microelement is connected with defending the cell against "oxidative stress" and regulating immunological functions of a living organism, among others. Selenium deficiency causes an increase of toxic components generating active forms of oxygen in various species of animals during their oxidative metabolism. On the other hand, selenium supplementation can prevent their toxic influence [4, 5].

Selenium concentration in the group of healthy people in Poland is 73,7±15,4 ng/ml. It is far from optimal, which is 100–120 ng/ml. The average concentration of selenium in the Poles' blood serum is 70 ng/ml, and differences between regions do not exceed ±10%. The level of selenium in over 95% of Poles is lower than 105µg/l and these people are particularly recommended to supplement their diet with selenium compounds [11].

For comparison, the average concentration of selenium in the blood serum of the adult population of Eastern Germany is 81 ng/Ml. Americans have the optimal dose of Se – its average concentration in the USA is 127–178 ng/ml [11, 12].

Review methods

The article is based on Polish and English works published between 1983–2018 and selected while searching the following databases: PubMed, Web of Science, ResearchGate, Google Scholar. The keywords used were: selenium (Se), prophylactics, disease, treatment, epidemiology and their combinations. The search was carried our mainly by means of electronic databases. 34 publications were identified and those evaluated as the most adequate for the subject of this article were used.

Epidemiology and requirement for selenium. Pathophysiologic importance of selenium compounds

As it was mentioned in the introduction, selenium was discovered in 1817 by a Swedish chemist Jöns Jacob Berzelius and named after the Greek goddess of the moon. However, it was only in the last 30 years that it became irrefutable that selenium is of fundamental importance for the proper development and functioning of living organisms, and that its deficiency adversely influences the spread of diseases, particularly cancers. Selenium is considered to be the least known trace element in the human body. In excess, it is a dangerous toxic microelement. In the late 1950s, beneficial properties of Se received substantial attention and Se was recognized as a trace element of key importance for human health. Noteworthy, routine checks hardly ever detect selenium deficiency [5, 6].

Selenium needs to be supplied with food. However, selenium levels in foods depend on its content in the soil, among others. There are regions with high soil concentrations of selenium (e.g. the USA, Canada, Eastern Ukraine, some regions in China), but there are also selenium deficient ones (e.g. Finland, Sweden) [13]. Poland belongs to the second group and the Pomerania region has particularly selenium-deficient soils. Low selenium level in soil means that Poles have its low concentration in their bodies. Selenium deficient areas are common worldwide, particularly some regions in South America, New Zealand, and Scandinavia. The average soil concentration of selenium ranges from 0.2 to 0.6 ppm. Increased concentration of selenium is observed in the soil rich in iron and organic substances, and in alkaline soil. In potable and ground water in Poland, the concentration of selenium is 0.05 µg/l on average, which is not much compared to other countries. The largest amount of selenium enters the atmosphere due to its oxidation from the surface of the sea [14, 15, 16].

Physiological role of selenium in plants has not been strictly defined yet. Selenium can replace sulfur in some metabolic processes, taking its position in amino acids. The reason why the existence of selenium in plants arouses significant interest is that it occupies an important role

in the human and animal nutrition. It is assumed that, most commonly, the concentration of selenium in plants reflects its level in soils. Lower plants (e.g. funguses) tend to accumulate selenium. Wheat seeds exhibit a moderate amount of selenium. A relatively large amount of Se is found in tea leaves. The analysis of the average content of selenium in particular groups of foods leads to a conclusion that the highest levels of selenium are found in fruit and vegetables, then in leaves, flowers and finally plant roots. Herbs and flowers are also a rich source of selenium. The lowest amount of selenium is found in roots. The highest amount of Se in Polish vegetables is found in pea and bean seeds [11, 17].

Residents of selenium deficient regions are diagnosed with cardiomyopathy and immune system deficiencies. Moreover, Se deficiency causes liver necrosis, increases the risk of cardiovascular diseases and cancers, and affects the activity of thyroid [17].

In the United States, the daily recommended allowance for selenium is 70 µg for men, and 55 for non-pregnant women. The situation is similar in Poland. Pregnant women are recommended to increase its daily dose by 10 µg. In infants, the demand for selenium is not strictly defined and ranges from 4 to 35 µg per day. Up until now, there are no strict data concerning recommended daily amounts of selenium intake with foods, but most scientific publications assume that the doses recommended by Food and Nutrition Board of the National Research Council developed in 1980 are safe and appropriate for people. They range from 50 to 200 µg per day (Table 1) [16].

Table 1. Safe and appropriate amounts of selenium intake in diet, broken down by age [16]

Period of development	Age (years)	Recommended daily intake (µg)
Infants	0.0–0.5 0.5–1.0	10–40 20–60
Children	1–3 4–6 7–11	20–80 30–120 50–200
Adults	-	50–200

Factors influencing an increased demand for Se include: gestation, age, vitamin E deficiency, and oxidative stress caused by UVB radiation [12].

Selenium is a particularly important element of pregnant women's diet due to the fact that the demand for this microelement increases significantly during gestation and confinement [12, 18].

It has been already mentioned that the distribution of selenium is uneven on the globe, which is reflected in the content of selenium in foods. People living in some regions (e.g. Scandinavia, New Zealand, China) have a low supply of selenium, about 30 µg per day, whereas others (e.g. in Venezuela, North America) live in seleniferous areas with its high supply (over 150 µg per day). Therefore, it is not surprising that the majority of scientific studies into the role of selenium in the incidence of diseases has been carried out in countries with a relatively low supply of selenium, particularly in Scandinavia. Noteworthy, a standard supply of selenium in the UK ranges from 50 to 70 µg per day. Selenium supply in some regions depends not only on its content in the soil, but also on the dietary habits of the population – the Japanese selenium-rich diet is based on consuming large amounts of deep-sea fish from the Pacific Ocean which are a rich source of selenium [13, 19, 20].

Residents of selenium deficient regions should eat a diet rich in: various types of cabbage, broccoli, onion, garlic, wholegrain cereals, wheat sprout, offal (liver), and sea fish [19, 20].

It is justified to generalize that the recommended daily intake of selenium in adults is 50–100 µg and should not exceed 200 µg. Its maximum daily dose should not exceed 400 µg. It is commonly believed that the average content of selenium in foods in Poland is too low. Table 2 presents Se concentration in the blood serum in adult inhabitants of Poland, according to various authors [7, 11, 21, 22, 23].

Table 2. Concentration of selenium in the blood serum of healthy adults in Poland

Region of Poland	Selenium concentration in the blood serum (ng/mL)	Authors
Pomerania	73.7±15.4	Łabędzka 1991
Pomerania	52.0	Zachara et al. 1983
Lodzkie Region	50.0–55.0	Wojtczak 2003
Upper Silesia	63.5±18.1	Kłapcińska et al. 2005
Lubelskie Region	51±8.26	Kapka et al. 2007
West Pomerania	70.0	Gertig et al. 2006

Source: Authors' original work according to various authors.

Table 3 and 4 present the recommended daily allowance for selenium in Poland by gender and age. As puberty progresses, it increases among both males and females. The demand for selenium is high during gestation, particularly during confinement among breastfeeding mothers [24, 25].

Table 3. Current updated *Recommended dietary allowance* (RDA) for selenium according to the data provided by the National Institute of Food and Nutrition (Instytut Żywności i Żywienia) in Warsaw for the Polish population [24]

Age / gender	Daily recommended allowance for selenium Se (µg)
Infants 0–0,5	15
Infants 0.5–1	20
Children 1–3	20
Children 4–9	30
Boys and girls 10–12	40
Boys and girls 13–18	55
Adults (women and men)	55
Pregnant women	60
Lactating women	70

Table 4. Daily recommended allowance for selenium in Poland [25]

Gender and age	Daily demand for selenium (µg)
Infants	10–15
Children	20–30
Girls aged 10–12	45
Girls over 12	60
Pregnant women	65
Lactating women	75
Boys aged 10–12	45
Boyes aged 13–15	60
Boys over 15 and men	70

Table 5 presents a daily supply of selenium in some European countries (according to various authors). Compared to other European countries, the Polish population has approximately the lowest daily supply of selenium in diet, which is only 11–24 µg [4].

Table 6 presents the content of Se in selected foods. The highest amount of Se is found in salmon, chicken eggs and buckwheat [19].

Table 5. Daily supply of selenium in some European countries [4]

Country	Supply (µg per day)
Great Britain	29–39
Belgium	28–61
France	29–43
Germany (Bavaria)	35
Denmark	38–47
Sweden	38
Switzerland	70
Poland	**11–24 (approximately)**
Sloyakia	38

Table 6. Selenium content in 100 g of selected food products [19]

Food product	Selenium µg
Fresh salmon	32.2
Smoked salmon	26
Chicken egg	23.3
Buckwheat	20
Cocoa, powder	14.3
Smoked ham	12.1
Cheese, emmenthal (full-cream)	9.5
Rice (white)	6.0
Cheese, brie (full-cream)	5.8
Plain chocolate	4.5
Milk chocolate	4.5
Milk 1.5% fat	1.54
Yoghurt with fruit	1.3

Selenium and carcinogenesis processes

It is assumed that 35% of all cancers are connected with the diet. The anti-cancer potential of nutrients seems to be relatively high owing to the fact that their consumption in adequate and large amounts may decrease the incidence of certain types of cancers. Selenium and vitamins A, C and E belong to the nutrients which have anti-cancer properties and therefore change the incidence, diversity and progression of the disease. Antioxidants may also turn out to be beneficial in the course of treatment or cancer prevention [15, 16, 26]

The importance of selenium in the functioning of a human body is revealed only when abnormalities in its absorption, transport and excretion are detected [27, 28].

Over recent years, selenium has gained recognition as an effective tool in the fight against cancers. Numerous studies suggest that selenium can influence the risk of developing the disease owing to the fact that, being an antioxidant, it protects the human body against the adverse effect of free radicals. Moreover, it boosts the activity of immune system cells and slows down the development of blood vessels in tumours. The protective

role of this element against pro-oxidants results, among others, from the fact that selenium is present in the active site of antioxidant enzymes, e.g. in glutathione peroxidase, GPX, which is one of the best known enzymes and whose function is to protect cell components (DNA, lipids) against the damaging activity of H2O2 and various organic peroxides produced during metabolic processes within living organisms [29, 30].

Se anti-cancer (antiproliferative) properties are widely recognized and used for therapeutic purposes. Low Se level is observed in numerous diseases. However, it is often difficult to prove whether the deficit is of primary or secondary nature. Generally, it is known that it is caused by abnormalities in absorption, nutritional mistakes, excess use, or pathological states with a strictly defined role of selenium [31, 32].

Numerous studies demonstrate the following health effects of selenium:

1. fights mutagenic free radicals. Cell damage caused by active forms of oxygen can lead to carcinogenic transformations of the cells;
2. stimulates the immune system increasing the production of IgG and IgA antibodies;
3. slows down the division of cancer cells;
4. shows anticoagulant properties and decreases the hematogenous spread of cancer cells;
5. decreases the toxicity of chemotherapeutics [32].

Antioxidants, supplied to living organisms with food, enhance the synthesis of prostacyclins by means of preventing the influence of lipid hydroperoxides on inhibiting the activity of prostacyclins. Clinical research indicates that supplementation with antioxidants enhances the production of prostacyclins. In the light of evidences that the aggregation of platelets supports the implementation of hematogenous metastasis, additional use of antioxidants should also slow down the spread of cancer. The aforementioned activity is additionally enhanced by the immunostimulating influence of these nutrients. Because of their anti-cancer, immunostimulating and antimetastatic properties, antioxidants slow down the development of cancer at all stages. Moreover, deficiency

of selenium inhibits the release of prostacyclins and enhances the production of PAF (*Platelet Activating Factor*) by endothelium cells of platelets [32, 33, 34].

Conclusions

The hypotheses put forward in the 1970s have been confirmed – some diseases in human being are related to the deficiency of selenium. It has been demonstrated that selenium concentration in the blood is much lower in patients with: coronary thrombosis, diabetes, asthma, fatty liver disease and cirrhosis, malignant tumours, rheumatoid arthritis, skin conditions, neurological diseases, childhood diseases, alcoholism and nicotinism [15, 16, 28].

Selenium protects against detrimental effects of ultraviolet radiation and its fundamental role in the metabolism of thyroid hormones needs to be particularly emphasised [16].

Studies conducted on rat aortas indicated a high production of lipid hydroperoxides in atherosclerotic platelets, whereas the production of PGI_2 (prostaglandin I_2) in the diseased tissues was significantly lower than in the healthy ones. It was demonstrated that even a slight increase in the concentration of lipid hydroperoxides could influence the biochemical path of arachidonic acid and support an increased production of TXA_2 (Tromboxane A_2). Selenium supplementation led to an increase in the synthesis of PGI_2 [1, 20].

Preventive and therapeutic effects of selenium is also shown in the treatment of coronary thrombosis. The use of coenzyme Q_{10} and selenium for one year improves long term prognosis after a myocardial infraction. Clinical research leads to a conclusion that treatment with the use of antioxidants (selenium, vitamin E, coenzyme Q_{10}) improves the prognosis in a significant way and decreases mortality after the myocardial infraction Therefore, it should become a permanent component of the complex clinical treatment. It needs to be emphasized that the aforementioned procedure is recommended in all forms of coronary thrombosis [20].

Results of numerous studies conducted over recent years show that the role of selenium in medicine and recommendations concerning its supplementation in the aforementioned diseases ought to be reassessed [16, 28].

A review of publications on the subject indicates that the majority of authors show a beneficial effect of selenium as a therapeutic agent in the treatment of numerous diseases [14, 15, 16, 25, 27].

While analysing the aforementioned relations, a range of other factors should be taken into account, which include:

1. selenium concentration in a given patient, compared to the whole population,
2. the kind as well as optimal and adequate amount of other nutrients, particularly vitamins A and E;
3. influence of environmental factors;
4. virulence and the course of a disease;
5. influence of the intake of other medicines;
6. proper control of therapeutic trials with selenium [7].

It needs to be emphasized that selenium is of fundamental importance in chemoprevention. Chemoprevention means reducing the risk of cancers by means of chemical compounds provided in a form of supplements, food additives, or medicines (e.g. tamoxifen decreases the incidence of breast cancer in the higher-risk group). A properly balanced diet and supplementation can decrease the so-called "penetration" – i.e. the possibility of developing cancers in people with higher risk of the disease [4, 19].

Abbreviations:

Se – selenium
GPX – glutathione peroxidase
H2O2 – hydrogen peroxide
DNA – deoxyribonucleic acid
PAF – Platelet Activating Factor
PGI_2 – Prostaglandyny I2

TXA_2 – Tromboksan A2
Ig G – Immunoglobulines G
Ig A – Immunoglobulines A

References

1. Ip C, Hayes C, Budnick M et al. Chemical form of selenium critical metabolites, and cancer prevention. Cancer Res 1991; 51(2): 595–600.

2. Patrick L. Selenium biochemistry and cancer: A review of the literature. Altern Med Rev 2004; 9(3): 239–258.

3. Kieliszek M, Błażejak S, Gientka I et al Accumulation and metabolism of selenium by yeast cells. Appl Microbiol Biotechnol 2015; 99(13): 5373–5382. https://doi.org/10.1007/s00253-015-6650-x.

4. Kieliszek M, Błażejak S. Selenium: significance, and outlook for supplementation. Nutrition 2013; 29(5): 713–718. https://doi.org/10.1016/j.nut.2012.11.012.

5. Reid ME, Duffield-Lillico AJ, Sunga A et al. Selenium supplementation and colorectal adenomas: An analysis of the nutritional prevention of cancer trial. Int J Cancer 2006; 118(7): 1777–1781.

6. Kieliszek M, Błażejak S. Current knowledge on the importance of selenium in food for living organims: A review. Molecules 2016; 21(5): E609. https://doi.org/10.3390/molecules21050609.

7. Wojtczak A. Selenium as an anticancerogenic agent. Acta Pol Pharm 2003; 60(3): 215–217.

8. Lener MR, Gupta S, Scott RJ et al. Can selenium levels act as a marker of colorectal cancer risk? BMC Cancer 2014; 13: 214. https://doi.org/10.1186/1471-2407-13-214.

9. Fernandes AP, Gandin V. Selenium compounds as therapeutic agents in cancer. Biochim Biophys Acta 2015; 1850(8): 1642–1660. https://doi.org/10.1016/j.bbagen.2014.10.008.

10. Nilsonne G, Sun X, Nyström C et al. Selenite induces apoptosis in sarcomatoid malignant mesothelioma cells through oxidative stress. Free Radic Biol Med 2006; 41(6): 874–885. https://doi.org/10.1016/j.freeradbiomed.2006.04.031.

11. Kłapcińska B, Poprzecki S, Danach A et al. Selenium levels in blond of Upper Silesian population: evidence of suboptimal elenium status in a significant percentage of the population. Biol Trace Elem Res 2005; 108(12): 1–15.

12. Lippman SM, Klein EA, Goodman PJ et al. Effect of selenium and vitamin E on risk of prostate cancer and other cancers: the Selenium and Vitamin E Cancer Prevention Trial (SELECT). JAMA 2009; 301(1): 39–51.

13. Ferlay J, Colombet M, Soerjomataram I et al. Cancer incidence and mortality patterns in Europe: Estimates for 40 countries and 25 major cancers in 2018. Eur J Cancer 2018; 103: 356–387. https://doi.org/10.1016/j.ejca.2018.07.005.

14. Żbikowska H. Selen w organizmach żywych. I. Toksyczność selenu i działanie antynowotworowe. Acta Universitatis Lodziensis. Folia Biochim Biophys 1997; 12: 29–37.

15. Pfister C, Dawczynski H, Schingale FJ. Sodium selenite and cancer related lymphedema: Biological and pharmacological effects. J. Trace Elem Med Biol 2016; 37(45): 111–116. https://doi.org/10.1016/j.jtemb.2016.05.005.

16. Rayman MP. Selenium and human health. Lancet 2012; 379(9822): 1256–1268. https://doi.org/10.1016/S0140-6736(11)61452-9.

17. Miller AB. Screening for breast cancer in the Eastern Mediterranean Region. East Mediterraneaen Health Journal 2010; 16(10): 1022–1024. https://doi.org/10.26719/2010.16.10.1022.

18. Selvaraj V, Tomblin J, Armistead MY et al. Selenium (sodium selenite) causes cytotoxicity and apoptotic mediated cell death in PLHC-1 fish cell line through DNA and mitochondrial membrane potential damage. Ecotoxicol Environ Saf 2013; 87: 80–88. https://doi.org/10.1016/j.ecoenv.2012.09.028.

19. Combs GF. Jr. Selenium in global food systems. Br J Nutr 2001; 85(5): 517–547. https://doi.org/10.1079/BJN2000280.

20. Weekley CM, Harris HH. Which form is that? The importance of selenium speciation and metabolism in the prevention and treatment of disease. Chem Soc Rev 2013; 42(23): 8870–8894. https://doi.org/10.1039/c3cs60272a.

21. Łabędzka H. Wpływ podaży różnych preparatów selenu na stężenie selenu oraz aktywność paroksydazy glutationowej we krwi osób zdrowych [rozprawa doktorska]. Bydgoszcz: Akademia Medyczna w Bydgoszczy; 1991.

22. Zachara B, Wąsowicz W, Gromadzińska J et al. Stężenie selenu i aktywność peroksydazy glutationowej we krwi mieszkańców Łodzi i okolic. PZH 1983; 34(6): 359–364.

23. Kapka L, Baumgartner A, Siwińska E et al. Environmental lead exposure increases micronuclei in children. Mutagenesis 2007; 22(3): 201–207.

24. Jarosz M. Normy żywienia dla populacji polskiej – nowelizacja. Warszawa: Instytut Żywności i Żywienia; 2012.

25. Gertig H, Przysławski J. Bromatologia – zarys nauki o żywności i żywieniu. Warszawa: PZWL; 2006, pp. 228–229.

26. Kasseroller R. Sodium selenite as prophylaxis against erysipelas in secondary lymphedema. Anticancer Res 1998; 18(3C): 2227–2230.

27. Clark LC, Combs GF. Jr, Turnbull BW et al. Effects of selenium supplementation for cancer prevention in patients with carcinoma of the skin. A randomized controlled trial. Journal of the American Medical Association 1996; 276(24): 1957–1963. https://doi.org/10.1001/jama.1996.03540240035027.

28. Duntas LH, Benvenga S. Selenium: An element for life. Endocrine 2015; 48(3): 756–775. https://doi.org/10.1007/s12020-014-0477-6.

29. Vinayak S, Gilmore HL, Harris LN. Biology of breast cancer. In: De Vita VT, Lawrence TS, Rosenberg SA, eds. Cancer principles and practice of oncology. 10th edition. Philadelphia: Wolters Kluwer; 2015, pp. 1107–1116.

30. Morrow M, Burnstein HJ, Harris JR. Malignant tumors of the breast. In: De Vita VT, Lawrence TS, Rosenberg SA, eds. Cancer principles and practice of oncology. 10th edition. Philadelphia: Wolters Kluwer; 2015, pp. 1117–1156.

31. Schrauzer GN. Selenium and cancer: A review. Bioinorg Chem 1976; 5: 275–281. https://doi.org/10.1016/S0006-3061(00)82026-8.

32. Lipinski B. Prostate cancer vaccines, fibrin and selenium: A conceptual review. Open Prost Cancer J 2010; 3(2): 69–73. https://doi.org/10.2174/1876822901003010069.

33. Ghiorzo P. Genetic predisposition to pancreatic cancer. World J Gastroenterol 2014; 20(31): 10778–10789. https://doi.org/10.3748/wjg.v20.i31.10778.

34. Edlich RF, Winters KL, Lin KY. Breast cancer and ovarian cancer genetics. J Long Term Eff Med Implants 2005; 15(5): 533–545.

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Subjective Assessment of Health in People with Varying Degrees of Nicotine Addiction

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Abstract

Introduction: *Subjective population health indicators, including subjective health assessment, are strongly correlated with health promoting behaviors of the population. SRH (self-rated health) determinants, such as lifestyle factors (including smoking) and specific health conditions, are important for targeted prevention and can help healthcare professionals prioritize education, intervention disease prevention, and health promotion.*

Aim: The aim of the study was to assess the subjective health status of smokers, including the assessment of subjective health status among people with varying degrees of nicotine addiction (i.e. those who are strong and less addicted to nicotine).

Material and methods: *The study covered smokers of Piotrków district in 2015. The research tool was a questionnaire. For the purposes of this study, smokers were distinguished among those who were less addicted to nicotine and those who were highly addicted to nicotine, using the Fagestrom test. The study received a positive opinion from the Bioethics Committee of the Medical University of Lodz (RNN/243/15 /KE).*

Results: *117 people smoking cigarettes from Piotrków County took part in the study. It was found that 49.5% of the respondents assessed their health as fairly good, 38.5% as good, only 1.7% believed that their health was bad. People strongly addicted to nicotine constituted 8.5% of all smokers; people less addicted to nicotine accounted for 18.8% of the respondents. In the group of smokers strongly addicted to nicotine, the majority assessed their health as fairly good (60.0%), and good (30.0%). In the group of smokers less addicted to nicotine, 59.1% assessed their health as good, and 40.9% as fairly good.*

Conclusions: *SRH can be a simple, quick, and inexpensive measure to monitor health in a variety of populations, including people with varying degrees of nicotine addiction.*

Key words: *subjective health assessment, smoking tobacco, nicotine addiction.*

Introduction

People often treat their health as a natural thing that does not require any efforts on their part, and when a disease appears, they reject the idea of participating in its development [1]. Health-related quality of life (HRQL) concerns aspects of life that are related to health, as well as all activities aimed at maintaining it, in an objective and subjective dimension [2].

Subjective population health indicators, including subjective health assessment, are strongly correlated with health promoting behaviors of the population, influencing the decisions made in the field of therapy and having a direct or indirect impact on the behavior of individuals [3].

Self-Rated Health (SRH) was found to be an important and reliable health indicator based on a simple question asked of respondents to assess their current general health [4]. The conducted research shows evidence of a relationship between health self-assessment and morbidity, mortality, lifestyle, and socio-demographic factors [5, 6, 7, 8]. SRH determinants, such as lifestyle factors (including smoking) and specific health conditions, are important for targeted prevention and can help healthcare professionals prioritize education, intervention disease prevention, and health promotion [9].

Smoking is one of the anti-health behaviors, having a detrimental effect on human health, causing various diseases after many years [10]. Smoking is also a well-known major cause of early mortality and preventable morbidity [11]. WHO (the World Health Organization) recognizes smoking as a global, long-term health problem with over 7 million deaths annually [12]. WHO estimates that in 2018 in Poland, about 37% of men and about 26% of women smoked cigarettes, and the forecasts predict that in 2025 it will be approximately 26% of men and 16% of women, respectively [13]. In 2019 over one-fifth of Poles (21%) admitted to smoking (daily) addiction [14]. Estimated data on tobacco smokers place Poland slightly above the average European level, and the downward trend in the percentage of smokers observed in the last few years has been stopped [15].

Smoking cessation reduces the risk of developing cardiovascular diseases, respiratory diseases, cancer, and other chronic diseases resulting from this addiction, and after a few years, it even completely equalizes it with that of people who have never smoked [16]. Although over 80% of smokers say they want to quit, only 7% are successful annually. However, quitting smoking even for a while is a health benefit, because a day without a cigarette is a day when your health is not damaged. The health effects are determined not only by the number of cigarettes smoked but to a greater extent by the duration of the addiction [1].

Education and public awareness of the effects of tobacco consumption, as well as nationwide smoking cessation interventions, are key to reducing the demand for tobacco [17]. Minimal anti-smoking intervention during a medical visit, consisting of the identification of a smoking patient and providing them with professional help to quit smoking, can help reduce the percentage of smoking.

The aim of the study was to assess the subjective health status of smokers, including the assessment of subjective health status among people with varying degrees of nicotine addiction (in those who are strongly and less addicted to nicotine).

Materials and methods

A cross-sectional study was conducted in 2015. A detailed description of the study area has been published elsewhere [18]. The study included all smokers from the Piotrków County who gave their written consent to participate in the study. The study was approved by the Bioethics Committee of the Medical University of Lodz (project identification code: RNN/243/15/KE).

The research tool was a questionnaire. The study included current daily smokers (smokers of one or more cigarettes a day in the last 30 days) and occasional smokers (smokers less frequent than daily). For the purposes of this study, among smokers, people who were less addicted to nicotine and those who were strongly addicted to nicotine were distin-

guished using the Fagerström test [19]. A person who is highly addicted to nicotine was defined as the current every day smoker who smokes more than 20 cigarettes a day, lights the first cigarette up to 30 minutes after waking up, the hardest thing is to give up the first cigarette in the morning, smokes even when sick. The person less addicted to nicotine was a current daily smoker who did not meet the criteria for being heavily addicted.

The respondents were asked to assess their health condition on the basis of the question "assess your current health condition" and the answers were received: "good", "fairly good", "rather bad", "bad".

Results

The study involved 117 people who smoked cigarettes in the Piotrków County and were referred to a doctor to encourage them to quit smoking.

56% of the respondents were women, 44% men. Daily smokers accounted for 90.6% of all respondents. The most frequent smokers were people aged 50–59 (32.5%), while the least numerous group (8.5%) were those aged 40–49. 47.9% of the studied population were married persons, 23.9% single persons: single/unmarried.

The respondents with secondary education constituted 38.5%, and those with higher education – 29.9%. Most of them (60.7%) were employed, and every 5th person was a pensioner. The monthly net income per person in a family was above PLN 1000 to PLN 1500 (25.6%) for every fourth person and over PLN 1500 to PLN 2000 for every fifth person (Table 1).

Table 1. Characteristics of the studied population (N=117)

Variable	N	%
Sex		
• female	65	56.0
• man	52	44.0
Age (years)		
• <30	14	12.0
• 30–39	28	23.9
• 40–49	10	8.5
• 50–59	38	32.5
• ≥60	27	23.1
Marital status		
• bachelor/miss	28	23.9
• married	56	47.9
• divorced	18	15.4
• widower/widow	15	12.8
Education		
• basic	2	1.7
• basic vocational	21	17.9
• average	45	38.5
• post-secondary	14	12.0
• higher (bachelor's degree)	10	8.5
• higher (master's)	25	21.4
Professional status in the last 12 months		
• salaried employee	71	60.7
• self-employed person	11	9.4
• a person running a farm	3	2.6
• pupil/student	2	1.7
• housewife	15	12.8
• annuitant	8	6.8
• pensioner	7	6.0
• unemployed		
Monthly net family income per person		
up to 500 PLN	11	9.4
• over 500 to 700 PLN	9	7.7
• over 700 to 1000 PLN	18	15.4
• above 1000 to 1500 PLN	30	25.6
• above 1500 to 2000 PLN	26	22.2
• above 2000 to 2500 PLN	13	11.1
• above 2500 PLN	10	8.6
Subjective health assessment		
• good	45	38.5
• pretty good	58	49.6
• rather bad	12	10.2
• bad	2	1.7

Smoking tobacco		
• Yes, everyday	106	90.6
• Yes, less than every day	8	6.8
• No	3	2.6
Number of years of regular smoking daily		
• <5 years	12	10.3
• ≥5 years	105	89.7
How many cigarettes do you smoke during the day		
• less than one cigarette a day	4	3.4
• one cigarette a day	0	0
• 2 to 5 cigarettes a day	6	5.1
• 6 to 10 cigarettes a day	27	23.1
• 11 to 20 cigarettes a day	61	52.1
• more than 20 cigarettes a day	19	16.3
How soon after you wake up do you smoke your first cigarette?		
• in the first 5 minutes	26	22.2
• after 6–15 minutes	31	26.5
• after 16–30 minutes	23	19.7
• after 31–60 minutes	16	13.7
• after more than 60 minutes	19	16.2
• no data	2	1.7
Do you find it difficult to refrain from smoking in non--smoking public places?		
• Yes	32	27.4
• No	85	72.6
Which cigarette is the most difficult for you to give up		
• in the first morning	59	50.4
• any other	57	48.7
• no data	1	0.9
Do you smoke more cigarettes in the morning than in the rest of the day?		
• Yes	29	24.8
• No	88	75.2
Do you smoke cigarettes even when you are so sick that you are lying in bed?		
• Yes	62	53.0
• No	55	47.0
Have you tried to quit smoking in the last 12 months?		
• Yes	24	20.5
• No	82	70.1
• No data	11	9.4

Intention to quit smoking		
• I intend to quit smoking within the next month	77	65.8
• I'm considering quitting in the next 12 months	27	23.1
• I'll quit smoking, but not in the next 12 months	5	4.3
• I'm not going to quit smoking	1	0.85
• I don't know	6	5.1
• No data	1	0.85
During a visit to a doctor or other health care representative in the last 12 months, have you been asked if you smoke?		
• Yes	61	52.1
• No	50	42.8
• No data	6	5.1
Were you advised to quit smoking during a visit to a doctor or other health care representative in the last 12 months?		
• Yes	54	46.2
• No	50	42.7
• No data	13	11.1
Are you concerned about the harmful effects of smoking on your health?		
• I am very concerned	48	41.0
• I'm a little concerned	57	48.7
• I'm not too concerned	11	9.4
• I'm not at all concerned	1	0.9

When asked about subjective health status, 49.6% of respondents assessed their health as fairly good, 38.5% as good, and only 1.7% believed that their health was bad. When asked "are they concerned about the harmful effects of smoking on their health?" 41.0% of respondents replied that they were very concerned and 48.7% a little concerned. Women assessed their health better: as good (37.0%) and fairly good (50.8%), compared to men who assessed their health as good (40.4%) and fairly good (48.1%). 9.6% of men assessed their health condition as rather bad, and 1.9% as bad. People who assessed their health condition as good were mostly from the age group of 30–39 (12.8%), married (21.4%), with secondary or higher education (12.8% and 15.4%), who are employed (29.0%). Among the subjects who assessed their health condition at a fairly good level, the majority were aged 50–59 (18.8%), married (21.4%), with secondary or higher education (23.0% and 13.7%), who are employed (29.0%) (Table 3).

In the group of daily smokers, 89.7% were smokers for 5 years and longer. Every second respondent (52.1%) smokes from 11 to 20 cigarettes a day, 16.3% smokes more than 20 cigarettes a day. 68.4% light their first cigarette during the day immediately after waking up (up to 30 minutes). Most of the respondents (72.6%) did not find it difficult to refrain from smoking in public places where smoking is forbidden.

Half of the smokers (50.4%) find it hardest to quit their first cigarette in the morning. Every fourth person smokes cigarettes in the morning than in the rest of the day. 53.0% smoke cigarettes even when they are sick and in bed. Only every fifth (20.5%) of the respondents tried to quit smoking in the last 12 months, but 65.8% declared their intention to quit smoking within the next month. To the question: "during a visit to a doctor or other health care representative in the last 12 months, where you asked if they smoke?" more than half (52.1%) gave a positive answer, and to the question: "were they advised to quit smoking during a visit to a doctor or other health care representative in the last 12 months?" 46.2% answered in the affirmative. The study identified smokers who were less addicted to nicotine and those who were highly addicted to nicotine using the Fagerström test. People strongly addicted to nicotine constituted 8.5% of all smokers; 40.0% of which were women and 60.0% men. The most numerous group were people aged 60 and more (40.0%). People less addicted to nicotine accounted for 18.8% of the respondents, 54.5% were women, and 45.5% were men. The most numerous group were people under the age of 30 (27.3%). A detailed description of the respondents who are less and strongly dependent on nicotine, taking into account socio-demographic characteristics, is presented in Table 2.

In the group of smokers strongly addicted to nicotine, the majority assessed their health as fairly good (60.0%), and as good (30.0%), none of the respondents assessed their health as bad. In the group of smokers less addicted to nicotine, 59.1% assessed their health as good, and 40.9% as fairly good. None of the less addicted respondents assessed their health as rather bad and bad.

70.0% of those who are heavily addicted to nicotine are somewhat concerned about the harmful effects of smoking, and 45.5% of those less addicted. Among the less addicted, 45.5% are very concerned about the harmful effects of smoking on health, while in the group of highly addicted people it is only 10.0% of the respondents (p=0.05).

Every second highly addicted person was asked during a visit to a doctor or other health care representative in the last 12 months whether they smoke tobacco, and 60.0% of respondents were advised to quit smoking during such a visit. In the group less addicted to nicotine, 59.1% were asked by health care workers in the last 12 months whether they smoke, and every second person (50.0%) was advised to quit smoking in the last 12 months (Table 2).

Table 2. Characteristics of the less addicted and strongly addicted to nicotine subjects

Variable	Less addicted N=22 (%)	Strongly addicted N=10 (%)	p-value*
Sex			
• female	12 (54.5)	4 (40.0)	p=0.226
• man	10 (45.5)	6 (60.0)	
Age (years)			
• <30	6 (27.3)	-	-
• 30–39	5 (22.7)	1 (10.0)	p=0.291
• 40–49	1 (4.6)	2 (20.0)	p=0.200
• 50–59	5 (22.7)	3 (30.0)	p=0.300
• ≥60	5 (22.7)	4 (40.0)	p=0.197
Marital status			
• bachelor/miss	8 (36.4)	1 (10.0)	p=0.114
• married	11 (50.0)	3 (30.0)	p=0.180
• divorced	1 (4.5)	3 (30.0)	p=0.073
• widower/widow	2 (9.1)	3 (30.0)	p=0.138
Education			
• basic	-	-	-
• basic vocational	2 (9.1)	3 (30.0)	p=0.138
• average	7 (31.8)	5 (50.0)	p=0.190
• post-secondary	1 (4.6)	-	-
• higher (bachelor's degree)	3 (13.6)	-	-
• higher (master's)	9 (40.9)	2 (20.0)	p=0.173

Professional status in the last 12 months			
• salaried employee	15 (68.2)	4 (40.0)	p=0.103
• self-employed person	2 (9.1)	3 (30.0)	p=0.138
• a person running a farm	-	-	-
• pupil/student	2 (9.1)	-	-
• housewife	-	-	-
• annuitant	2 (9.1)	3 (30.0)	p=0.138
• pensioner	1 (4.5)	-	-
• unemployed	-	-	-
Monthly net family income per person			
• up to 500 PLN	-	-	-
• over 500 to 700 PLN	3 (13.6)	-	-
• over 700 to 1000 PLN	3 (13.6)	2 (20.0)	p=0.344
• above 1000 to 1500 PLN	9 (41.0)	3 (30.0)	p=0.264
• above 1500 to 2000 PLN	2 (9.1)	3 (30.0)	p=0.138
• above 2000 to 2500 PLN	3 (13.6)	-	-
• above 2500 PLN	2 (9.1)	2 (20.0)	p=0.289
Subjective health assessment			
• good	13 (59.1)	3 (30.0)	p=0.099
• pretty good	9 (40.9)	6 (60.0)	p=0.185
• rather bad	-	1 (10.0)	-
• bad	-	-	-
During a visit to a doctor or other health care representative in the last 12 months, have you been asked if you smoke?			
• Yes	13 (59.1)	5 (50.0)	p=0.266
• No	8 (36.4)	5 (50.0)	p=0.232
• No data	1 (4.5)	-	-
Were you advised to quit smoking during a visit to a doctor or other health care representative in the last 12 months?			
• Yes	11 (50.0)	6 (60.0)	p=0.262
• No	10 (45.5)	3 (30.0)	p=0.223
• No data	1 (4.5)	1 (10.0)	p=0.444
Are you concerned about the harmful effects of smoking on your health?			
• I am very concerned	10 (45.5)	1 (10.0)	p=0.050
• I'm a little concerned	10 (45.5)	7 (70.0)	p=0.137
• I'm not too concerned	2 (9.0)	2 (20.0)	p=0.289
• I'm not at all concerned	-	-	-

*Fisher's exact test was used

Table 3. Subjective health status assessment and characteristics of the studied population

Variable	Subjective health assessment			
	good N (%)	pretty good N (%)	rather bad N (%)	bad N (%)
Sex				
• female	24 (37.0)	33 (50.8)	7 (10.7)	1 (1.5)
• man	21 (40.4)	25 (48.1)	5 (9.6)	1 (1.9)
Age (years)				
• <30	9 (7.8)	5 (4.3)	-	-
• 30–39	15 (12.8)	11 (9.4)	2 (1.7)	-
• 40–49	6 (5.1)	4 (3.4)	-	-
• 50–59	8 (6.8)	22 (18.8)	6 (5.1)	2 (1.7)
• ≥60	7 (6.0)	16 (13.7)	4 (3.4)	-
Marital status				
• bachelor/miss	15 (12.8)	9 (7.7)	4 (3.4)	-
• married	25 (21.4)	25 (21.4)	6 (5.1)	-
• divorced	2 (1.7)	14 (12.0)	-	2 (1.7)
• widower/widow	3 (2.6)	10 (8.5)	2 (1.7)	-
Education				
• basic	1 (0.9)	-	1 (0.9)	-
• basic vocational	6 (5.1)	7 (6.0)	6 (5.1)	2 (1.7)
• average	15 (12.8)	27 (23.0)	3 (2.6)	-
• post-secondary	5 (4.2)	8 (6.8)	1 (0.9)	-
• higher (bachelor's degree)	6 (5.1)	4 (3.4)	-	-
• higher (master's)	12 (10.3)	12 (10.3)	1 (0.9)	-
Professional status in the last 12 months				
• salaried employee	34 (29.0)	34 (29.0)	3 (2.6)	-
• self-employed person	5 (4.2)	5 (4.2)	1 (0.9)	-
• a person running a farm	-	-	-	-
• pupil/student	1 (0.9)	2 (1.7)	-	-
• housewife	1 (0.9)	1 (0.9)	-	-
• annuitant	2 (1.7)	10 (8.5)	3 (2.6)	-
• pensioner	1 (0.9)	1 (0.9)	4 (3.4)	2 (1.7)
• unemployed	1 (0.9)	5 (4.2)	1 (0.9)	-

Monthly net family income per person				
• up to 500 PLN	5 (4.2)	6 (5.1)	-	-
• over 500 to 700 PLN	4 (3.4)	3 (2.6)	2 (1.7)	-
• over 700 to 1000 PLN	7 (6.0)	7 (6.0)	2 (1.7)	2 (1.7)
• above 1000 to 1500 PLN	9 (7.7)	18 (15.4)	3 (2.6)	-
• above 1500 to 2000 PLN	6 (5.1)	17 (14.5)	3 (2.6)	-
• above 2000 to 2500 PLN	9 (7.7)	3 (2.6)	1 (0.9)	-
• above 2500 PLN	5 (4.2)	4 (3.4)	1 (0.9)	-

Discussion

To our knowledge, this is one of the first studies on SRH in people with varying degrees of nicotine addiction. No significant link was found in our study of smoking and self-assessed health. It was shown that 49.5% of the surveyed smokers assessed their health as fairly good, 38.5% as good. Our results (although statistically insignificant in most cases) showed that in the group of smokers heavily dependent on nicotine, the majority assessed their health as fairly good (60.0%) and as good (30.0%), while in the group of smokers less addicted to nicotine, the majority assessed their health as their health condition as fairly good (40.9%) and good (59.1%). None of the respondents in both groups assessed their health condition as bad. Similarly, in a study by Jurewicz et al., no relationship was found between cigarette smoking and SRH [9]. The situation is different in other literature, which suggests such a relationship [20]. Moreover, in our study, women rated their health as good (37.0%) and fairly good (50.8%), compared to men who assessed their health as good (40.4%) and fairly good (48.1%). Only 9.6% of men assessed their health condition as rather bad, and 1.9% as bad. In the study by Jurewicz et al., in the self-assessment of health conditions, 11% of respondents declared poor health. Men more often assessed their health condition as bad (15%) compared to women (8.5%), which was also similar to the results of

the study conducted in Estonia [9, 21]. Among people assessing their health condition subjectively at a good level, people in the 30–39 age group (12.8%) prevailed, at a fairly good level in the 50–59 age group (18.8%), at a rather poor level in the group age 50–59 (5.1%). This is consistent with other studies conducted in the UK, Denmark, and Iceland, where the self-esteem of health deteriorates with age [22, 23, 24]. The results of our study are statistically insignificant, but the sample size was small, so further research in this area is necessary.

Our study additionally assessed respondents awareness of the harmful health effects of smoking. It was found that 41% of the smokers surveyed were very concerned and 48.7% were somewhat concerned about the harmful effects of smoking, while the majority (70%) of the group heavily addicted to nicotine were only slightly concerned about the harmful effects of smoking. Driezen et al. in a study conducted in Bangladesh showed that smokers' concerns about health risks significantly influenced their chances of quitting smoking: smokers who were very worried about their health were nearly 9 times more likely to plan to quit than smokers who weren't worried at all. The results from International Tobacco Control Bangladesh revealed that smokers who were moderately concerned were more than 4 times more likely to quit, while smokers who were only slightly worried about their health were 3.9 times more likely to quit [25].

Lanari et al. showed that people with poor health are more likely to quit smoking during the observation period, which means that current smokers report worse health than never-smokers or former smokers [26]. Other research confirms that smoking is associated with worse overall health. Smokers perform worse on SRH in the long term compared to nonsmokers, and the size of this estimate has grown at a declining pace [27].

Smoking has been found to be the most important risk factor for SRH, with patterns of this association being involved in assessing the effects of long-term smoking [28, 29].

In our study, every second person with a strong addiction was asked at the doctor's in the last year whether they smoke, and 60% of them were

advised to quit smoking during such a visit. In the group less addicted to nicotine, 59.1% were asked by health care workers over the past year whether they smoke, and every second person (50%) was advised to quit smoking. Differently, in the study of Kaleta et al., where it was shown that hardcore smokers who visited health care workers were less often asked about smoking or were advised to quit smoking compared to non-hardcore smokers [30].

It is necessary to conduct education, shape pro-health attitudes, and motivate smokers to fight the addiction. SRH can play a role here as an important screening tool to identify people at risk.

Our current study has several strengths. There has not been such a study so far. For the first time, the study was conducted among the socially disadvantaged adult rural population. The limitation of the study is a small group of the population. In addition, the study used a cross-sectional design that tends to be observed at one point in time, making it impossible to observe changes over longer periods of time. The study was limited to the population of Piotrków County, which may limit the generalization of the results to the population of Poland.

Conclusions

SRH can be a simple, quick, and inexpensive measure to monitor health in a variety of populations, including people with varying degrees of nicotine addiction.

References

1. Wojtczak A. Zdrowie publiczne wyzwaniem dla systemów zdrowia XXI wieku. Warszawa: Wydawnictwo Lekarskie PZWL; 2020.

2. Woynarowska B. Edukacja zdrowotna. Warszawa: Wydawnictwo Naukowe PWN; 2017.

3. Kaczmarek M. Koncepcja i pomiar jakości życia związanej ze zdrowiem. In: Kaczmarek M, Szwed A, eds. Między antropologią a medycyną. Koncepcje teoretyczne i implikacje praktyczne. Poznań: Wyd. Naukowe UAM; 2009, pp. 35–48.

4. Kawada T. Self-rated health and life prognosis. Arch Med Res 2003; 34: 343–347.

5. Theme Filha MM, Szwarcwald CL, Souza Junior PR. Measurements of reported morbidity and interrelationships with health dimensions. Rev Saude Publica 2008; 42(1): 73–81.

6. Singh-Manoux A, Gueguen A, Martikainen P et al. Self-rated health and mortality: Short and long-term associations in the Whitehall II Study. Psychosom Med 2007; 69(2): 138–143.

7. Idler EL, Benyamini Y. Self-rated health and mortality: A review of twenty-seven community studies. J Health Soc Behav 1997; 38(1): 21–37.

8. Szwarcwald CL, Souza-Júnior PR, Esteves MA et al. Socio-demographic determinants of self-rated health in Brazil. Cad Saúde Pública 2005; 21: 54–64.

9. Jurewicz J, Kaleta D. Correlates of Poor Self-Assessed Health Status among Socially Disadvantaged Populations in Poland. Int J Environ Res Public Health 2020; 17(4): 1372.

10. Jopkiewicz A, Gawron J, Majecka-Kotwica M. Charakterystyka wybranych elementów stylu życia osób dorosłych z województwa świętokrzyskiego. Zdrowie i Dobrostan 2015; 2: 161–173.

11. Esmer B, Sengezer T, Aksu F et al. Clinical, sociodemographic and tobacco-use factors associated with smoking cessation rates at three years follow-up, Ankara, Turkey. Tob Prev Cessat 2019; 5: 47.

12. WHO Report on the global tobacco epidemic 2019: offer help to quit tobacco use Geneva: World Health Organization; 2019 [Internet]. Available from: https://www.who.int/teams/health-promotion/tobacco-control/who-report-on-the-global-tobacco-epidemic-2019 [cited 15.11.2020].

13. WHO Global Report on Trends in Prevalence of tobacco use 2000-2025. Geneva: World Health Organization; 2019 [Internet]. Available from: https://www.who.int/tobacco/publications/surveillance/reportontrendstobaccosmoking/en/index4.html [cited 15.11.2020].

14. A Report from a Nation-wide Survey about Attitudes towards Tobacco Consumption. Kantar for the Chief Sanitary Inspectorate (GIS). Warszawa: Główny Inspektorat Sanitarny; 2019.

15. Wojtyniak B, Goryński P. Sytuacja zdrowotna ludności Polski i jej uwarunkowania. Warszawa: NIZP-PZH; 2019.

16. Zatoński W. Jak rzucić palenie? Warszawa: Fundacja Promocja Zdrowia; 2007.

17. Jankowski M, Kaleta D, Zgliczyński WS et al. Cigarette and E-Cigarette Use and Smoking Cessation Practices among Physicians in Poland. Int J Environ Res Public Health 2019; 16(19): 3595.

18. Milcarz K, Makowiec-Dąbrowska T, Bąk-Romaniszyn L et al. Smoking Patterns and Smoking Cessation Willingness – A Study among Beneficiaries of Government Welfare Assistance in Poland. Int J Environ Res Public Health 2017; 14(2): 131.

19. Test tolerancji nikotyny Fagerströma. 2020 [Internet]. Available from: https://www.poradnikzdrowie.pl/ psychologia/ zdrowie-psychiczne/test-tolerancji-nikotyny-fagerstroma-kwastionariusz-aa-Thzh-L6Yg-f8hG.html [cited 15.11.2020].

20. Darviri C, Artemiadis AK, Tigani X et al. Lifestyle and self-rated health: A cross-sectional study of 3,601 citizens of Athens, Greece. BMC Public Health 2011; 11: 619.

21. Abuladze L, Kunder N, Lang K et al. Associations between self-rated health and health behaviour among older adults in Estonia: A cross-sectional analysis. BMJ Open 2017; 7: e013257.

22. Andersen FK, Christensen K, Frederiksen H. Self-rated health and age: A cross-sectional and longitudinal study of 11,000 Danes aged 45–102. Scand J Public Health 2007; 35: 164–171.

23. McFadden E, Luben R, Bingham S et al. Social inequalities in self-rated health by age: Cross-sectional study of 22 457 middle-aged men and women. BMC Public Health 2008; 8: 230.

24. Arnadottir SA, Gunnarsdottir ED, Stenlund H et al. Determinants of self-rated health in old age: A population-based, cross-sectional study using the International Classification of Functioning. BMC Public Health 2011; 11: 670.

25. Driezen P, Abdullah AS, Quah ACK et al. Determinants of intentions to quit smoking among adult smokers in Bangladesh: Findings from the International Tobacco Control (ITC) Bangladesh wave 2 survey. Glob Health Res Policy 2016; 1: 11. https://doi.org/ 10.1186/s41256-016-0012-9.

26. Lanari D, Bussini O, Minelli L. The Effects of Immigrant Status and Age at Migration on Changes in Older Europeans' Health. International Migration Review 2019; 52(4): 1218–1249.

27. Lanari D, Pasqualini M, Pieroni L. Is it Time to Quit? Smoking Persistence and Self-Rated Health. Journal of Population Aging 2020. https://doi.org/10.1007/s12062-020-09292-5.

28. McClave AK, Dube SR, Strine TW et al. Associations between health--related quality of life and smoking status among a large sample of US adults. Prev Med 2009; 48(2): 173–179.

29. US Surgeon General Report 2014. U.S. Surgeon General Report 2014. The health consequences of smoking: 50 years of Progress [Internet]. Available from: https://www.cdc.gov/tobacco/data_statistics/sgr/50th-anniversary/index.ht [cited 15.11.2020].

30. Kaleta D, Usidame B, Dziankowska-Zaborszczyk E et al. Prevalence and factors associated with hardcore smoking in Poland: Findings from the Global Adult Tobacco Survey (2009–2010). BMC Public Health 2014; 14: 583.

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Satisfaction of Patients under Gynaecological and Obstetric Care in a Selected Medical Facility Providing Services under Coordinated Care for Pregnant Women (CCPW)

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Abstract

Introduction: *The objective of services provided within CCPW is providing pregnant women with coordinated care at the 2nd or 3rd level of perinatal care, including specialist outpatient care, childbirth and care for the newborn, and, if there are medical indications, also hospitalisation.*

Objective: *The main objective of the paper was to learn about change in satisfaction level of patients under gynaecological and obstetric care in a selected medical facility providing services under Coordinated Care for Pregnant Women (CCPW).*

Material and methods: *The study was conducted in two stages. The first stage of the study was carried out one month after the introduction of Coordinated Care for Pregnant Women (CCPW) in the facility, while the second stage of the study was carried out after seven months of providing services under the CCPW. In the first stage of the study, 150 patients, i.e. 98.7% of those who gave birth in the analysed period, returned the completed questionnaires, and 162 patients (83.1% of those giving birth) in the second stage.*

Results: *Most of the respondents (103 people), i.e. 68.7%, participating in the first stage of the study, assessed the services provided under outpatient care very well. The second largest group were patients who rated the discussed services as good – 22.7% (34 people). In the second stage of the study, as in the first stage, the majority of people assessed the outpatient specialist care very positively – 79.6% (129 people), while 28 women, i.e. 17.3% of the respondents, rated it good. The respondents were asked if they would choose the facility again as a place for giving birth again. Both in the first and in the second stage of the study, almost all respondents – 98.0% (147 people) vs 98.1% (159 people) answered the question: yes or definitely yes.*

Conclusions: *The conducted research has shown a high level of patient satisfaction with care and proper functioning of the assessed elements of service provision both in outpatient specialist care and during hospitalisation.*

Key words: *coordinated care for a pregnant woman, patient satisfaction, quality of medical care.*

Introduction

Elements of coordinated health care are being introduced more and more often in the Polish health care system as a tool to improve the quality of medical care, and thus the effectiveness of patient treatment, e.g. coordinated care for an oncologically ill patient DILO, Coordinated Care for Pregnant Women CCPW, Comprehensive Patient Care Programme after a Heart attack [1]. Coordinated Care for Pregnant Women (CCPW) was introduced as part of the comprehensive support program for families, "For Life" [2]. The objective of services provided within CCPW is providing pregnant women with coordinated care at the 2nd or 3rd level of perinatal care, including specialist outpatient counselling, childbirth and care for the newborn, and, if there are medical indications, also hospitalisation. The facility providing services under the Coordinated Care for Pregnant Women is obliged to perform a wider range of tasks compared to standard obstetric and gynaecological care for a pregnant woman. The tasks of the coordinating facility include, *inter alia*: coordinating the entire process of caring for a pregnant woman; developing an individual perinatal care plan; developing and submitting to the National Health Fund an organisational chart for the implementation of the CCPW; preparing "Information for a woman under coordinated care for pregnant women" for patients; coordination of activities related to the provision of additional specialist consultations resulting from the care process; providing the patient with the possibility of 24/7 contact with the facility on an individual telephone number for patients covered by the CCPW programme; establishing the principles of consultation and cooperation with the 3rd reference level centre, which provides consultations in cases of abnormalities in the course of pregnancy [3].

One of the tasks of the facility providing services under Coordinated Care for Pregnant Women is to evaluate the satisfaction of patients with care and the quality of services provided by means of regular surveys among patients.

The method of assessing the quality of medical care provided to patients more and more often used nowadays is testing their satisfaction with the received services [4, 5, 6, 7]. Constant monitoring of the level of patient satisfaction is of great importance for entities providing healthcare services because patients shape the current market of medical services, *inter alia*, by expressing their opinions and expectations towards medical and nursing care [8, 9]. Particularly noteworthy is the fact that patient satisfaction is positively correlated with the safety and clinical effectiveness of health care [10, 11, 12].

The high quality of services determines the patient's safety, which in turn translates into their life and health. The quality of services and its role is still growing, it is, *inter alia*, a consequence of the progressive standardisation, but also the growing importance of the individual approach to the patient, as well as the increase in their expectations towards care and the service provider [13, 14, 15, 16].

The importance of assessing patient satisfaction with health care services for health system evaluation is underlined by the fact that patient satisfaction, along with mortality and morbidity, was included among the three measures of overall health care assessment established in 1970 by the United States National Center for Health Services Research and Development. The Organization for Economic Cooperation and Development (OECD) and the World Health Organization (WHO) also emphasise the importance of assessing health care services from the perspective of recipients for the development of health care and the quality of medical care [17, 18, 19].

Objective

The main objective of the paper was to learn about change in satisfaction level of patients under gynaecological and obstetric care in a selected medical facility providing services under Coordinated Care for Pregnant Women (CCPW).

Material and methods

The study was carried out in 2020 in a selected medical facility providing services in the field of obstetrics and gynaecology as part of the basic hospital health care system. The study was conducted in two stages. The first stage of the study was carried out one month after the introduction of Coordinated Care for Pregnant Women (CCPW) in the facility, while the second stage of the study was carried out after seven months of providing services under the CCPW. At each stage of the study, empirical material has been collected for two months.

When collecting the empirical material, a questionnaire provided by the National Health Fund was used to assess the level of satisfaction of patients using CCPW services, consisting of 21 questions, including 8 questions on outpatient care and 13 questions on hospital care. The questionnaire was intended for self-completion by respondents. Participation in the study was voluntary and anonymous. Patients were asked to fill in the questionnaire after delivery, before leaving the hospital.

In the first stage of the study, 150 patients, i.e. 98.7% of those who gave birth in the analysed period, returned the completed questionnaires, and162 patients (83.1% of those giving birth) in the second stage.

The data contained in the surveys were entered into the MS Excel spreadsheet. In order to develop the collected empirical material, descriptive methods and methods of statistical inference were used. For the description of the whole group of examined and subgroups distinguished on the basis of qualitative features, structure indicators were calculated, which were expressed as a percentage [%]. To compare the incidence of particular categories of quantitative features in the analysed groups, the chi-square independence was used. The results for which the values of the statistics obtained in the conducted tests belonged to the critical area of the relevant distribution at the significance level p=0.05 were considered significant.

Results

Among the total number of patients (150 women) who submitted the completed questionnaires in the first stage of the study, the vast majority, i.e. 86.7% (130 people) of the respondents admitted that the person conducting the pregnancy established a plan of care for her and the baby at the first visit, during which the patient's pregnancy was confirmed. In the second stage of the study, the percentage of women who confirmed the plan of care for the patient and the child was higher and amounted to 95.7% (155 people). The observed differences turned out to be statistically significant – $p<0.005$, $Chi^2=8.003$ (Table 1).

In the first stage of the study, 123 patients (82.0%) replied that they had obtained information on practical and theoretical preparation for childbirth while using the outpatient specialist care. In the group of 162 women who took part in the study, 151 respondents, i.e. 93.2%, gave a similar answer after 7 months of CCPW services in a facility. The differences in the distribution of answers to the question asked were statistically significant – $p<0.005$, $Chi^2=9.15$ (Table 1).

In the group of 150 women participating in the first stage of the study, the majority, that is 79.3% of the respondents (119 people), stated that they had received information on newborn care and breastfeeding in the outpatient specialist care. Among 162 women who submitted completed questionnaires in the second stage of the study, the percentage of patients who admitted that they had been provided with such information was significantly higher and amounted to 92.0% (149 people) – $p<0.005$, $Chi^2=10.276$ (Table 1).

In the last question on outpatient specialist care, patients were asked to give an overall assessment of the services provided. Most of the respondents (103 people), i.e. 68.7% of those participating in the first stage of the study, assessed the services provided under outpatient care very well. The second largest group were patients who rated the discussed services as good – 22.7% (34 people). In the second stage of the study, as in the first stage, the majority of people assessed the outpatient specialist

care very positively – 79.6% (129 people), while 28 women, i.e. 17.3% of the respondents, rated it good (Table 1).

Table 1. Implementation and comparison of the assessment of selected elements of specialist outpatient care by patients under Coordinated Care for Pregnant Women (CCPW) in the analysed periods

Outpatient specialist care	**One month after the introduction of CCPW**		**7 months after the introduction of CCPW**		**p**
Establishing a care plan for the patient and the child by the person carrying out the pregnancy at the first visit	N	%	N	%	
yes	130	86.7	155	95.7	p<0.005 Chi^2=8,003
no	20	13.3	7	4.3	
Obtaining information on preparation for childbirth	N	%	N	%	p
yes	123	82	151	93.2	p<0.005 Chi^2=9,15
no	27	18	11	6.8	
Obtaining information on newborn care and breastfeeding	N	%	N	%	p
yes	119	79.3	149	92.0	p<0.005 Chi^2=10,276
no	31	20.7	13	8.0	
Assessment of outpatient care	N	%	N	%	p
very good	103	68.7	129	79.6	p<0.05
good	34	22.7	28	17.3	
rather good	12	8	5	3.1	
poor	1	0.7	0	0	
very poor	0	0	0	0	

Source: own research.

Another analysed area of CCPW benefits was hospital care. In the first stage of the study, the vast majority of the respondents, i.e. 87.3% (131 people), assessed the organisation of admission to the ward as good or very good. A similar distribution of responses was noted among the

women participating in the second stage of the study. The organisation of admission to the ward was rated very well by 82.7% (134 people) of the respondents, while well by 9.3% of the respondents, i.e. 15 people (p>0.05) (Table 2).

Almost all patients participating in the first stage of the study – 96.7% (145 people) admitted that during their stay in hospital, care was always performed with preservation of privacy. In the second stage of the study, the percentage of people who gave a similar answer was higher by over two percentage points (98.8%, 160 people) – p>0.05 (Table 2).

Among 150 women participating in the first stage of the study, 139 people (92.7%) admitted that all information about their health was always provided to them in an understandable way. In the group of patients who took part in the study, seven months after the commencement of CCPW in the facility, almost all patients – 97.5%, gave a similar response (p>0.05) (Table 2).

The patients were then asked to assess the availability of a doctor and midwife in the ward. The availability of a doctor, both in the first and in the second stage of the study, was assessed by almost all patients as good or very good – 98.0% vs 98.2% (p>0.05) (Table 2).

The availability of the midwife, regardless of the stage of the study, was assessed by all patients as good or very good (Table 2).

In the last question on hospital care, the respondents were asked if they would choose the facility again as a place to deliver another baby. Both in the first and in the second stage of the study, almost all respondents – 98.0% (147 people) vs 98.1% (159 people) answered the question: yes or definitely yes 2).

Table 2. Comparison of the assessment of selected elements of hospital care by patients under Coordinated Care for Pregnant Women (CCPW) in the analysed periods

Hospital care	One month after the introduction of CCPW		7 months after the introduction of CCPW		p
Assessment of the organisation of admission to the ward	N	%	N	%	
very good	120	80.0	134	82.7	p<0.05
good	11	7.3	15	9.3	
rather good	13	8.7	12	7.4	
poor	6	4.0	1	0.62	
Preservation of privacy and confidentiality while being taken care of	N	%	N	%	p
yes, always	145	96.7	160	98.8	p>0.05
usually yes	5	3.3	2	1.2	
rarely	0	0.0	0	0.0	
no, never	0	0.0	0	0.00	
Understandable communication of information on health	N	%	N	%	p
yes, always	139	92.7	158	97.5	p>0.05
usually yes	7	4.7	3	1.9	
rarely	4	2.7	1	0.6	
no, never	0	0.0	0	0.0	
Doctor's availability assessment	N	%	N	%	p
very good	135	90.0	155	95.7	p>0.05
good	12	8.0	4	2.5	
rather good	3	2.0	3	1.9	
poor	0	0.0	0	0.0	
very poor	0	0.0	0	0.00	
Midwife's availability assessment	N	%	N	%	p
very good	140	93.3	155	95.7	p>0.05
good	10	6.7	7	4.3	
rather good	0	0.0	0	0.0	
poor	0	0.0	0	0.0	
very poor	0	0.0	0	0.0	

Choosing the hospital as a good place to deliver another baby	N	%	N	%	p
definitely yes	137	91.3	150	92.6	p>0.05
yes	10	6.7	9	5.5	
rather yes	3	2.0	3	1.9	
no	0	0.0	0	0.0	
definitely yes	0	0.0	0	0.0	

Source: own research.

Discussion and Conclusions

The provision of services under Coordinated Care for Pregnant Women imposes additional obligations on medical facilities, including the need to evaluate the quality of selected elements of service delivery and the level of patient satisfaction with care. This, in turn, allows the identification of factors that are worse assessed by patients or implemented at an inappropriate level.

The conducted research has shown a high level of patient satisfaction with care and the proper functioning of the assessed elements of service provision both in outpatient specialist care and during hospitalisation.

Compared to the first stage of the study in the second stage, i.e. 7 months from the start of CCPW, a statistically significant improvement was observed in the following elements of the provision of services in outpatient specialist care: establishing a care plan for the patient and the child by the person carrying out the pregnancy at the first visit 86.7% vs 95.7%; obtaining information on preparation for childbirth 82.0% vs 93.2% and obtaining information on newborn care and breastfeeding 79.3% vs 92.0%. The observed improvement of the assessed elements did not, however, significantly change the overall, very high assessment of the services provided in outpatient specialist care, which almost all patients, both in the first and in the second stage of the study, assessed well or very well. It should be emphasised that the assessment of outpatient specialist care performed by patients does not give fully reliable results,

which is related to the process of providing services. Individual patients can be included in CCPW at any stage of pregnancy. Some of them, before the first visit to a given facility, receive care in other clinics or private doctor's offices, which in turn may negatively or positively translate into the overall assessment of outpatient specialist care used by the patient during pregnancy.

The conducted studies did not show statistically significant changes in the level of patient satisfaction with selected elements of obstetric and gynaecological care during hospitalisation in the first and second stages of the study. The lack of the observed differences could be caused by a very high assessment of all analysed elements of care in the first stage of the study.

In order to maintain high-quality medical care and to quickly identify possible unfavourable changes in the level of satisfaction of patients with CCPW programme, regular analyses of empirical material from the conducted surveys among patients covered by Coordinated Care for Pregnant Women should be conducted.

References

1. Nessler J, Kozierkiewicz A, Gackowski A et al. Coordinated heart failure care in Poland: towards optimal organisation of the health care. Kardiol Pol 2018; 76(2): 479–487.

2. Uchwała nr 160 Rady Ministrów z dnia 20 grudnia 2016 r. w sprawie programu kompleksowego wsparcia dla rodzin "Za życiem". M.P. 2016 poz. 1250.

3. Zarządzenie Nr 178/2019/DSOZ Prezesa Narodowego Funduszu Zdrowia z dnia 31 grudnia 2019 r. w sprawie warunków zawierania i realizacji umów o udzielanie świadczeń opieki zdrowotnej przez podmioty realizujące świadczenia koordynowanej opieki nad kobietą i dzieckiem w związku z przepisami ustawy o wsparciu kobiet w ciąży i rodzin "Za życiem".

4. Lenartowicz H. Zarządzanie jakością w pielęgniarstwie. Warszawa: CEM; 1998.

5. Xesfingi S, Vozikis A. Patient satisfaction with the healthcare system: Assessing the impact of socio-economic and healthcare provision factors. BMC Health Serv Res 2016; 16: 94. https://doi.org/10.1186/s12913-016-1327-4.

6. Moon J, Kolar C, Brummel A et al. Development and Validation of a Patient Satisfaction Survey for Comprehensive Medication Management. J Manag Care Spec Pharm 2016; 22(1): 81–86. https://doi.org/10.18553/jmcp.2016.22.1.81.

7. Kisuule F, Howell EE. Hospitalists and Their Impact on Quality, Patient Safety, and Satisfaction. Obstet Gynecol Clin North Am 2015 Sep; 42(3): 433–446. https://doi.org/10.1016/j.ogc.2015.05.003.

8. Małecka B, Marcinkowski JT. Satysfakcja pacjenta czynnikiem kształtującym współczesny rynek usług medycznych. Probl Hig Epidemiol 2007; 88(1): 17–19.

9. Hefner JL, McAlearney AS, Spatafora N et al. Beyond Patient Satisfaction: Optimizing the Patient Experience. Adv Health Care Manag 2019; 18. https://doi.org/10.1108/S1474-823120190000018010.

10. Doyle C, Lennox L, Bell D. A systematic review of evidence on the links between patient experience and clinical safety and effectiveness. BMJ Open 2013; 3(1): e001570.

11. Jha AK, Orav EJ, Zheng J et al. Patients' perception of hospital care in the United States. N Engl J Med 2008; 359(18): 1921–1931.

12. O'Leary KJ, Cyrus RM. Improving patient satisfaction: Timely feedback to specific physicians is essential for success. J Hosp Med 2015; 10(8): 555–556.

13. Nowatorska-Romaniak B. Marketing usług zdrowotnych. Zakamycze: Wydawnictwo Kantor; 2002, p. 67.

14. Małecka B, Marcinkowski JT. Satysfakcja pacjenta czynnikiem kształtującym współczesny rynek usług medycznych. Probl Hig Epidemiol 2007; 88(1): 17–19.

15. Doyle C, Lennox L, Bell LD. A systematic review of evidence on the links between patient experience and clinical safety and effectiveness. BMJ Open 2013; 3(1): 1–18.

16. Jha AK, Orav EJ, Zheng J et al. Patients' perception of hospital care in the United States. N Engl J Med 2008; 359(18): 1921–1931.

17. Jurst J, Jee-Hughes M. Performance measurement and performance management in OECD halth systems. Labour Market and Social Policy Occasional Papers 47. Paris: OECD; 2000.

18. Murray CJL, Frenk J. A Framework for assessing the performance of health systems. Bulletin of the World Health Organization 2000; 78(6): 717–731.

19. Garratt AM, Solheim E, Danielsen K. National and cross-national surveys of patient experiences: a structured review. Rapport no. 7. Oslo: Nasjonalt kunnskapssenter for helsetjenesten; 2008.

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The Prospect of an HIV Vaccine – a Review of Recent Research

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Abstract

Human immunodeficiency virus, HIV, causes a progressive decline in humans' immune system, leading to development of AIDS. According to the World Health Organization, approximately 36.7 million people are living with HIV in the world, and more than 1 million people died in 2019. Vaccination is one effective method of stopping HIV from spreading around the world. So far, no effective vaccine against HIV has been found. Research teams are conducting 40 trials worldwide to find a vaccine against HIV. The nature of the virus, which is primarily characterized by an extremely high genetic variability, is a significant obstacle to vaccine development. The RV144 *clinical trial has become a precursor to the use, and further development of biology system approaches for the correlation of infection risk. Analyzing the virus, which involved studying HIV genetic sequences, breakthrough infections, vaccine components, and observed functional immune relationships, helped scientists develop associations and differences that might be indicative of protection against the virus. The* RV144 *and RV217 clinical trials, which hypothesized that a vaccine could induce host immunity, are still speculation. Vaccines are adapted to current approaches to ensure that study participant are exposed to HIV antigens in a variety of ways to elicit mixed immune responses i.e., humoral, cellular, and innate arms of the host immune system using heterologous vaccines to induce non-specific immunity. HIV vaccine clinical trials are significant to humanity. Epidemiological data make us aware of the great problem we are dealing with. The medical experiment* RV144 *shows that it is possible to obtain a vaccine. We must hope that the nearest future in HIV prevention is an effective and safe vaccine.*

Key words: *HIV vaccine, RV 144*

Introduction

Human immunodeficiency virus, HIV – so far, two types of this virus have been known: HIV-1 and HIV-2. HIV causes a progressive decline in humans' immune system, leading to the development of AIDS. According to the World Health Organization, approximately 36.7 million people are living with HIV in the world, and more than 1 million people died in 2019. The most significant number of people living with active infection are in Sub-Saharan Africa, about 25.7 million, in Western and Central Europe, about 2.5 million [1]. According to the National Institute of Hygiene, in Poland, from the implementation of the research from 1985 to December 31, 2019, HIV infection was found in 25.544 people, 3.768 AIDS cases were reported; 1.429 sick people died [2]. From the beginning of 2017, there were nearly 10.000 patients under antiretroviral treatment in Poland [3]. People access to medical services and antiretroviral therapies vary considerably across the world. Third world countries cannot afford the cost of antiretroviral treatments for most patients. The U.S. President's Global AIDS Relief Program (PEPFAR) and heroic efforts to curb the HIV pandemic are still insufficient to equalize the opportunities for treatment [4]. Economic barriers, totalitarian political systems, and an uneducated society keep HIV a death sentence in some parts of the world rather than a chronic disease that can be controlled through antiretroviral therapy.

Vaccination is one effective method of stopping HIV from spreading around the world. So far, no effective vaccine against HIV has been found. Research teams are conducting 40 trials worldwide to find a vaccine against HIV. A review of the literature and research will bring closer the current state of knowledge on the invention of the HIV vaccine.

The essence of the problem with the invention of a vaccine against HIV

Research teams around the world are trying to get an effective HIV vaccine; this discovery would become one of the most important events of

the 21st century. Therefore the financial outlays and social expectations are huge. The central aspect is that humans do not develop natural protective immunity to HIV infection. Except for rabies, vaccines only exist for diseases for which there is specific immunity. There are people in the world who remain infected with HIV but do not develop clinical disease symptoms for a long time, and this is a tiny group of people called "elite controllers". Unfortunately, the overwhelming majority, as many as 99% of people, are not able to control the infection themselves, in the absence of treatment [5]. Elite controllers, however, still produce the virus and suffer the consequences of inflammation. Another problem in the invention of a vaccine is the absence of a specific response. It remains the immune, cellular, and antibody functions, which are poorly understood. Since the host immune response to HIV is incapable of completely eradicating the virus, developing a vaccine to elicit an effective immune response presents a particular challenge since a natural infection does not provide any blueprint for vaccine design.

The nature of the virus is a significant obstacle to vaccine development. It is primarily characterized by an extremely high genetic variability. Modeling studies demonstrate that the virus is sufficiently variable to obstruct the typical host development of broadly neutralizing antibody responses that require extensive somatic mutation in the immunoglobulin gene locus and deviation in immune tolerance mechanisms [6]. The virus is so flexible that, thanks to its ability to evade Tc cell responses, many forms of the virus can survive, not necessarily in a single variant.

Scientists cite HIV latencies as another significant problem in vaccine development. The human immunodeficiency virus genetically integrates into the host's chromosomes. Recent studies show that HIV latency may be related to how at least some variants of the virus are made. The infected cell is most often re-infected with multiple options of the virus, allowing genetically recombinant forms to emerge in reactivated mutant infections [7]. Host cells containing the reactivated ones are relatively rare in the presence of an antigen. They are, therefore, relatively insensitive to antibody-dependent cellular cytotoxicity (ADCC) and other forms

of immune surveillance. Attempts to develop an effective HIV vaccine on a global scale have evolved. To date, only six clinical trials have been conducted with the efficacy of the vaccine. Scientists focused on monomeric HIV envelope proteins, combined with canarypox viral vectors and adeno-induced HIV genes, either alone or in combination with HIV DNA [8]. Due to well-founded safety concerns, no methods based on viral attenuation or virion inactivation were included in clinical trials. Historically, the technique that has been effective and best known for vaccine development for many years has been eliminated.

A review of the most promising studies

The clinical study "RV144", which was conducted in Thailand on more than sixteen thousand men and women randomly assigned to receive placebo or a combination of canarypox vector vaccine (ALVAC-HIV vCP1521) and recombinant HIV glycoprotein 120 (gp120) product of B and E subtypes (AIDSVAX B / E) in 2003-2009, has demonstrated potential protection against HIV. So far, this is the only study that has shown the effectiveness of the vaccine. By excluding people infected with HIV at the beginning of the clinical trial, the vaccine proved to be effective at the level of 31.2% at three years after the primary injection. From a global point of view, this is not satisfactory effectiveness. However, scientists already have a starting point, and further work is more than likely. The protective effect six months after the primary vaccination series was 60.5%; unfortunately, this effect quickly diminished [9]. Vaccinations affected viral load following infection or CD4 + T cell counts in people with breakthrough HIV infection. Immunological markers related to the protective effect of the vaccine have been identified. The extensive collaboration of international laboratories has shown in HIV-infected and tested individuals the strongest association providing protection for IgG antibodies against the variable regions of the HIV 1 and 2 envelope (V1V2) – IgG3 in particular – and low serum IgA antibodies [10]. This allows us to look to the future with optimism. Phase II of the clinical trial "RV144"

arouses widespread emotions among the public due to the expectation of even better vaccine effectiveness [11]. Phase II focuses primarily on the efficiency in the various conditions of the existence of the virus and its subtypes.

The "RV144" clinical trial has become a precursor to the use, and further development of biology systems approaches for the correlation of infection risk. By analyzing the virus, which involved studying HIV genetic sequences, breakthrough infections, vaccine components, and observed functional immune relationships, it helped scientists develop associations and differences that might be indicative of protection against the virus [12]. Further exploratory studies around the world following the presentation of the analysis of the clinical experiment "RV144" reflect the multilateral investigative approaches, and the use of potential vaccine "products" for further clinical trials in other subtypes, such as subtype C in South Africa [13].

Another approach by scientists to fight HIV is to try without a vaccine. The story of how the immune system can partially or more fully control HIV is complex and, in a sense, has been told backward, starting with artificially induced immunity from vaccine research, rather than on a real understanding of HIV infection as it has been established. Decades of experience with HIV patients passed before the acute course of the infection was properly understood. The observational study "RV217" is a prospective analysis of patients at high risk of infection in East Africa and Thailand. 2.300 patients were recruited for the study. The acute phase of the disease was noted in 5% of respondents. A maximum viral load was achieved after approximately 30 days, and a positive "EIA" test was achieved after 14 days. Up to the time of peak viral load, N.K. cells responded variable; The B cells initially dropped and then returned to normal. CD8 + T cells, CD4 + T cells decreased and remained inversely proportional to the viral load [14, 15]. This information is beneficial for developing an HIV vaccine strategy in several ways. Like many other viral syndromes, the human immunodeficiency virus fills most of its distribution in host tissues during the first two weeks. The diverse effect on the population

of B and T cells is still unclear about the importance of innate immunity. HIV causes less symptomatic acute disease (and therefore less inflammation throughout the body) than previously thought and stabilizes fairly quickly. Consequently, a neutralizing antibody available during log virus expansion would be a useful, but potentially insufficient, control mechanism. Scientists believe that key here will be primarily antibody-mediated non-neutralizing functions – and possibly innate effector functions.

The "RV144" and "RV217" clinical trials, which hypothesized that a vaccine could induce host immunity, are still speculation. Vaccines are adapted to current approaches to ensure that study participant are exposed to HIV antigens in a variety of ways to elicit mixed immune responses i.e., humoral, cellular, and innate arms of the host immune system using heterologous vaccines to induce non-specific immunity. Researchers' current efforts are focused on designing immunogens that would elicit a sustained and broad neutralizing antibody response against HIV. The number of monoclonal antibodies capable of extensively neutralizing anti-HIV activity is increasing exponentially thanks to the currently dominant molecular techniques for their recovery from HIV infected patients. Monoclonal antibodies, i.e., PGT121, VRC01, and VRC03, have been observed in cellular assays to inhibit CD4 + T cell insertion by latent viruses from chronically infected individuals. PGT121 and VRC01 antibodies were used in preclinical studies in acute phase infected king macaques with SIVs virus to reduce both viral load and viral DNA associated with cells [16]. It is not possible to cause such a reaction through active vaccination in humans at this point. Still, their use for HIV prevention and control by passive immunization is currently being tested in several clinical trials, which would provide evidence why they would likely work in active immunization. Researchers continue to search based on their observations of virus neutralization for the real antibody and antigen.

Ongoing research into an HIV vaccine

Table. 1 Clinical trials HIV vaccine, own study [14]

Country	Substance	Title of study	Type of Study	Phase	NCT number
US	N/A	A T Cell-based HIV Vaccine	Observational	N/A	NCT02389595
Thailand	AIDSVAX B/E	Study of Immune Responses Induced by an HIV Vaccine	Interventional double blind	2	NCT01933685
South Africa	ALVAC-HIV (vCP2438) and Bivalent Subtype C gp120/MF59	Pivotal Phase 2b/3 ALVAC/Bivalent gp120/MF59 HIV Vaccine Prevention Safety and Efficacy Study in South Africa	Interventional	2b/3	NCT02968849
US	(A, B, C, A/E)/gag (C) DNA Vaccine, gp120 (A, B, C, A/E) Protein Vaccine, GLA-SE adjuvant	Evaluating the Safety and Immunogenicity of Env (A, B, C, A/E) /Gag (C) DNA and gp120 (A, B, C, A/E) Protein/GLA-SE HIV Vaccines, Given Individually or Co-administered, in Healthy, HIV-1-Uninfected Adults	Interventional double blind	N/A	NCT03409276
US	a1DC + inactivated whole autologous HIV, a1DC + conserved HIV peptides, a1DC + no antigen, pgDC + inactivated whole autologous HIV, pgDC + conserved HIV peptides, pgDC + no antigen	Comparison of Dendritic Cell-Based Therapeutic Vaccine Strategies for HIV Functional Cure (DC-HIV04)	Interventional double blind	1	NCT03758625
Germany	N/A	HIV and STIs Clinical Study in Germany	Observational		NCT03884816

Thailand	ALVAC-HIV, AIDSVAX B/E, ALVAC-HIV Placebo, AIDSVAX B/E Placebo	Study of Late Boost Strategies for HIV--Uninfected Participants From Protocol RV 144	Interventional double blind	2	NCT01435135
US	PENNVAX-GP, INO-6145, INO-9012, CELLECTRA® 2000	Therapeutic Vaccination in Treated HIV Disease	Interventional	1/2	NCT03606213
France, Hungary, Italy, Poland, Spain	N/A	Prospective Observational Cohort HIV & STI Study in Europe	Observational	N/A	NCT03866759
US	Ad4-Env145NFL, Ad4-Env150KN, VRC-HIVRGP096--00-VP (Trimer 4571) with alum	Safety and Immunogenicity of Ad4--HIV Envelope Vaccine Vectors in Healthy Volunteers	Interventional	1	NCT03878121
US	p4CE1/2 pDNA Vaccine, p55^gag pDNA Vaccine, IL-12 pDNA Adjuvant	Evaluating the Safety and Immunogenicity of pDNA Vaccines Expressing HIV M Group p24^Gag Conserved Elements and/or p55^Gag, Administered With IL-12 pDNA by Intramuscular Electroporation, in Healthy, HIV-Uninfected Adults (HVTN 119)	Interventional	1	NCT03181789
Brazil	Yellow Fever vaccination (17 DD Biomanguinhos)	Immunogenicity and Safety of the Yellow Fever Vaccine in HIV-Infected Individuals (YF-HIV)	Interventional	4	NCT03132311
Taiwan	Vaqta Injectable Product	Effectiveness of Booster With 1 or 2 Doses of HAV Vaccine Among HIV-Infected Patients	Interventional	4	NCT03855176
Taiwan	Engerix-B	Hepatitis B Virus Vaccination in HIV-Positive Patients and Individuals at High Risk for HIV Infection	Interventional	4	NCT03854630

US	p24CE1/2 pDNA vaccine, p24CE1/2 pDNA vaccine admixed with full--length p55^gag pDNA vaccine, Full-length p55^gag pDNA vaccine	HIV-1-Gag Conserved-Element DNA Vaccine as Therapeutic Vaccination in HIV-Infected Persons With Viral Suppression on Antiretroviral Therapy	Interventional	1/2	NCT03560258
Spain	HPV9v	A Clinical Trial to Evaluate the Immunogenicity of the Nonavalent Vaccine Against Human Papillomavirus in Men Infected by HIV Who Have Sex With Men. GESIDA 10017 (GESIDA10017)	Interventional	4	NCT03626467
Belgium	HPV vaccine genotype	Vaccination Against Human Papillomavirus (HPV) With the 9-Valent Vaccine in HIV--Positive Women (the Papillon Study) (Papillon)	Interventional	4	NCT03391921
Netherlands	ConM SOSIP.v7 gp140, adjuvanted with MPLA liposomes	Amsterdam UMC Clinical Trial With a Native-like HIV-1 Envelope Vaccine (ACTHIVE-001)	Interventional	1	NCT03961438
US	Prevnar-13	Impact of HIV-1 and Aging on Mucosal Vaccine Responses	Interventional	4	NCT03729778
US	eOD-GT8 60mer + AS01B/ DPBS sucrose/IM, DPBS Sucrose	A Phase I Trial to Evaluate the Safety and Immunogenicity of eOD-GT8 60mer Vaccine, Adjuvanted	Interventional	1	NCT03547245

Spain	Vaccine + extension of the ATI period, Placebo + extension of the ATI period	Study to Assess the Safety and Durability of Viral Control Beyond 24 Weeks of Analytical Treatment Interruption After the Administration of Candidate HIV-1 Vaccines DNA.HTI, MVA.HTI and ChAdOx1.HTI or Placebo in Early Treated HIV-1 Positive Individuals (ATI Extension of AELIX-002 Study)	Interventional double blind	1	NCT04385875
US	AIDSVAX® B/E	Evaluating HIV-1 Neutralization Antibody Breadth in Response to HIV gp120 Protein Vaccine in HIV-Uninfected Adults With Quiescent Systemic Lupus Erythematosus	Interventional	1	NCT03618056
Malawi, Mozambique, South Africa, Zambia, Zimbawe	Ad26.Mos4.HIV, Clade C gp140	A Study to Assess the Efficacy of a Heterologous Prime/Boost Vaccine Regimen of Ad26.Mos4.HIV and Aluminum Phosphate-Adjuvanted Clade C gp140 in Preventing Human Immunodeficiency Virus (HIV) -1 Infection in Women in Sub-Saharan Africa	Interventional	2	NCT03060629
Spain	Human Papillomavirus 9-valent Vaccine, Recombinant	Immunogenicity and Safety of a 9-Valent Human Papillomavirus Vaccine in HIV-positive Women (9-VPH-MVIH)	Interventional	4	NCT04270773
France	Additional blood sampling	Study on the Response to Tetanus Vaccination of People Living With HIV (VACTE-VIH)	Interventional	N/A	NCT03853681
US	N/A	Immunogenicity of Novel H1N1 Vaccination Among HIV-Infected Compared to HIV-Uninfected Persons	Observational	N/A	NCT00996970

France	N/A	Influenza Vaccination in Patients Living With HIV in the Northern Region (VACCI-GRIPPE)	Observational	N/A	NCT04402684
Brazil	CYD Dengue Vaccine, Placebo (NaCl 0.9%) vaccine group	Safety and Immunogenicity of a Tetravalent Dengue Vaccine in HIV-Positive Adults	Interventional	2	NCT02741128
Sub-Saharan Africa	Recombinant Human Papillomavirus Nonavalent Vaccine	HPV Vaccine Therapy in Reducing High-Grade Cervical Lesions in Patients With HIV and HPV (COVENANT)	Interventional	3	NCT03284866
Spain	ChAdOx1.HTI, MVA.HTI, GS-9620	Safety, Tolerability and Immunogenicity of MVA.HTI and ChAdOx1.HTI With Vesatolimod in HIV-1-positive Patients (AELIX-003)	Interventional double blind	2	NCT04364035
US	HIVAX, saline solution	Safety and Immunogenicity of HIVAX in HIV-1 Infected Subjects (GCHT01)	Interventional	1	NCT01428596
Spain	DNA.HTI 0.5mL, MVA.HTI 0.5mL, DDDMM, ChAdOx1.HTI 0.5mL, MVA.HTI 0.5mL	Safety and Immunogenicity Study of DNA.HTI, MVA.HTI and ChAdOx1.HTI in HIV-1-Positive Patients (AELIX-002)	Interventional duble blind	1	NCT03204617
Moldova	N/A	Immune Response to BCG Vaccination in Neonates Born to HIV and LTBI Infected and Non-infected Mothers (IMMUNEO)	Observational	N/A	NCT03383211
US	p24CE DNA prime (p24CE/IL-12), IL-12 adjuvanted DNA boost (p24CE plus p55gag)	Combinatorial Therapy to Induce an HIV Remission	Interventional	1/2	NCT04357821

Argetina, Brazil, Italy, Mexico, Peru, Poland, Spain, US	Ad26.Mos4.HIV, Clade C gp140	A Study of Heterologous Vaccine Regimen of Adenovirus Serotype 26 Mosaic4 Human Immunodeficiency Virus(Ad26.Mos4.HIV), Adjuvanted Clade C gp140 and Mosaic gp140 to Prevent HIV-1 Infection Among Cis-gender Men and Transgender Individuals Who Have Sex With Cis-gender Men and/or Transgender Individuals (MOSAICO)	Interventional triple blind	3	NCT03964415
South Africa	ChAdOx1 nCoV-19	COVID-19 Vaccine (ChAdOx1 nCoV-19) Trial in South African Adults With and Without HIV-infection	Interventional oduble blind	1/2	NCT04444674
UK	Engerix B, Fendrix	A Pilot Study Comparing the Immunogenicity of Fendrix vs. Double-dose Engerix B in HIV-infected Non-responders to Standard Hepatitis B Vaccination Courses	Interventional	2/3	NCT02434848
Thailand	Rabies vaccine	Immune Responses After a Four-site Intradermal Rabies Booster Vaccination in HIV--Infected Adults	Observational	N/A	NCT02547727
Thailand	ALVAC-HIVAIDSVAX B/EALVAC--HIV Placebo, AIDSVAX B/E Placebo	Study of Boosting Strategies After Vaccination With ALVAC-HIV and AIDSVAX® B/E	Interventional double blind	2	NCT01931358

Conclusion

HIV vaccine clinical trials are significant to humanity. Epidemiological data make us aware of the great problem we are dealing with. The medical experiment "RV144" shows that it is possible to obtain a vaccine. There is still a lot of work ahead of researchers to get an entirely safe and effective vaccine. Thanks to continuous investment, scientists can conduct further clinical trials in populations most at risk of HIV infection. HIV vaccine research has become an innovative mechanism for vaccine research, as demonstrated by a variety of vaccine vector products used in the study of other pathogens. The invention of the HIV vaccine is no longer a dream but a reality that scientists scrupulously pursue. We must hope that the nearest future in HIV prevention is an effective and safe vaccine.

References

1. WHO, HIV database [Internet]. Available from: http://www.who.int/hiv/data/en/ [cited 10.06.2020].

2. PZH, HIV epidemiology [Internet]. Available from: http://wwwold.pzh.gov.pl/oldpage/epimeld/hiv_aids/index.htm [cited 10.06.2020].

3. HIV, AIDS [Internet]. Available from: http://www.aids.gov.pl/hiv_aids/450/ [cited 10.06.2020].

4. PEPFAR Program [Internet]. Available from: https://www.pepfar.gov [cited 10.06.2020].

5. Crowell TA, Hatano H. Clinical outcomes and antiretroviral therapy in 'elite' controllers: a review of the literature. J Virus Erad 2015; 1(2): 72–77.

6. Sunshine JE, Larsen BB, Maust B et al. Fitness-balanced escape determines resolution of dynamic founder virus escape processes in HIV-1 infection. J Virol 2015; 89(20): 10303–10318.

7. Bednar MM, Hauser BM, Zhou S et al. Diversity and tropism of HIV-1 rebound virus populations in plasma level after treatment discontinuation. J Infect Dis 2016; 214(3): 403.

8. Barouch DH, Michael NL. Accelerating HIV-1 vaccine efficacy trials. Cell 2014; 159(5): 969–972.

9. Rerks-Ngarm S, Pitisuttithum P, Nitayaphan S et al. Vaccination with ALVAC and AIDSVAX to prevent HIV-1 infection in Thailand. N Engl J Med. 2009; 361(23): 2209–2220.

10. Robb ML, Rerks-Ngarm S, Pitisuttithum P et al. Risk behaviour and time as covariates for efficacy of the HIV vaccine regimen ALVAC-HIV (vCP1521) and AIDSVAX B/E: a post-hoc analysis of the Thai phase 3 efficacy trial RV 144. Lancet Infect Dis 2012; 12(7): 531–537.

11. Yates NL, Liao HX, Fong Y et al. Vaccine-induced Env V1-V2 IgG3 correlates with lower HIV-1 infection risk and declines soon after vaccination. Sci Transl Med 2014; 6(228): 228ra239.

12. Rolland M, Edlefsen PT, Larsen BB et al. Increased HIV-1 vaccine efficacy against viruses with genetic signatures in Env V2. Nature 2012; 490(7420): 417–420.

13. Database of Preventative HIV Candidates. International AIDS Vaccine Initiative. New York; 2017 [Internet]. Available from: https://www.iavi.org/trials-database. Accessed 02 NOV 2017 [cited 20.07.2020].

14. ClinicalTrials.gov. U.S. National Institutes of Health, Bethesda. 2016 [Internet]. Available from: https:// clinicaltrials.gov/ct2/results?term=vrc01&Search=Search [cited 20.07.2020].

15. Robb ML, Eller LA, Kibuuka H et al. Prospective study of acute HIV-1 infection in adults in East Africa and Thailand. N Engl J Med 2016; 374(22): 2120–2130.

16. Chun TW, Murray D, Justement JS et al. Broadly neutralizing antibodies suppress HIV in the persistent viral reservoir. Proc Natl Acad Sci USA 2014; 111(36): 13151–13156.

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Assessment of the Patient Satisfaction with Services Provided in Stationary Health Care of a Chosen Hospital in the Lodzkie Voivodeship

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The research was conducted among patients of a hospital in Lodzkie voivodeship. The exact data of the hospital are available for inspection by the Editorial Board of the Journal of Health Studies and Medicine.

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Abstract

Introduction: *Satisfaction arises from meeting expectations. Patient satisfaction can be defined as the level of satisfaction that results from the service provided, but also as the degree resulting from the acceptance of the healthcare received by the recipient, paying attention to the patient's expectations and needs.*

Objectives: *The aim of the study was to determine the level of satisfaction of inpatient health care patients in a selected medical facility in the Lodzkie voivodeship.*

Material and methods: *The study was conducted among patients of a hospital in the Lodzkie voivodeship in the second half of 2019 among 1,280 patients from 11 wards. The research technique used was a diagnostic survey with the use of a questionnaire consisting of 4 questions relating to the respondent's characteristics and 24 questions relating to the most important issues affecting the level of patient satisfaction, in terms of: admission to hospital, admission to the ward, social conditions, medical care and nursing care.*

Results: *The process of completing the formalities related to admission to the hospital was positively assessed by patients of four departments (pediatric, laryngology, gynecology-obstetrics and rheumatology). Moreover, over 80% of patients from each ward declared that they had been acquainted at admission with the Patient Rights Charter, topography and daily schedule in the ward. The respondents of the laryngology and rheumatology wards assessed the provision of information by the doctor related to the course of the disease, information about drugs, but also about the side effects of their use very positively. Maintaining intimacy during nursing activities performed by the nursing team was very well assessed by patients of the following wards: laryngology, neurology and pulmonology. The quality of the meals served was rated the worst by the patients staying in the wards. The influence of the patients' socio-demographic characteristics on the satisfaction ratings was also analyzed.*

Conclusions: *The analysis of the obtained results of the study allowed for the identification of areas, the quality of which, in the patients' assessment, is insufficient and requires taking corrective actions.*

Key words: *patient satisfaction, inpatient health care, health services.*

Introduction

Patient's satisfaction with the obtained medical care results from meeting their expectations. The patient is the most important entity in the structure of health care organization, and above all in the quality assessment of medical services [1, 2]. According to the World Health Organization, health care quality is defined as "the degree to which health services involving individuals and populations increase the likelihood of meeting expectations in terms of treatment outcomes and comply with current and professional knowledge" [3]. One of the most popular ways of measuring the quality of healthcare is measuring patient opinion. Patient satisfaction assessment as an assessment indicator helps in understanding their expectations as clients and in identifying the needs and expectations of the health care system [4].

The level of patient satisfaction is influenced by various factors, such as: interest and time devoted to the patient, the way the doctor and the nursing team approach the patient, the quality and quantity of information provided by medical personnel [5].

In recent years, more and more professionals from the health sector have turned to projects related to satisfaction with care users. It is characteristic that in the literature there are over 1000 studies related to patient satisfaction every year [6]. Patient satisfaction research is an important source that is conducted to identify the needs of the recipient. Patient feedback is also used to quickly analyze the problem if the patient has a low level of satisfaction with the services they receive. Performing such tests will help managers and health service providers implement actions that will have remedial features, and thus it will be possible to improve the quality of services provided in public medical institutions [7, 8].

Material and methods

The presented research concerns the assessment of patient satisfaction with the services provided in the stationary health care of a selec-

ted facility in the Lodzkie voivodeship. The study was conducted in the second half of 2019 among 1,280 patients from 11 selected hospital wards (the number of respondents corresponded to approx. 12% of all patients treated in a given period, and the number of respondents from individual wards was proportional to the number of patients treated in these wards). The research technique used was a diagnostic survey with the use of a patient satisfaction survey consisting of 35 questions. Participation in the study was voluntary. The first part of the questionnaire concerned the assessment of the activities related to admission to hospital, i.e. the process of completing the formalities related to admission, the assessment of the care of medical staff in the admission room, and maintaining privacy during examinations. The second part was related to the assessment of admission to the ward (familiarizing the patient with the topography of the ward, the applicable Patient Rights Charter, or the possibility of submitting complaints). The third part related to social conditions, i.e. cleanliness in rooms, toilets and identification of staff. The fourth was devoted to medical care – providing information about the disease, the method of its treatment, but also possible side effects related to the treatment. The last part of the questionnaire is the assessment of nursing care – showing interest and courtesy by the nurses and the way the nursing team talks to the patient.

The data from the study was statistically analyzed using the *Statistica* version 13 statistical package. The independence test (Chi square – $\chi 2$) was used to calculate the dependencies and the selected statistical features.

Own research results

56% of women and 43% of men took part in the study. The respondent group was dominated by people aged over 60 (30% of respondents, followed by the age groups: 51–60 years old – 20.5% of respondents, and 41–50 years old – 20.7% of respondents), with secondary and vocational education (38% and 25% respectively). Almost 0% of the respondents lived in urban areas, and 30.3% of patients in rural areas.

Due to a significant socio-demographic differentiation of patients from individual wards (e.g. the dominance of women up to 30 years of age with higher education in the gynecology and obstetrics ward, the dominance of patients in the 41–50 age group with secondary education in the surgery ward, the dominance of women aged 50 plus with secondary education in the rheumatology ward, the dominance of men aged 60 plus with secondary education in the cardiology ward or the dominance of patients from rural areas with vocational education aged 60 plus in the pulmonology ward) and due to the specificity of clinical diagnoses specific to each ward it was decided to present the results of satisfaction surveys separately for each of them.

Admission to hospital

The data analysis shows that the efficiency of completing the formalities related to admission to the hospital in the Hospital Emergency Department with the Admission Room was highly rated by patients from the pediatric ward (68.3% of respondents), laryngology (66.7% of respondents), gynecology and obstetrics (62.2% of respondents) and respondents from the rheumatology ward (58.9% of respondents). Every third patient from the orthopedics ward assessed the admission process negatively.

When it comes to ensuring a sense of intimacy during admission to the hospital, the best grades were given by patients from the pediatric ward, i.e. 70% of the respondents (separate emergency room) and from the laryngology ward – 66.7% of the respondents.

Admission to the ward

All patients from the laryngology and pulmonology wards declared that they had been acquainted with the topography of the ward (regarding information on location of doctor's room, treatment room, nurses' station or social room). The worst grades were given by patients of the surgery ward – 13.4% of negative responses. Interestingly, in the wards highly

rated in terms of organizational information, patients pointed to the lack of information about their rights.

Social conditions

The cleanliness in the rooms and toilets was assessed very well by patients from the pulmonology ward – 80.9% and from the gynecology and obstetrics ward – 71% of the respondents. Similarly, high scores in these departments were obtained by the cleanliness and aesthetics of bed linen in the wards (71% and 75% of the respondents respectively). The highest negative response rates in these ranges were observed in the orthopedic ward (2.5% and 5.1% of respondents from these wards, respectively). The respondents of all wards positively assessed the quality of meals and ensuring peace and quiet in the ward (interestingly, the lowest ratings in this regard were observed in the neonatology department).

Doctor's care

The availability of doctors during their on-call duty was assessed as very good or good by the respondents of most of the analyzed wards (Chart 1). The information provided to the patient by the doctor regarding the course of the disease, but also the methods of its treatment (familiarizing the patient with the medicines, but also their side effects) was best assessed by patients from the rheumatology – 65.7% of responses, laryngology – 63.3% responses. Showing kindness and understanding by the doctor towards the patient was assessed best by the respondents from rheumatology – 75% of the respondents and pulmonology – 59.6% of the respondents. Ensuring and respecting the patient's intimacy during medical examinations was positively assessed by the respondents from the laryngology (75% of respondents), rheumatology (71%) and pulmonology (65.1% of respondents) ward. Only in the neurology ward, 10.1% of patients negatively assessed the sphere of ensuring intimacy during the tests. The culture in the doctor's conversation with the patient in the

study was assessed very well by the respondents from the rheumatology (70.4% of respondents), pulmonology (68.2% of respondents) and laryngology ward (65% of respondents).

Nursing care

The method of providing and transferring information by the nursing team to the patient was assessed very positively by the respondents from the gynecology and obstetrics (83.3% of responses), laryngology (81.7%) and pulmonology (65.9%) ward. The culture resulting from the conversation between the nurse and the patient was assessed very well by the respondents from the laryngology (95% of respondents), pediatric 80% (respondents), neurology (77.8% respondents) and orthopedics (72%) ward. Maintaining intimacy during nursing activities was positively assessed by patients of laryngology (90%), neurology (77.8%) and pulmonology (71.7%). The respondents positively assessed the speed of the nurses' response to patient calls in the event of problems. The most negative answers to this question were recorded by pediatric and internal ward. Showing interest and understanding towards the patient by the nursing team was assessed very well by the laryngology – 95%, neurology – 76.4% and rheumatology patients – 75.3%. However, it should be noted that only 1.7% of patients negatively assessed the manner of showing interest and understanding by nurses towards the patient. (Diagram 2).

Assessment of hospitalization

The dominant very good assessment of hospital stay were recorded in the laryngology (66.7% of all assessments) and cardiology wards (62.4% of all assessments). Good assessments were clearly dominant among the respondents from the gynecology and obstetrics (75.4% of the assessments) and orthopedics (70.9% of the assessments) wards.

The analysis of the relationship between the respondents' answers and their socio-demographic characteristics allowed for the identification of

a statistically significant difference ($p<0.05$) between the level of satisfaction with the nursing care received and the gender of the study group. The question relating to the level of satisfaction with the nursing care received contained 6 variants of questions with 3 answers. The most common answer to the question related to the speed of nurses' response to patient calls was "very good" – 83.3% of respondents indicated such an answer. Most often, this answer appeared in surveys completed by women.

statistics	statistics: variable 1(2) x variable 2(2)		
	α^2	df	p
α^2 Pearsona	60,48008	df=1	p=,00000
α^2 NW	69,18608	df=1	p=,00000

The analysis of the results of the conducted study allows for the following conclusions:

1. Completing the formalities related to admission to the hospital was assessed very well, in particular by patients of the pediatric, laryngology, gynecology and obstetrics, and rheumatology ward.
2. The satisfaction of hospital patients with the care provided in HED and the emergency room requires more detailed analyses.
3. The hospital patients were informed and acquainted with the topography of the ward. The provision of information on Patient Rights Charter needs improvement.
4. Particularly noteworthy is the assessment of ensuring intimacy during tests and the speed of the nursing team's response to patients' calls in the event of problems.

Discussion

The most important element in striving to achieve the best quality of medical care is conducting research on patient satisfaction with the services received. This study is the respondents' subjective assessment based primarily on experience, expectations and requirements. Conducting such

tests makes it possible to recognize an increase in patient's level of satisfaction, but also to determine what causes dissatisfaction in a sick person. In an increasingly competitive health care market, managers should focus on obtaining high or excellent patient satisfaction ratings. For this, it is necessary to characterize the factors influencing patient satisfaction. Numerous literature studies present various dimensions of perceived quality of services as significant and basic measures of patients' perception of the quality of health care. Kaneet et al. (1997) and Marley et al. stated that the measurement of satisfaction should "take into account the dimensions of technical, interpersonal, social and moral aspects of care" [9]. Patient satisfaction surveys in developed and developing countries share many unique variables and attributes that influence overall patient satisfaction [10]. Most of the studies in the literature review concern the correlation between demographic factors such as: gender, age, education level, and patient satisfaction; however, the results of these studies are often contradictory [11, 12].

A similar trend is presented in the results of Polish research on patient satisfaction with health care. In the study conducted in 2008 at the Poviat Hospital in Pabianice, in which 331 patients from gynecology and obstetrics, surgical and internal medicine wards participated. Patients were asked to evaluate the physician approach to the patient with courtesy, understanding and interest. Most, 72.2% of respondents from the surgery ward and patients from the gynecology and obstetrics ward assessed it positively [13]. In turn, in a study conducted at the Voivodeship Specialist Hospital of Stefan Kardynał Wyszyński Independent Public Healthcare Institution in Lublin in 2013, 56% of patients assessed the doctors to be very kind and showing interest in the patient [14]. On the other hand, in the study by K. Skowron 87% of respondents stated that doctors approach patients with understanding [15]. In own study, the highest rating was given by 75% of patients from the rheumatology and pulmonology wards. The doctor's proper approach and attitude allows to build trust among patients and build a proper doctor-patient relationship.

The results of the research conducted by M. Leźnicka in 2013 show that 45% of patients rated the sphere of ensuring intimacy by the doctor very well during the examinations and medical procedures performed [16]. Analysis of the results of my own research showed that the preservation of the sense of intimacy during medical examinations and procedures performed by a doctor in the ward was assessed very well by patients from the laryngology, rheumatology and pulmonology wards.

In a study on the "Level of satisfaction with medical services in the department of neurology" conducted by A. Smolińska at the Department and Clinic of Neurology of the Dr. A. Jurasz University Hospital in Bydgoszcz in the question concerning respecting personal dignity by nurses during nursing procedures, 60% of patients assessed it as very good , and 36% as good. 98% assessed that nursing staff was available when needed by the patient. Moreover, 62% of people assessed the nurses speed of response to patients' calls as very good [17]. The results of own research showed that almost 80% of the respondents assessed the respect for intimacy during nursing procedures performed by nurses of the neurology department very well. On the other hand, the category of the nursing team's response to patients' requests was assessed less favorably.

An important issue for patients that should also be considered is the provision of information by the doctor about the patient's health, the course of the disease and methods of its treatment, but also about the risks associated with the treatment. As shown in the study by M. Zarzeczna-Baran, 21% of patients declared that they had not received detailed information about their health condition, 22% of respondents about the methods of treating the disease, and 33% were not informed about the risks associated with the undertaken treatment [18]. In another study presented by M. Szpringer, 47.1% of patients positively assessed the information provided by the doctor regarding the patient's health condition and the treatment [19]. In another study presented by A. Fronczak, 45.1% of respondents assessed the amount of relevant information provided on the treatment method of a given disease, its course and the results of the conducted research very positively [20]. Other results were

obtained by M. Leźnicka. 94% of the respondents indicated that at the time of their stay in the hospital they had received sufficient information about their health condition. 11% of people assessed that they had not obtained adequate information about the risks associated with the treatment. As for the side effects associated with drugs, 26% of patients assessed that they had not received sufficient information [16]. The analysis of own study showed that the respondents assessed the transfer of information about the course of the disease and the risks associated with the treatment, as well as the methods of treating the disease and familiarizing the patient with the medicines and their effects very well, especially in rheumatology and laryngology wards. It can be concluded that the doctors of these wards appropriately used the time for the patient, took care of the correct approach in communication with the patient, so that the patient could actively participate in the conversation about their health.

Another important issue is the provision of information to the patient by nursing staff regarding planned medical procedures. In her study, B. Lisowska showed that 94% of patients assessed very positively the ability of nurses to provide information in connection with the medical procedure [21]. In the study by D. Kochman 56% of patients fully agreed with the statement that the nurses explained what the procedure would involve, 24% of the respondents stated that they very much agree with this statement [22]. The results of own research confirm the importance of communication between the patient and the nurse during the treatment process.

International studies also confirm the lack of a consistent correlation between patient satisfaction with medical services and their socio-demographic features. An analysis of the PubMed and Scopus databases from January 2007 to February 2015 for publications on patient satisfaction and the identification of patient satisfaction predictors based on measurements from the HCAHPS (Hospital Consumer Assessment of Healthcare Providers and Systems) survey showed that only a small number of studies found an association between determinants at the market level

and patient satisfaction. There was a common key factor between the studies, which was interpersonal skills in terms of courtesy, respect by healthcare professionals, as well as communication skills, which are often more important in the patients' opinion than clinical competences or hospital technological conditions [23, 24, 25, 26].

Unfortunately, while feedback from patient satisfaction surveys is an established measure of healthcare improvement plans, they are still not systematically used to develop improvement initiatives. They provide healthcare managers and health decision makers the opportunity to better understand patients' views and perceptions and their degree of commitment to improving the quality of care and services.

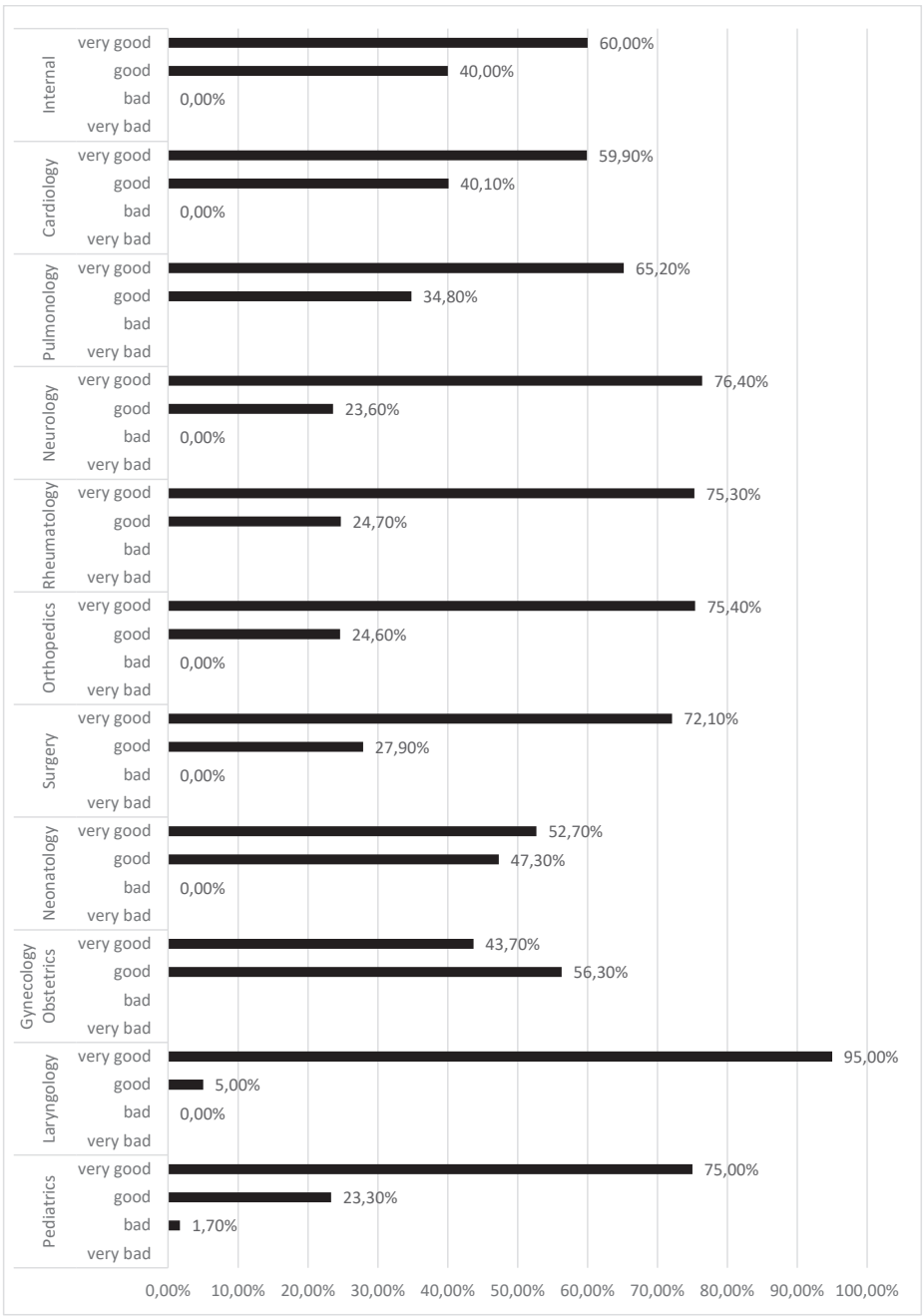

Diagram 1. Presence of doctors on duty

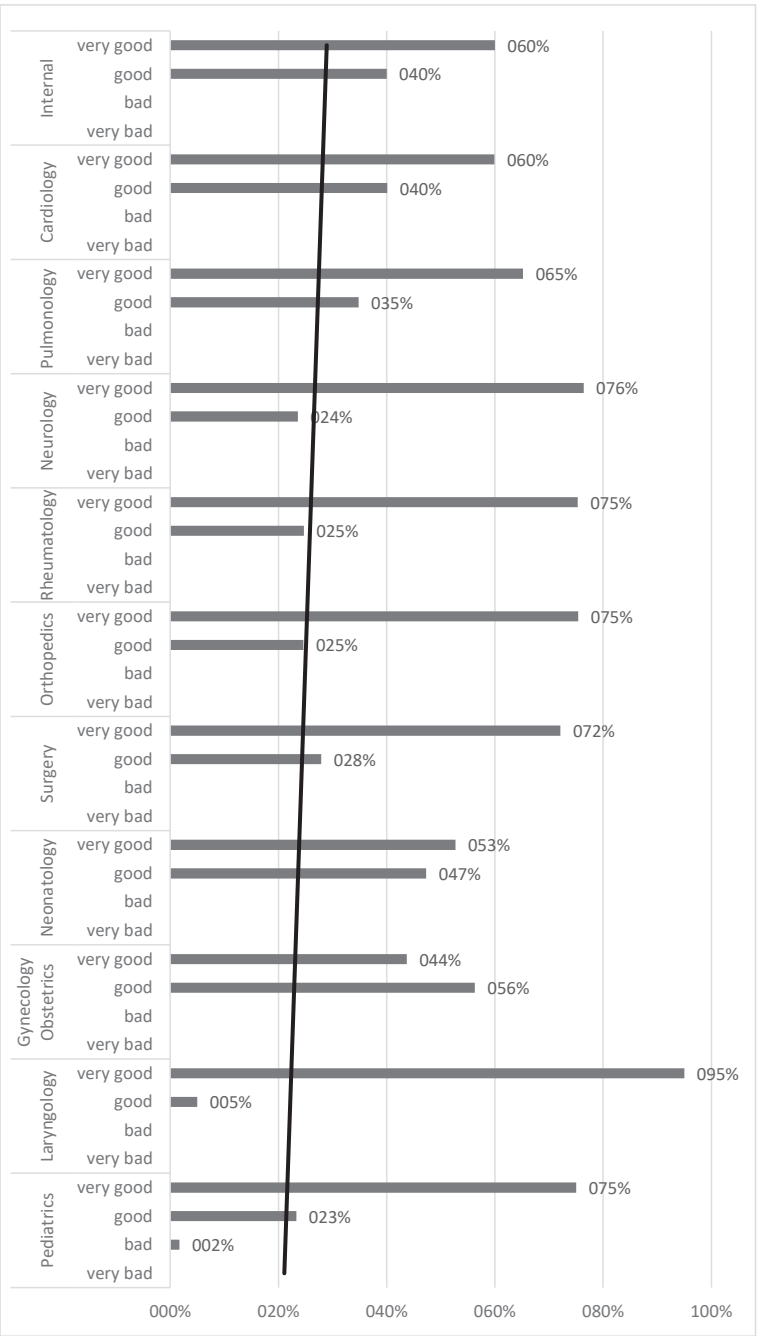

Diagram 2. Showing understanding and interest by nurses

References

1. Pękacz A, Kądalska E, Skoczylas A et al. Patient satisfaction as an element of healthcare quality – a single-center Polish survey. Reumatologia 2019; 57(3): 135–144.

2. Czekirda M, Mianowana V, Sobótka H et al. Poziom satysfakcji pacjentów w szpitalnych oddziałach ratunkowych. Logistyka 2014; 4.

3. Maconko M, Kopański Z, Strychar J et al. Satysfakcja pacjenta i metody jej pomiaru. Journal of Clinical Healthcare 2016; 3: 14–19.

4. Szpringer M, Chmielewski J, Kosecka J et al. Poziom satysfakcji pacjenta jako jeden z aspektów jakości opieki medycznej. Medycyna Ogólna i Nauki o Zdrowiu 2015; 21(2): 132–137.

5. Gilmore KJ, Pennucci F, De Rosis S et al. Value in Healthcare and the Role of the Patient Voice. Healthc Pap 2019; 18(4): 28–35.

6. Karanikolos M, Mladovsky P, Cylus J et al. Financial crisis, austerity and health in Europe. The Lancet 2013; 381(9874): 1323–1331.

7. Sodani PR, Kumar RK, Srivastava J et al. Measuring patient satisfaction: A case study to improve quality of care at public health facilities. Indian J Community Med 2010; 35(1): 52–56 [Internet]. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2888368/ [cited 09.10.2020].

8. Majerski Ł. Satysfakcja pacjentów z opieki pielęgniarskiej realizowanej w Izbie Przyjęć. Innowacje w Pielęgniarstwie i Naukach o Zdrowiu 2016; 2(1): 47–62.

9. Berning V, Heidegger T, Laupheimer M et al. Patient satisfaction and quality of recovery. Anaesthesia 2018; 73(4): 521–522.

10. Iftikhar A, Allah N, Shadiullah K et al. Predictors of patient satisfaction. Gomal Journal of Medical Sciences 2011 9(2): 183–188.

11. Otani K, Herrmann PA, Kurz RS. Improving patient satisfaction in hospital care settings. Health Serv Manage Res 2011; 24(4): 163–169. https://doi.org/10.1258/hsmr.2011.011008.

12. Al-Abri R, Al-Balushi A. Patient Satisfaction Survey as a Tool Towards Quality Improvement. Oman Medical Journal 2014; 29(1): 3–7.

13. Krakowiak J, Sułkowska J, Zagier K et al. Satysfakcja pacjentów jako czynnik kształtujący rynek usług medycznych. Badanie własne na przykładzie Szpitala w Pabianicach. Przedsiębiorczość i Zarządzanie 2010; XI(7)2010: 169–187.

14. Ocena poziomu satysfakcji pacjenta Wojewódzkiego Szpitala Specjalistycznego im. Kardynała Wyszyńskiego Samodzielnego Publicznego Zakładu Opieki Zdrowotnej w Lublinie [Internet]. Available from: http://szpital.lublin.pl/attachments/article/59/I%20KW%202013%20OCENA%20POZIOMU%20SATYSFAKCJI%20PACJENTA%202013.pdf?fbclid=IwAR0uBk5JsdVzZQulWJAshNpwNLJVvlU1XVc5rMRIU8r2dH2uiaeGRy_DqfM [cited 09.10.2020].

15. Skowron K, Mocigemba A, Osial P. Jakość obsługi pacjenta we współczesnym podmiocie leczniczym na przykładzie Samodzielnego Publicznego Szpitala Klinicznego Nr 6 Śląskiego Uniwersytetu Medycznego w Katowicach Górnośląskie Centrum Zdrowia Dziecka im. Jana Pawła II. Zesz Nauk Politechniki Śląskiej. Organizacja i Zarządzanie 2016; 1(33): 131–144.

16. Leźnicka M, Warunek A, Hartwich E, Kryn P. Ocena satysfakcji pacjenta z usług świadczonych w stacjonarnej opiece zdrowotnej w województwie kujawsko-pomorskim. Hygeia Public Health 2014; 49(4): 787–792.

17. Smolińska A, Marciniak M, Ślusarz R et al. Poziom satysfakcji z usług medycznych na oddziale neurologii. Udar Mózgu. Problemy Interdyscyplinarne 2008; 10(2): 70–82.

18. Zarzeczna-Baran M, Bandurska E, Nowalińska M et al. Ocena jakości usług opiekuńczo leczniczych dokonana przez pacjentów psychiatrycznego lecznictwa zamkniętego. Ann Acad Med Gedan 2012; 42, 41–52.

19. Szpringer M, Chmielewski J, Kosecka J et al. Poziom satysfakcji pacjenta jako jeden z aspektów jakości opieki medycznej. Medycyna Ogólna i Nauki o Zdrowiu 2015; 21(2): 132–137.

20. Fronczak A, Kowalska A, Sułkowska J et al. Opinie pacjentów oddziału laryngologicznego dotyczące bazy techniczno-lokalowej i standardów przyjęcia pacjentów do Szpitala Powiatowego w Tomaszowie Mazowieckim. Przedsiębiorczość i Zarządzanie 2012; XIII(9): 17–23.

21. Lisowska B, Smolak A, Wielgus M. Ocena pracy personelu medycznego w oddziale pooperacyjnym przez pacjentów po operacjach ortopedycznych. Anestezjologia i Ratownictwo 2014; 8: 310–320.

22. Kochman D, Wojasińska P. Doświadczenia badanych pacjentek oddziału położniczo-neonatologicznego dotyczące opieki pielęgniarskiej w okresie hospitalizacji w zależności od wybranych zmiennych socjodemograficznych z wykorzystaniem polskiej wersji skali NEWCASTLE. Innowacje w Pielęgniarstwie i Naukach o Zdrowiu 2019; 1(4).

23. Mazurenko O, Collum T, Ferdinand A et al. Predictors of Hospital Patient Satisfaction as Measured by HCAHPS: A Systematic Review. J Healthc Manag 2017; 62(4): 272–283.

24. McFarland DC, Shen MJ, Holcombe RF. Predictors of patient satisfaction with inpatient hospital pain management across the United States: A national study. J Hosp Med 2016; 11(7): 498–501.

25. McFarland DC, Johnson Shen M, Holcombe RF. Predictors of Satisfaction with Doctor and Nurse Communication: A National Study. Health Commun 2017; 32(10): 1217–1224.

26. Hooker RS, Moloney-Johns AJ, McFarland MM. Patient satisfaction with physician assistant/associate care: an international scoping review. Hum Resour Health 2019; 17(1): 104.

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Atherosclerosis and Chlamydia Pneumoniae: What Is the Connection?

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Introduction

Diseases resulting from unhealthy lifestyle are a growing global problem nowadays. The number of patients suffering from them is increasing at a different pace around the world [1]. One of these groups are cardiovascular diseases (CVD), which are the first cause of death in the European Union, despite the significant decrease in the associated standardised death rate in recent years [2]. Moreover, according to GUS (Główny Urząd Statystyczny) data, in 2014 CVD were the cause of 46% of all deaths in Poland [3]. However, if the patient's risk factors are identified in a timely manner and preventive measures are taken, the occurrence of CVD and other complications can be significantly averted [4].

The group of cardiovascular diseases include atherosclerosis, which is a chronic vascular disease [5]. The process can start very early, and the first changes in the form of rolls of fat can be seen in children [6]. Atherosclerotic plaques are usually located in large vessels like the aorta and medium vessels in places where they are divided into smaller branches [7]. Deposition of lipids in the vessel wall is one of the most characteristic and commonly known features of this process [5, 6]. However, the cause and factor initiating this inflammation is under investigation. Many factors are taken into account – from foetal life, maternal lipid levels during pregnancy, genetic and lifestyle factors to social status [7].

However, there have been more and more publications about contribution of microorganisms and past infections in the development of this process. It involves an immune response to inflammation as a result of bacterial or viral infection along with the acceleration of the atherosclerotic process in the vessels [5]. Therefore, this review will follow the development of the concept of atherosclerosis aetiology, focusing on the latest insights on the relationship between previous Chlamydia pneumoniae infection and the mechanism of the appearance and development of atherosclerotic changes in the arteries.

Results

Atherosclerosis etiology

Atherosclerosis is a process caused by the coexistence of many different risk factors. The most known and acknowledged ones are included in Table 1. One of the most important are genetic factors, because there is scientific evidence for heredity of predisposition to atherosclerosis, which is estimated at 40 to 60%. There are currently 60 known loci associated with atherosclerosis [8]. However, in the study of Willer et al. in which over 180,000 patients were examined, as many as 157 gene loci affecting blood lipid levels, closely related to atherosclerosis, were recognized. What's more, almost half of them have just been identified and have never been associated with lipid levels before [9]. As it turns out, regulation of HDL and LDL levels is connected with miRNA in the liver by affecting gene expression. Such a relationship was observed with miR--148a during an experiment, in which an increase in HDL and a decrease in LDL levels was visible due to a decrease in the activity of this miRNA. This probably caused an increase in the expression of the genes responsible for the coding of LDL receptor proteins. MiR-148a is not the only one miRNA that may be associated with dyslipidemia and atherosclerosis, miR-122 or miR-223 may have similar effects at various stages of lipid level regulation [10].

Another risk factor for atherosclerosis is diet and its effect on blood lipid levels. As Kuchta et al. showed after examining 42 people, whether people eat only plants or animal products significantly changes the content of individual lipid fractions in the blood serum. As a matter of fact, the people participating in the study were in the age range between 23 and 38 years old, none of them smoked or practiced sport professionally, and their BMI was within normal limits. Patients were divided into two 21-person groups. Before the study, the vegan group had to be on a diet completely devoid of animal products for a minimum of 22 months. The study lasted at least 10 months. As demonstrated, the vegan group did not differ from the second group of omnivorous patients only by the level

of HDL-C, the other results measured in serum like LDL-C and TC were significantly lower. This suggests that a plant-based diet may be an effective way to prevent atherosclerosis, while a diet containing animal-derived products may be a risk factor for atherosclerosis [11].

What is more, the effect of intestinal microflora and its composition disorders is also highlighted as a factor in atherosclerosis [12]. Emoto et al. also indicate the involvement of intestinal microflora in this process. The composition of the microflora differed between groups mainly in the amount of Lactobacillales and Bacteroidetes. Lactobacillales bacteria were at higher number in people with known atherosclerotic lesions, and there were more Bacteroidetes in healthy patients [13]. However, not only intestinal microflora may be associated with the atherosclerotic process, impaired oral microflora may also affect its course. Fåk et al. examined the composition of microflora in 92 people and found that patients without atherosclerosis vary from those with clinical signs of atherosclerosis in the amount of Anaeroglobus bacteria. A group of people with no change in their arteries had fewer of them [14].

Another interesting thing indicating bacteria's big role in atherosclerosis is that Calandrini et al., analyzing samples taken from atherosclerotic plaques in the carotid arteries, found bacterial DNA in more than 30% of them [15]. Chlamydia pneumoniae has a certain part in the etiology but still discussed.

Table 1. Atherosclerosis main risk factors [16]

Hypercholesterolemia	Hypertension
Obesity	Diabetes mellitus
Unhealthy diet	Smoking cigarettes
Endothelial inflammation	Increased procoagulant activity

The development of atherosclerotic plaque is multi-staged and does not have to be carried out in just one vessel. Various arteries may have plaques at different stages of development. The entire process begins with damage to the endothelium, i.e. the inner lamina of the artery [17, 18].

Endothelial damage promotes the adhesion of cells of the immune system, the most important of which are macrophages and lymphocytes. These cells produce pro-inflammatory cytokines, such as interferon gamma or tumor necrosis factor, and chemokines, e.g. interleukin 8. They stimulate the transmigration of leukocytes inside the vessel wall and the inflammatory process within it [8, 17, 18]. Macrophages formed from peripheral blood monocytes and other cells, e.g., myocytes and fibroblasts, use scavenger receptors to capture low-density lipoproteins. Then, LDL cholesterol undergoes chemical changes that lead to the formation of foam cells, so characteristic of atherosclerotic plaques [8, 18]. Among the substances secreted by macrophages there are also growth factors that stimulate the migration of myocytes from the middle membrane. All of these processes lead to the deposition of low-density lipoproteins, which can undergo mineralization, connective tissue formation and plaque formation [18, 19]. The atherosclerotic process is very complex and may take several or several dozen years [17].

Chlamydia pneumoniae – a significant cause of various diseases

Chlamydia pneumoniae is a common microorganism occurring widely around the globe. The presence of specific antibodies in serum of about 40–70% of people in the population overall confirms the cosmopolitan nature of this bacteria [20]. It is gram-negative and grows only in cellular lines [21]. Ch. pneumoniae is characterised by biphasic cycle because it numerously converses between extracellular EBs (infective, non-replicative elementary bodies) and intracellular RBs (replicating reticulate bodies) and replicates in inclusion vacuoles. It is very hard to eradicate the bacteria because of its intracellular cycle – most antibiotics cannot be used, though tetracyclines, macrolides, fluoroquinolones might help [22].

The infection caused by Chlamydia pneumoniae is mostly asymptomatic (60-80%). Due to its strong affinity for respiratory epithelial cells it leads to infections of upper respiratory tract: pharynx, larynx, paranasal sinuses, middle ears and lower respiratory tract: bronchi and pneumonia.

If symptoms appear they usually are mild, non-specific and chronic [21]. Many authors associate the inflammatory process with pathogenesis of coronary artery disease, atherosclerosis, vasculitis, arthritis, asthma [23].

There is evidence that Ch. pneumoniae presence has a major role in asthma, chronic bronchitis and chronic obstructive pulmonary disease (COPD) aetiology. It was found that infection of respiratory epithelial cells and macrophages cause the secretion of cytokines and activates inflammatory cells such as TNF-α, IL-1β, IL-4, IL-6, IL-8, whose role is to neutralize pathogens but can also contribute to long-term consequences [24]. Lipopolysaccharide and Heat Schock Protein 60 that Ch. pneumoniae produces can slowly change the tissue. Infectious asthma caused by it is more severe, difficult to diagnose and treat. It was revealed that Ch. pneumoniae stimulates IgE antibodies in asthmatic patients [25]. Moreover, the Nagahama study showed that seropositivity for *Chlamydia pneumoniae* along with Mycoplasma pneumoniae in Japanese population is a major risk factor for COPD [26]. There is a strong connection between chronic pulmonary diseases and cardiovascular complications that are more common in those patients and it is worth pointing out that Ch. pneumoniae often occurs in both.

Studies indicate that Ch. pneumoniae may also be a trigger in neurodegenerative diseases. Bacterial DNA was studied using PCR in post-mortem brain samples of people with dementia. Ch. pneumoniae was found near the amyloid area where cytokines were produced by glial cells and astrocytes -IL-1β and IL-1 may initialize Aβ production in Alzheimer's disease [27]. Genome analysis of Ch. pneumoniae compared strains from human with coronary heart disease and brain of person with Alzheimer's to strains available in GenBank. The goal was to study genetic differences between infection in various tissues. Some important dissimilarities were observed, especially deletions of loci probably responsible for virulence (*IncA*-like proteins, *tyrP*, *pmpG*) [28].

There is still a lot to prove in Ch. pneumoniae case. It certainly has exceptional impact on multiple human tissues and therefore whole organism. Ch. pneumoniae antibodies were found in patients' blood who

has had respiratory infection in the past [29]. Its occurrence detected in patients with so many diseases also hints that inflammation process that this bacteria evokes is indeed significant in causing slow but serious damage and dysfunction.

Chlamydia pneumoniae-induced atherosclerosis

In the early 20th century, William Osler and his associates were the first to state that the factor causing damage of the arteries is chronic inflammation process [30]. It is commonly associated with increase in blood cholesterol or an incorrect proportion of its fraction and that knowledge is widely-spread as prevention and treatment of atherosclerosis are mostly based on it. Many reports show a great part of Ch. pneumoniae's DNA and its antigen occurrence in cardiovascular diseases' etiopathogenesis, though. It gives a chance of better understanding, and so forth, starting new actions.

Chlamydia pneumoniae acts both directly and indirectly on the artery wall. It intracellulary stimulates macrophages to produce inflammatory factors, e.g. interleukins. Moreover, its antigens like Heat Shock Protein are structurally similar to human ones, what causes a cross-reaction, in which the immune system can attack both the bacteria and unfortunately its own tissue [31]. It indicates that atherosclerosis might have an autoimmune background and that Ch. pneumoniae perhaps contributes to it.

Meta-analysis including more than 10 000 patients showed that patients who were Ch. pneumoniae IgA seropositive had much higher levels of proinflammatory and prothrombotic factors such as fibrinogen, hsCRP and IL-6 than seronegative patients, both groups with atherosclerosis [32]. It gives possibility that those with Ch. pneumoniae can have a faster or greater degeneration of arteries because of presence of known initiators and promoters of the disease in a prominent amount. They can also be at better risk of severe cardiovascular consequences, what needs to be studied further.

Ch. pneumoniae's genomic DNA was detected through PCR reaction at a higher level in tissue from ascending aorta than in peripheral blood mononuclear cells. Group of patients had chronic coronary disease and were planned for CABG. Furthermore, those patients with Ch. pneumoniae in their aorta also suffered from diabetes and hypercholesterolemia [33]. Another study carried out in China found Ch. pneumoniae and Cytomegalovirus antigens at significant levels in plaque of participating patients with carotid artery stenosis, with Ch. pneumoniae antigens at 84% detection rate [34]. This proves that bacteria presence in the aorta and other arteries is not without any effect – it provokes constant changes in tissues that lead to cardiovascular diseases and can also negatively affect patients overall condition.

It is believed that not only chlamydial Heat Shock Protein 60 and interleukins but also activation of Toll-Like Receptor-4 and MAPK participates in atherosclerosis development. This is the result of Ch. pneumoniae stimulating impact on Human Vascular Smooth Muscle Cells. Furthermore, Ch. pneumoniae has a role in processes involving histones and NF-KB. Therefore, it can be seen that this bacteria affects many various reactions in human body resulting in vascular atherosclerotic degeneration [35].

Ch. pneumoniae is particularly linked to interleukin 8. IL-8 can be present in unstable plaques both with Chlamydia which can contribute to producing it in great amount [36]. Unstable plaque is very dangerous as it can tear itself away and be a cause of vascular obstruction. Heart attacks, strokes and other ischemic complications may occur. This is another trace that Ch. pneumoniae may not only contribute to atherosclerosis but also severe complications of this disease. The path showing one by one how Ch. pneumoniae infection can cause plaque formation is presented in Figure 1.

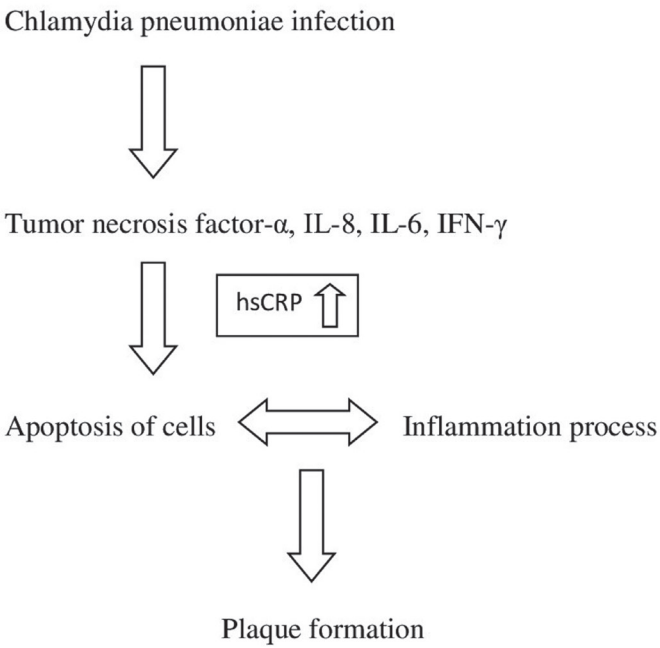

Figure 1. Scheme showing the path from Chlamydia pneumoniae infection to atherosclerosis [37]

All in all, there is no doubt that Ch. pneumoniae can have a strong, negative effect on blood vessels. It affects both structure and function of arteries mostly through chronic inflammation process and may clearly be mentioned as one of the most important among other pathogens causing atherosclerosis [38].

Discussion

Could Ch. pneumoniae alone be able to induce atherosclerosis? According to Sorrentino and Yilmaz it can in mice with ApoE deficiency. In those infected with the bacteria there was development of the conditions such like those appearing in atherosclerosis in humans as interferon γ concentration and Th1-like cells were characteristic [39].

Lantos and Endrész went one step further and used ApoB100only/LDLR−/− mice which more resemble human organisms with high cholesterol levels. They proved that Ch. pneumoniae infection aggravates atherosclerosis in the aorta compatible to the previous study [40]. Another recent study on mice that was supposed to show Murine Novovirus with Ch. pneumoniae influence on plaque formation confirmed that Ch. pneumoniae does indeed have a meaning impact as it alone enlarged the atherosclerotic obstruction in arteries by 62% in comparison with animals without infection [41].

Because of so much evidence of Ch. pneumoniae contributing to atherosclerosis it was promising that antibiotics would make a perfect testing form of treatment so thorough research was made, for example Wizard, ACES or PROVE IT-TIMI. In the WIZARD study there were almost 8000 patients after myocardial infarction included, randomly assigned to 3-month azithromycin or placebo therapy. They have been observed for a year and there was no satisfying effect on adverse clinical events such as death or recurrent heart attack due to exacerbation of coronary artery disease [42]. In ACES the time has been extended to one year of taking azithromycin and in PROVE IT-TIMI to two years with the antibiotic changed to gatifloxacin, though. Unfortunately, it did not meet scientists expectations because of the lack of effectiveness [43].

If antibiotics capable of Ch. pneumoniae eradication did not cause the clinical improvement in atherosclerosis treatment then Ch. pneumoniae as important etiologic factor loses its meaning. Suggestions escalated that the role of Ch. pneumoniae in this civilisation disease is in fact small as it mostly depends on other confirmed risk factors e. g. lipids. As a consequence the number of studies on this subject has decreased. On the other hand, different point of view has appeared. In those studies antibiotics were given to people with already developed atherosclerosis and often after myocardial infarction. There is a strong possibility that antibiotics could have worked in a group of children, as Ch. pneumoniae infection firstly appears in the young age, in order to prevent atherosclerotic acceleration in time [44].

So if antibiotics did not work then should studies concerning fight against Ch. pneumoniae to treat atherosclerosis end? Innovative thinking paths are necessary regarding to treatment, so it was revealed that vaccines may be a real breakthrough. Immunization with recombinant chlamydial protease-like activity factor (rCPAF), in particular with Il-12, reduces atherosclerosis development in mice infected by Ch. pneumoniae and on high fat diet through inducing specific antigens production [45].

Even though some big studies using antibiotics failed to prove atherosclerosis attenuation, there is still a great chance of them being useful in prevention of this disease. Furthermore, treatment based on Ch. pneumoniae role in atherosclerosis is still possible thanks to immunization and there is definitely a lot to investigate. It proves that further trials are needed regarding Ch. pneumoniae importance in initiation and progression of inflammation process of the arteries and atherosclerosis associated with it.

Conclusions

Atherosclerosis is a multifactorial process – many risk factors are already known but its cause cannot be clearly determined. The impact of some dangers leading to it can be reduced or completely eliminated. Knowing that there is a relationship between the development of the atherosclerotic process and the presence of Chlamydia pneumoniae will allow medics to better monitor the patient and implement earlier and more effective treatment.

Because of the universal prevalence of Chlamydia pneumoniae, infections caused by it are quite common, but in most cases without clinical symptoms. However, by stimulating the production of inflammatory factors they have a significant impact on the functioning of many tissues. A correlation has been demonstrated between the past infection and the risk of occurrence and severity of chronic respiratory diseases, which may be associated with an increased likelihood of cardiovascular complications. In addition, due to the long-term asymptomatic inflammatory

process, it can happen not only in the respiratory tract, but also in nerve tissue or vascular wall. Ch. pneumoniae induces similar immunological reactions that are observed in atherosclerosis, and also worsens the course of an ongoing process.

Determining the levels of inflammatory cytokines, especially Il-8 or TNF-α so strongly associated with both Chlamydia pneumoniae infection and atherosclerosis can be useful in assessing cardiovascular risk and preventing myocardial infarction and other atherosclerotic diseases. However, antibiotic therapy of existing lesions in patients with Ch. pneumoniae did not give satisfactory results, but perhaps it would be effective as a prophylaxis for infections with this pathogen in children. Therefore, research is being conducted into the possible use of vaccinations and their effectiveness in the prevention of atherosclerosis. To sum up, many processes determining atherosclerotic damage are not fully known yet, so staying open to new research all the time is a forward-looking approach.

References

1. De Backer G. Prevention of cardiovascular disease: Much more is needed. Eur J Prev Cardiol 2018; 25(10): 1083–1086. https://doi.org/10.1177/2047487318770297.

2. Causes of death statistics – methodology. 2019. Eurostat [Internet]. Available from: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Causes_of_death_statistics [cited 20.03.2020].

3. Cierniak-Piotrowska M, Marciniak G, Stańczak J. Statystyka zgonów i umieralności z powodu chorób układu krążenia. In: Strzelecki Z, Szymborski J, eds. Zachorowalność i umieralność na choroby układu krążenia a sytuacja demograficzna Polski. Warszawa: Rządowa Rada Ludnościowa, Główny Urząd Statystyczny; 2015.

4. Dąbek J, Majewski MM, Bałys M et al. Rokowanie chorych z wczesną miażdżycą tętnic wieńcowych w 4-letniej obserwacji. Ann Acad Med Siles 2019; 73: 1–7.

5. Campbell LA, Rosenfeld ME. Infection and Atherosclerosis Development. Arch Med Res 2015; 46(5): 339–350. https://doi.org/10.1016/j.arcmed.2015.05.006.

6. Chmiel Z, Hejda G, Binkowska-Bury M. Occurrence of risk factors of cardiovascular diseases, connected with arteriosclerosis as a health problem within upper gymnasium youth. Med Rodz 2018; 21(1A): 11–19. https://doi.org/10.25121/MR.2018.21.1A.11.

7. Beręsewicz A, Skierczyńska A. Miażdżyca – choroba całego życia i całej populacji krajów cywilizacji zachodniej. Choroby Serca i Naczyń 2006; 3(1): 1–6.

8. Guzik T, Undas A, Szczeklik A et al. Miażdżyca i ryzyko sercowo-naczyniowe. In: Szczeklik A, Gajewski P. Interna Szczeklika 2019. Kraków: Medycyna praktyczna; 2019, pp. 148–156.

9. Willer CJ, Schmidt EM, Sengupta S et al. Global Lipids Genetics Consortium. Discovery and refinement of loci associated with lipid levels. Nat Genet 2013; 45(11): 1274–1283. https://doi.org/10.1038/ng.2797.

10. Laffont B, Rayner KJ. MicroRNAs in the Pathobiology and Therapy of Atherosclerosis. Can J Cardiol 2017; 33(3): 313–324. https://doi.org/10.1016/j.cjca.2017.01.001.

11. Kuchta A, Lebiedzińska A, Fijałkowski M. Impact of plant-based diet on lipid risk factors for atherosclerosis. Cardiol J 2016; 23(2): 141–148. https://doi.org/10.5603/CJ.a2016.0002.

12. Torres N, Guevara-Cruz M, Velázquez-Villegas LA et al. Nutrition and Atherosclerosis. Arch Med Res 2015; 46(5): 408–426. https://doi.org/10.1016/j.arcmed.2015.05.010.

13. Emoto T, Yamashita T, Sasaki N et al. Analysis of Gut Microbiota in Coronary Artery Disease Patients: a Possible Link between Gut Microbiota and Coronary Artery Disease. J Atheroscler Thromb 2016; 23(8): 908–921. https://doi.org/10.5551/jat.32672.

14. Fåk F, Tremaroli V, Bergström G et al. Oral microbiota in patients with atherosclerosis. Atherosclerosis 2015; 243(2): 573–578. https://doi.org/10.1016/j.atherosclerosis.2015.10.097.

15. Calandrini CA, Ribeiro AC, Gonnelli AC et al. Microbial composition of atherosclerotic plaques. Oral Dis 2014; 20(3): 128–134. https://doi.org/10.1111/odi.12205.

16. White RA. Atherosclerosis and Arteriosclerosis. 1st edition. CRC Press; 1989.

17. Jóźwicka M, Głąbiński A. Patogeneza rozwoju blaszki miażdżycowej w tętnicach szyjnych. Aktualności Neurologiczne 2011; 11(4): 265–273.

18. Gieroba B. Miażdżyca – czynniki ryzyka i patogeneza. In: Maciąg M., Nowak BA, eds. Choroby cywilizacyjne i społeczne XXI w. – przegląd i badania. Lublin: Tygiel; 2016, pp. 35–46.

19. Kowalska J. Metody spektroskopowe wsparte analizą statystyczną w badaniu przekrojów aortalnych w chorobie miażdżycowej. StatSoft-Polska; 2017 [Internet]. Available from: https://www.statsoft.pl/wp-content/uploads/2018/01/metody_spektroskopowe_wsparte_analiza_1.pdf [cited 24.10.2020].

20. Hanski L, Ausbacher D, Tiirola TM et al. Amphipathic β2,2-Amino Acid Derivatives Suppress Infectivity and Disrupt the Intracellular Replication Cycle of Chlamydia pneumoniae. PLoS One 2016; 11(6): e0157306. https://doi.org/ 10.1371/journal.pone.0157306.

21. Jama-Kmiecik A, Frej-Mądrzak M, Sarowska J et al. Wybrane aspekty zakażeń Chlamydophila pneumonia. Selected aspects of Chlamydophila pneumoniae infections. Postepy Hig Med Dosw (online) 2015; 69: 612–623.

22. Nowak P, Zasowska-Nowak A. Pneumonia in palliative care patients. Part 2 – management of atypical and fungal pneumonia. Palliat Med 2019; 11: 58–66.

23. Porritt RA, Crother TR. Chlamydia pneumoniae Infection and Inflammatory Diseases. For Immunopathol Dis Therap 2016; 7(3–4): 237–254. https://doi.org/10.1615/ForumImmunDisTher.2017020161.

24. Webley WC, Hahn DL. Infection-mediated asthma: etiology, mechanisms and treatment options, with focus on Chlamydia pneumoniae and macrolides. Respir Res 2017; 18(1): 98. https://doi.org/10.1186/s12931-017-0584-z.

25. Loeffler J, Huang Y, Klein E et al. Levels of Chlamydia pneumoniae Immunoglobulin E antibody in patients with asthma compared with non-asthma. J Allergy Clin Immunol 2019; 143,(2): AB9. https://doi.org/10.1016/j.jaci.2018.12.028.

26. Muro S, Tabara Y, Matsumoto H et al. Relationship Among Chlamydia and Mycoplasma Pneumoniae Seropositivity, IKZF1 Genotype and Chronic Obstructive Pulmonary Disease in A General Japanese Population: The Nagahama Study. Medicine (Baltimore) 2016; 95(15): e3371. https://doi.org/10.1097/MD.0000000000003371.

27. Balin BJ, Hammond CJ, Little CS et al. Chlamydia pneumoniae: An Etiologic Agent for Late-Onset Dementia. Front Aging Neurosci 2018; 10: 302. https://doi.org/10.3389/fnagi.2018.00302.

28. Roulis E, Bachmann NL, Myers GS et al. Comparative genomic analysis of human Chlamydia pneumoniae isolates from respiratory, brain and cardiac tissues. Genomics 2015; 106(6): 373–383. https://doi.org/10.1016/j.ygeno.2015.09.008.

29. Maekawa M, Iwadate T, Watanabe K et al. Spontaneous remission of giant cell arteritis: possible association with a preceding acute respiratory infection and seropositivity to Chlamydia pneumoniae antibodies. Nagoya J Med Sci 2019; 81(1): 151–158. https://doi.org/10.18999/nagjms.81.1.151.

30. Podsiadły E, Tylewska-Wierzbanowska S. Chlamydia pneumoniae – czynnik etiologiczny choroby wieńcowej? Przeg Epid 1999; 53(3–4): 231–243.

31. Dudlik P, Miczke A, Bogdański P. Neopteryna – nowe możliwości monitorowania miażdżycy. Forum Zaburzeń Metabolicznych 2016; 7(4): 176–181.

32. Filardo S, Di Pietro M, Farcomeni A et al. Chlamydia pneumoniae-Mediated Inflammation in Atherosclerosis: A Meta-Analysis. Hindawi Publishing Corporation. Mediators Inflamm 2015: Article ID 378658. https://doi.org/10.1155/2015/378658.

33. Kuczaj A, Stryjewski PJ, Fudal M et al. The prevalence of Chlamydia pneumoniae in the aortic wall and in peripheral blood of patients scheduled for coronary artery bypass grafting. J Biol Regul Homeost Agents 2016; 30(2): 433–440.

34. Cao J, Mao Y, Dong B, Guan W, Shi J, Wang S. Detection of specific Chlamydia pneumoniae and cytomegalovirus antigens in human carotid atherosclerotic plaque in a Chinese population. Oncotarget 2017; 8(33): 55435–55442. https://doi.org/10.18632/oncotarget.19314.

35. Richard S. Pivotal Pathogenic and Biomarker Role of Chlamydia Pneumoniae in Neurovascular Diseases. Curr Neurovasc Res 2018; 15(3): 262–273. https://doi.org/10.2174/1567202615666180717161807.

36. Pigarevsk PV, Maltseva SV, Snegova VA et al. The Role of Chlamidia Pneumonia and Tnf-a In Destabilization of Atherosclerotic Plaque by Human. Med Akad Z; 2017: 17(2): 100–104. https://doi.org/10.17816/MAJ172100-104.

37. Freitas LS, Almeida NCC, Freitas Queiroz MA et al. In situ detection of Chlamydia pneumoniae, C. trachomatis, and cytokines among cardiovascular diseased patients from the Amazon region of Brazil. Infect Drug Resist 2017; 10: 109–114. https://doi.org/10.2147/IDR.S123801.

38. Karney A, Brągoszewska H, Soluch L, Ołtarzewski M. Czynniki ryzyka rozwoju miażdżycy u otyłych dzieci w wieku 6–12 lat. Aluna Developmental Period Medicine 2017; XXI: 3259.

39. Sorrentino R, Yilmaz A, Schubert K et al. A single infection with Chlamydia pneumoniae is sufficient to exacerbate atherosclerosis in ApoE deficient mice. Cell Immunol 2015; 294(1): 25–32. https://doi.org/10.1016/j.cellimm.2015.01.007.

40. Lantos I, Endrész V, Virok DP et al. Chlamydia pneumoniae Infection Exacerbates Atherosclerosis in ApoB100only/LDLR−/− Mouse Strain. Biomed Res Int 2018; Article ID 8325915. https://doi.org/10.1155/2018/8325915.

41. Karuna P, Campbell LA, Rosenfeld ME et al. Effects of Murine Norovirus on Chlamydia pneumoniae – Accelerated Atherosclerosis in ApoE−/− Mice. Comp Med 2016; 66(3): 188–196.

42. Tracz W. Chlamydia pneumoniae – przyczynowy patogen czy przypadkowy świadek rozwoju miażdżycy? Kardiol Pol 2009; 67: 9.

43. Campbell LA, Rosenfeld M. Persistent C. pneumoniae infection in atherosclerotic lesions: rethinking the clinical trials. Front. Cell Infect Microbiol 2014; 4: Article 34. https://doi.org/10.3389/fcimb.2014.00034.

44. Grayston JT, Belland RJ, Byrne GI et al. Infection with Chlamydia pneumoniae as a cause of coronary heart disease: the hypothesis is still untested. Pathog Dis 2015; 73(1): 1–9. https://doi.org/10.1093/femspd/ftu015.

45. Li W, Gudipaty P, Li C et al. Intranasal immunization with recombinant chlamydial protease-like activity factor attenuates atherosclerotic pathology following Chlamydia pneumoniae infection in mice. Immunol Cell Biol 2019; 97(1): 85–91. https://doi.org/10.1111/imcb.12192.

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Prevention of Cognitive Impairment in the Elderly

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Abstract

The growing number of older people in society and the increase in life expectancy contribute to an increase in the number of people with cognitive impairment. The aging process is associated with a natural impairment of cognitive functions. Pathological changes that may occur may lead to mild cognitive impairment, followed by dementia. The deterioration of the cognitive functioning of older people may lead to a decrease in independence in performing daily activities, a decrease in self-esteem and quality of life, and withdrawal from social life. An important element in the prevention of cognitive impairment and its consequences is early prevention, which often allows you to slow down or delay the progression of cognitive impairment. Mental and physical activity support the successful aging of the body, reduce the risk of developing cognitive impairment and improve overall cognitive functioning. Another important element of prevention is proper diet and proper hydration of the body, which has a positive effect on overall health. With age, thirst decreases physiologically, so it is important to control the amount of fluid intake by older people. Preventive actions have a positive impact on the cognitive and functional efficiency of seniors. Management of cognitive functions and dementia is not only a problem for a patient, but also burdens the family and close ones, who take part in the role of caregivers, so one should consider the use of prevention as soon as possible.

Key words: *older adults, cognitive impairment, prevention.*

Introduction

Life expectancy in Polish population is increasing, and as it grows, so does the number of people with cognitive impairment and dementia. The number of elderly people is systematically increasing. According to the Central Statistical Office (Główny Urząd Statystyczny, GUS) data, at the end of 2018, the number of people over 60 years of age reached 24.8% of Polish population and increased by 5.2% compared to 2010. As predicted by the Central Statistical Office, the number of people aged 60 and more in 2050 may increase to 40% of the total population [1]. An important part of everyone's mental health is their cognitive ability. Cognitive processes allow for receiving and assimilating information, its analysis and collection. They affect both the quality of functioning in society and the subjective perception of the quality of life. Deterioration of cognitive functions, including the skills of learning, remembering and thinking, adversely affects the daily functioning of older people, as well as their quality of life. This can lead to a decrease in their independence, lower self-esteem and withdrawal from many areas of activity [2]. The prevalence of dementia in the elderly population is estimated at around 10% [3]. It is estimated that 47 million people worldwide currently suffer from dementia, which could triple by 2050 [4]. So far, effective treatment of cognitive disorders has not been proven, but there is scientific evidence that the progression of progressive changes can be slowed down with non-pharmacological treatments, including exercise, weight normalization, and adequate cognitive stimulation [5,6]. Active participation in social life, support from friends, various forms of activity improve the global cognitive functioning of older people [7].

Aging of the body

The aging of the body is a demographic process and it progresses with increasing intensity. The number of elderly people is increasing every year. With age, more and more physiological changes related to aging appear

in the body. Old age is the last stage of the body's aging process. The age threshold for old age is 60 (according to WHO) or 65 (according to the UN). Old age is divided into three sub-periods: early old age (between 60 and 75 years of age), later old age (between 75 and 89 years of age) and longevity or old age (over 90 years of age) [3, 8].

Changes in the aging process, the so-called involutional changes take place in cells, tissues, and throughout the body. As a result of involutional changes in the nervous system, the number of neurons is reduced, especially in the hippocampus, which affects the transfer of information from short-term to long-term memory [9]. Neuropathological changes can also occur: neuronal filamentous degeneration associated with the formation of intracellular neurofibrillary tangles and senile plaques consisting of extracellular aggregates of beta-amyloid plaques. These changes disrupt the process of neurotransmission, which hinders signal transmission, leading to cognitive impairment [3, 4]. The presence of beta-amyloid in patients with mild cognitive impairment is likely to lead to Alzheimer's disease in the future. Neurological studies show a decrease in the volume of gray matter, which begins to decline after the age of 20, white matter, and a decrease in the level of neurotransmitters in an aging body, which can lead to cognitive impairment [10].

Changes in the cardiovascular system, pathologies of which lead to vascular dementia, are also important for cognitive functioning. With the aging of the organism, arterial vessels expand, the walls thicken, and their elasticity and flexibility decrease due to stiffening. Changes in the structure of the heart also occur in older people. Physiologically, there is an enlargement of the ventricular walls, i.e. septum of the left ventricle and the dimensions of the left atrium increase [8]. Research shows that people with left ventricular hypertrophy have poorer cognitive functions than people without left ventricular hypertrophy, especially in two areas, memory and executive function [11]. The aging process of the organism is also associated with the formation of functional and structural changes in the kidneys, the weight and size of the kidneys decrease, the blood flow through the kidneys and glomerular filtration decrease [8]. These

changes affect cognitive functioning, the SPRINT study showed that patients with a higher glomerular filtration rate scored worse in assessing cognitive functioning [12]. With age, changes in the respiratory system also occur, the chest stiffens, and the strength of the intercostal muscles and the diaphragm weakens. Forced vital capacity (FEV) and forced expiratory volume in one second (FEV1) are reduced [8], which affects the risk of cognitive dysfunction [13]. By means of preventive measures, it is possible to delay the emerging involutional changes.

Prevention of cognitive functions disorders

During the aging process, many cognitive functions are naturally impaired, which is known as cognitive aging. Particularly significant defects can be observed in certain aspects of memory and attention, processing speed, executive functions, and reasoning [14]. The consequences of the deterioration of the cognitive functioning of older people may be: a decrease in their independence, lower self-esteem, withdrawal from many areas of activity (e.g. professional, social, educational) due to the feeling of reduced mental competences [15]. That is why various strategies for the prevention of cognitive disorders are so important. Therefore, various types of interventions are undertaken to improve the cognitive functioning of older people.

Mental activity

Cognitive training is one of the possible interventions [16] and is still under research. Research on cognitive function training indicates an improvement in at least one of the measures of cognitive function used in cognitive interventions conducted among healthy elderly people [17] and a positive impact on global cognitive functioning, selected cognitive domains and psychosocial functioning of cognitive training in the elderly. In the case of people with mild cognitive impairment [18]. Some researchers point out that the effectiveness of such interventions in healthy

elderly people and people with mild cognitive impairment may have some limitations in their impact on the improvement of trained tasks, as well as the lack of transfer of this improvement to other cognitive tasks [19], but other analyses indicate the possibility of transferring the improvement of functioning in various areas and tasks. However, it is rather a close transfer, that is, a transfer to similar tasks, involving the same cognitive functions as the trained tasks [20]. This transfer can also take place among the elderly. The analysis by Karbach et al. [21] indicates not only a significant improvement in the performance of trained tasks, but also the effects of close and long transfer as a result of executive functions and working memory training conducted among older people (over 60 years of age). Elderly people more and more often use the Internet and available cognitive training programs, which, according to research results, may protect against the deterioration of cognitive functions in normally aging people [22]. It seems rational to take care of the mental activity of the elderly for as long as possible, the more so as most sources describe the improvement of cognitive functions in the elderly participating in mental training. Perhaps this could prevent or delay the onset of cognitive decline.

Physical activity

Maintaining physical activity in the elderly is as important as maintaining mental activity. World Health Organization (WHO) recommends people over 65 to exercise at moderate intensity for at least 150 minutes per week, suggesting that increasing this time to 300 minutes per week increases the health benefits [23]. Participation in physical activity is believed to contribute to successful aging and maintaining psychomotor performance [24]. Guure et al. indicates that physical activity reduces the risk of dementia from various causes, especially Alzheimer's disease [25]. More and more scientific publications seem to confirm that a lifestyle that includes physical activity significantly increases the chance of successful aging also in terms of cognition [26]. This indicates the usefulness of endurance (aerobic), strength (resistance), stretching and equivalent

exercises in health training of the elderly [27, 28, 29, 30, 31]. The optimal type of intervention is the use of all exercises. Interventions with the use of various types of exercise not only improve cognitive functioning, but also increase muscle strength, reduce the risk of depression and have a positive effect on the quality of life [30]. The researchers' attention is also drawn to other, less popular forms of physical activity in terms of possible improvement of the cognitive functioning of the elderly. Research conducted on a group of people over 55 years of age practicing yoga has shown a significant improvement in memory as well as an overall improvement in cognitive functioning [32]. Cognitive functioning was also improved by researchers who used an intervention with aerobic dance exercises, in patients with mild cognitive impairment. After the training, episodic memory and processing speed were particularly improved [33]. Physical activity contributes to the increase in vascularity and reduces the negative impact of oxidative stress on the body and a decrease in energy metabolism. Physical activity, like mental activity, protects against cognitive impairment [34]. Physical activity, while often beneficial, may not always be effective in fighting dementia. Not all studies support a reduction in the risk of developing vascular dementia associated with exercise [29]. There are also suggestions that aerobic training does not significantly affect cognitive performance [35]. However, most scientific research seems to confirm the beneficial effects of exercise on cognitive and functional functions in seniors. Regular exercise appears to have preventive effects on the brain, both in terms of physiological and pathological aging. The availability and low costs associated with the introduction of physical activity as a form of prevention and therapy make it a very attractive means of influencing health.

Diet

Proper nutrition is one of the main components of maintaining cognitive well-being. A proper diet slows down the aging process of the body, reduces the risk of developing neurodegenerative diseases by acting as

an anti-inflammatory. Moreover, it slows down the process of the formation of atherosclerotic plaques in the arteries of the brain and increases blood flow and stimulates the immune system [34, 36]. The Mediterranean diet and the DASH diet used in the treatment of hypertension have a neuroprotective effect. They are particularly rich in omega-3 acids, antioxidants and polyphenols [37], which positively influence the inhibition of oxidative stress and the reduction of neuroinflammatory processes [38, 39]. The Mediterranean diet is characterized by high consumption of vegetables and fruits, legumes, nuts and olive oil, along with low intake of saturated lipids and meat, moderate consumption of fish, low to moderate consumption of dairy products, and regular to moderate alcohol consumption (usually wine). The DASH diet is also rich in fruit and vegetables, foods low in saturated fat, and low-fat dairy products [40]. These diet regimens provide essential micronutrients, fiber, and other plant-based foods that are believed to promote health. Adherence to the Mediterranean diet and DASH lead to a reduction in the risk of cognitive dysfunctions and a slower process of their deterioration, and improvement in the global cognitive functioning of the elderly [37, 41, 42].

An important element of prevention of cognitive disorders is adequate hydration of the body, which should be especially paid attention to by the elderly. Adequate hydration of the body reduces the feeling of fatigue and improves well-being and mood. It has a positive effect on cognitive functioning, especially in the field of short-term memory, attention and reaction [43]. Dehydration increases the risk of developing dementia, including Alzheimer's disease and vascular dementia. These patients show greater dehydration of the organism than without dementia [44].

Summary

The growing number of elderly people in society and the extension of life expectancy lead to an increase in the number of people with cognitive impairment. Physiological aging of the organism leads to the formation of involutional changes that occur with varying intensity. Changes in the

bodies of older people lead to a decline in cognitive functions. The aging of the body and the brain, is an inevitable process, but scientific research shows that the preventive measures taken delay the aging process and reduce the risk of developing cognitive disorders. Important elements of prevention include mental and physical activity as well as a diet with adequate hydration. One of the ways to improve cognitive functioning is also a cognitive training. All these affect not only the improvement in selected domains, but also the global cognitive functioning, the effect of close and far transfer is also noticed, improving functioning in everyday life and its quality. In addition to mental activity, physical activity is also important to promote successful aging and reduce the risk of dementia. The analysis of the presented studies allows to confirm the beneficial effect of mental and physical activity, as well as changes in eating habits on the cognitive performance of the elderly. As many activities as possible should be undertaken to improve the functioning of the elderly, because progressive cognitive disorders lead to difficulties in performing everyday activities, which becomes a big problem not only for the sick person, but also for their relatives. Dementia diseases are a great challenge for every country in terms of providing adequate medical care, also institutional, and in economic terms, which is why their prevention is so important.

References

1. Wyszkowska D, Gabińska M, Romańska S. Sytuacja osób starszych w Polsce w 2018 r. Warszawa, Białystok: Główny Urząd Statystyczny, Urząd Statystyczny w Białymstoku; 2020, pp. 18–21.

2. Cebulak M, Markiewicz I, Guty E, Ocena funkcji poznawczych u chorych objętych domową długoterminową opieką pielęgniarską. Prob Piel 2014; 22(1): 20–26.

3. Klicz-Rączka A, Siuda J, Piotrowicz K et al. Zaburzenia funkcji poznawczych u osób w starszym wieku. In: Mossakowska M, Więcek A, Błędowski P, eds. Aspekty medyczne, psychologiczne, socjologiczne i ekonomiczne starzenia się ludzi w Polsce. Poznań: Termedia Wydawnictwa Medyczne; 2012, pp. 109–122.

4. Tiwari S, Atluri V, Kaushik A et al. Alzheimer's disease: pathogenesis, diagnostics, and therapeutics. Int J Nanomedicine 2019; 14: 5541–5554.

5. Sanford AM, Mild Cognitive Impairment. Clin Geriatr Med 2017; 33(3): 325–337.

6. Jongsiriyanyong S, Limpawattana P. Mild Cognitive Impairment in Clinical Practise: A Review Article. Am J Alzheimers Dis Other Demen 2018; 33(8): 500–507.

7. Fu C, Li Z, Mao Z. Association between Social Activities and Cognitive Function among the Elderly in China: A Cross-Sectional Study. Int J Environ Res Public Health 2018; 15(2): 231.

8. Muszalik M, Kędziora-Kornatowska K, eds. Pielęgnowanie pacjentów w starszym wieku. Warszawa: Wydawnictwo PZWL; 2018, pp. 3–12, 317–336.

9. Biechowska D, Orłowska E. Neuropsychologiczna charakterystyka wybranych zespołów otępiennych. Pol Przegl Neurol 2012; 8(2): 66–75.

10. Harada CN, Netelson Love MC, Triebel K. Normal Cognitive Aging. Clin Geriatr Med 2013; 29(4): 737–752.

11. Restrepo C, Patel SK, Rethnam V et al. Left ventricular hepertrophy and cognitive function: A systematic review. J Hum Hypertens 2018; 32(3): 171179.

12. Weiner DE, Gaussoin SA, Nord J, et al. Cognitive Function and Kidney Disease: Baseline Data From the Systolic Blood Pressure Intervention Trial (SPRINT). Am J Kidney Dis 2017; 70(3): 357–367.

13. Feng L, Lim ML, Collinson S et al. Pulmonary function and cognitive decline in an older Chinese population in Singapore. COPD: Journal of Chronic Obstructive Pulmonary Disease 2012; 9(5): 555–562.

14. Murman D. The Impact of Age on Cognition. Semin Hear 2015; 36: 111–121.

15. Zając-Lamparska L, Izdebski P, Wiłkość-Dębczyńska M. Efektywność zastosowania oprogramowania GRADYS – treningu poznawczego z elementami wirtualnej rzeczywistości – u osób po 60. roku życia bez zaburzeń funkcji poznawczych, Neuropsychiatria i Neuropsychologia 2017; 12(4): 143–151.

16. Wójcik-Topór Paulina. Niefarmakologiczne metody oddziaływania na funkcje poznawcze w otępieniach. In: Tłokiński W, Milewski S, and Kaczorowska-Bray K, eds. Gerontologopedia (seria: Logopedia XXI wieku). Gdańsk: Harmonia Universalis; 2018, pp. 451–468.

17. Tardif S, Simard M. Cognitive stimulation programs in healthy elderly: a review. Int J Alzheimers Disease 2011: Article ID: 378934.

18. Hill NTM, Mowszowski L, Naismith SL et al. Computerized cognitive training in older adults with mild cognitive impairment or dementia: A systematic review and meta-analysis. American Journal Psychiatry 2017; 174(4): 329–340.

19. Zając-Lamparska L, Trempała J, Effects of working memory and attentional control training and their transfer onto fluid intelligence in early and late adulthood. Health Psychol Rep 2016; 4(1): 41–53.

20. Weicker J, Villringer A, Thoene-Otto A. Can Impaired Working Memory Functioning Be Improved By Training? A Meta-Analysis With a Special Focus on Brain Injured Patients, Neuropsychology 2015; 30(2): 190–212.

21. Karbach J, Verhaeghen P. Making Working Memory Work: A Meta-Analysis of Executive-Control and Working Memory Training in Older Adults. Psychol Sci 2014; 25(11): 2027–2037.

22. Klimova B. Use of the Internet as a prevention tool against cognitive decline in normal aging. Clin Interv Aging 2016; 11: 1231–1237.

23. World Health Organization. Global strategy on diet, physical activity and health: physical activity and older adults [Internet]. Available from: http://www.who.int/dietphysicalactivity/factsheet_olderadults/en/ [cited 25.04.2020].

24. Rottermund J, Knapik A, Szyszka M. Aktywność fizyczna a jakość życia osób starszych. Społeczeństwo i Rodzina 2015; 42(1): 78–98.

25. Guure CB, Ibrahim NA, Mohd BA et al. Impact of Physical Activity on Cognitive Decline, Dementia, and Its Subtypes: Meta-Analysis of Prospective Studies. Biomech Research International 2017; 17: Article ID 9016924.

26. Daskalopoulou C, Stubbs B, Kralj C, et al. Physical activity and healthy ageing: A systematic review and meta-analysis of longitudinal cohort studies. Ageing Res Rev 2017; 38: 6–17.

27. Gajos A, Kujawski S, Gajos M et. al. Effect of physical activity on cognitive functions in elderly. Journal of Health Sciences 2014; 4(8): 91–100.

28. Zalewski P, Kujawski S, Tudorowska M. et. al. The Impact of a Structured Exercise Programme upon Cognitive Function in Chronic Fatigue Syndrome Patients. Brain Sciences 2019; 10(1): 4.

29. Heyn P, Abreu BC, Ottenbacher KJ. The effects of exercise training on elderly persons with cognitive impairment and dementia: a meta-analysis. Arch Phys Med Rehabil 2004; 85(10): 1694–1704.

30. de Camargo Smolarek A, Ferreira L, Mascarenhas L et al. The effects of strength training on cognitive performance in elderly women. Clinical Interventions in Aging 2016; 11: 749–754.

31. Dedeyne L, Deschodt M, Verschueren S et al. Effects of multi-domain interventions in (pre)frail elderly on frailty, functional, and cognitive status: a systematic review. Clin Interv Aging 2017; 12: 873–896.

32. Zhu Y, Wu H, Wang S et al. Effects of a specially designed aerobic dance routine on mild cognitive impairment. Clin Interv Aging 2018; 11(13): 1691–1700.

33. Eyre H, Siddarth P, Acevedo B et al. A randomized controlled trial of Kundalini yoga in mild cognitive impairment. Int Psychogeriatr 2017; 29(4): 557–567.

34. Klimova B, Valis M, Kuca K. Cognitive decline in normal aging and its prevention: a review on non-pharmacological lifestyle strategies. Clin Interv Aging 2017; 12: 903–910.

35. Kishimoto H, Ohara T, Hata J et al. The long-term association between physical activity and risk of dementia in the community: the Hisayama Study. European Journal of Epidemiology 2016; 31(3): 267–274.

36. Petersson SD, Philippou E. Mediterranean Diet, Cognitive Function, and Dementia: A Systematic Review of the Evidence. Adv Nutr 2016; 7(5): 889–904.

37. McGrattan AM, McGuinness B, McKinley MC et al. Diet and Inflammation in Cognitive Ageing and Alzheimer's Disease. Curr Nutr Rep 2019; 8(2): 53–65.

38. Devassy JG, Leng S, Gabbs M et al. Omega-3 Polyunsaturated Fatty Acids and Oxylipins in Neuroinflammation and Management of Alzheimer Disease. Adv Nutr (Bethesda, Md) 2016; 7(5): 905–916.

39. Monacelli F, Acquarone E, Giannotti C et al. Vitamin C, Aging and Alzheimer's disease. Nutrients 2017; 9(7): 670.

40. Loughrey DG, Lavecchia S, Brennan S et al. The impact of Mediterranean Diet on the Cognitive Functioning of Healthy Older Adults: A Systematic Review and Meta-Analysis. Adv Nutr 2017; 8(4): 571–586.

41. Juraschek SP, Miller ER, Weaver CM et al. Effects of Sodium Reduction and the DASH Diet in Relation to Baseline Blood Pressure. J Am Coll Cardiol 2017; 70(23): 2841–2848.

42. Van den Brink AC, Brouwer-Brolsma E, Berendsen AAM et al. The Mediterranean, Dietary Approaches to Stop Hypertension (DASH), and Mediterranean – DASH Intervention for Neurodegenerative Delay (MIND) Diets Are Associated With Less Cognitive Decline and a Lower Risk of Alzheimer's Disease – A Review. Adv Nutr 2019; 10(6): 1040–1065.

43. Zhang N, Du MS, Zhang JF, Ma GS. Effects of Dehydration and Rehydration on Cognitive Performance and Mood among Male College Students in Cangzhou, China: A Self-Controlled Trial. Int J Environ Res Public Health 2019; 16(11): 1891.

44. Lauriola M, Mangiacotti A, D'Onofrio G et al. Neurocognitive Disorders and Dehydration in Older Patients: Clinical Experience Supports the Hydromolecular Hypothesis of Dementia. Nutrients 2018; 10(5): 562.