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ORIGINAL PAPER

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Additive interaction for three-drug combination of carbamazepine, lacosamide and lamotrigine against maximal electroshock-induced seizures – a type I isobolographic analysis

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ABSTRACT

Introduction. Treatment of epilepsy patients with one antiepileptic drug often fails and then the insufficiently medicated patients need two or three antiepileptic drugs combined together to stop their seizures. However, polytherapy is always associated with drug-drug interactions whose nature may or may not be favorable for epilepsy patients. Preclinical studies on animals can help to select beneficial combinations of antiepileptic drugs that could be used in further clinical settings.

Aim. To isobolographically characterize anticonvulsant effects of a combination of three antiepileptic drugs (carbamazepine, lacosamide and lamotrigine) at the fixed drug dose ratio of 1:1:1 in the mouse maximal electroshock-induced seizure test.

Material and methods. Maximal electroconvulsions were evoked in male Swiss mice by a current (25 mA, 500 V, 0.2 s stimulus duration) delivered *via* auricular electrodes. Type I isobolographic analysis was applied to assess the interaction among carbamazepine, lacosamide and lamotrigine.

Results. Isobolographic analysis revealed that the combination of carbamazepine, lacosamide and lamotrigine produced additive interaction in the mouse maximal electroshock-induced seizure test.

Conclusions. Additivity among carbamazepine, lacosamide and lamotrigine in this preclinical study can be translated to clinical settings and this three-drug combination can be recommended as a treatment option for epilepsy patients who are resistant to standard treatment regimens.

Keywords. antiepileptic drugs, isobolographic analysis, maximal electroshock, three-drug combination

Introduction

Despite our advanced knowledge about epileptogenesis and progress in epilepsy treatment, there is still a number of epilepsy patients who need efficacious treatment.[1,2] Monotherapy with current frontline antiepileptic drugs is the preferred option for these patients. Unfortunately, if three consecutive monotherapies fail, clinicians are obliged to start rational polytherapy with two or more antiepileptic drugs.[3-5] To date, many dozens of two-drug combinations were tested in preclinical studies, however, only a few three-drug combinations were experimentally investigated.[6-9] Generally, evalu-

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ation of the effectiveness of combined treatment with two or three antiepileptic drugs in preclinical studies is usually performed using an isobolographic analysis of interaction.[10-12]

Available preclinical evidence indicates that the three-drug combinations of lacosamide + carbamazepine + phenobarbital and lacosamide + lamotrigine + phenobarbital exerted additive interaction in the mouse maximal electroshock-induced seizure model.[6,9] Only the combination of carbamazepine + phenobarbital + topiramate synergistically protected the mice from maximal electroshock-induced seizures.[7]

The selection of antiepileptic drugs for combination into three-drug mixtures is based on theoretical presumptions concerning diverse molecular mechanisms of anticonvulsant action of the selected drugs. It is widely accepted that drugs whose molecular mechanisms of anticonvulsant activity differ, may offer a wide range of protection from seizures, and simultaneously, the drugs do not produce side effects.[13] This is the main reason to combine together the drugs with different mechanisms of action to avoid harmful and/or intolerable adverse effects accompanied polytherapy with antiepileptic drugs.

The purpose of this study was to determine the anticonvulsant effects for the combination of three (the first-, second- and third-generation) antiepileptic drugs in the mouse model of tonic-clonic seizures using the type I isobolographic analysis. In this study, we combined carbamazepine (a first-generation antiepileptic drug), lamotrigine (a second-generation antiepileptic drug) and lacosamide (a third-generation antiepileptic drug) in a mixture at the fixed drug dose ratio of 1:1:1. The three-drug mixture was administered to mice and the animals were subjected to the maximal electroshock-induced seizures that are thought to be a model of tonic-clonic seizures in humans.[14] Additionally, due to the isobolographic analysis we characterized a type of interactions occurring among carbamazepine, lamotrigine and lacosamide in order to try to translate the results from this preclinical study to clinical conditions.

Materials and Methods

Animals

Experiments on animals were conducted in a strict accordance with the Guide for the Care and Use of Laboratory Animals (NIH, USA), the ARRIVE guidelines and EU Directive 2010/63/EU for animal experiments. All experimental procedures were approved by the Second Local Ethics Committee at the University of Life Sciences in Lublin, Poland. Adult male albino Swiss mice (six-week-old, weighing 22-26 g), after 4 days of acclimatization to laboratory conditions, were randomly assigned to experimental groups consisting of 8 mice. Total number of animals used in this study was 256.

Drugs

In this study we used: carbamazepine (Sigma-Aldrich, Poznan, Poland), lacosamide (Vimpat®, UCB Pharma, Brussels, Belgium), and lamotrigine (Lamictal®, Glaxo Wellcome, Greenford, Middlesex, UK). All drugs were suspended in an aqueous 1% solution of Tween 80 (Sigma-Aldrich, Poznan, Poland) and administered intraperitoneally (i.p.) as follows: carbamazepine and lacosamide at 30 min, and lamotrigine at 60 min, prior to the maximal electroshock-induced seizures as documented earlier.[6,7]

Maximal electroshock-induced seizures

The antielectroshock activities of carbamazepine, lacosamide, lamotrigine (administered singly) and their mixture at the fixed drug dose ratio of 1:1:1 were expressed as the median effective doses (ED_{50} in mg/kg). Maximal electroconvulsions (seizure activity) were produced by a current (25 mA, 500 V, 50 Hz, 0.2 s stimulus duration) delivered *via* auricular electrodes from a Hugo Sachs generator (Rodent Shocker, Freiburg, Germany). The animals after receiving different drug doses were subjected to the maximal electroshock-induced seizures and percentage of the mice protected from tonic-clonic seizures allowed us to construct dose-response effect lines for the studied antiepileptic drugs.[15] The anticonvulsant activity of the mixture of carbamazepine, lacosamide and lamotrigine was expressed as the experimental median effective dose ($ED_{50\ exp}$) against maximal electroshock-induced seizures.

Type I isobolographic analysis of interaction

Interactions among drugs combined together in a mixture are usually analyzed with isobolographic analysis as described earlier.[10,16,17] Percentage of animals protected from tonic-clonic seizures per doses of carbamazepine, lacosamide and lamotrigine administered alone were fitted using log-probit linear regression analysis.[15] The ED_{50} values for carbamazepine, lacosamide and lamotrigine were calculated from the respective equations. The test for parallelism of log-probit dose-response effect lines was used, as described in more detail elsewhere.[18] Meanwhile, the median additive dose ($ED_{50\ add}$) of the mixture of carbamazepine, lacosamide and lamotrigine for the fixed-ratio combination of 1:1:1 was calculated, as presented elsewhere.[16] Subsequently, mass quantities of carbamazepine, lacosamide and lamotrigine in the purely additive mixture for the fixed drug dose ratio combination of 1:1:1 were theoretically calculated and the respective mixtures of the studied drugs were administered to animals. The experimentally-derived $ED_{50\ exp}$ at the fixed-ratio of 1:1:1 was calculated from doses of the mixture protecting the tested animals from tonic-clonic seizures. Ultimately, to calculate doses of particular antiepileptic drugs in the mixture, the $ED_{50\ exp}$ value was multiplied by the respective proportions of carbamazepine, lacosamide and lamotrigine (denoted earlier for purely additive mixture), as presented elsewhere.[6,19]

Statistical analysis of data

Log-probit analysis was used to calculate the ED_{50} and $ED_{50\,exp}$ values for the tested antiepileptic drugs administered separately and combined together at the fixed-ratio of 1:1:1.[15] The unpaired Student's *t*-test was used to statistically compare the experimentally-derived $ED_{50\,exp}$ value with the theoretical additive $ED_{50\,add}$ value for the three-drug mixture, as described earlier.[6,20]

Results

Antielectroshock activities of carbamazepine, lacosamide and lamotrigine along with isobolographic analysis of interaction among the antiepileptic drugs

Carbamazepine, lacosamide and lamotrigine administered separately exerted, in a dose-dependent manner, the anticonvulsant effects in the mouse maximal electroshock-induced seizure test. The experimentally determined equations of log-probit dose-response effects for carbamazepine, lacosamide and lamotrigine (Figure 1), allowed us to calculate the median effective doses (ED_{50} values) for the studied drugs (Table 1).

The test for parallelism of log-probit dose-response effects revealed that carbamazepine had its log-probit dose-response line non-parallel to that of lamotrigine and lacosamide (Table 1; Figure 1). In contrast, log-probit dose-response lines of lacosamide and lamotrigine were parallel to each other (Table 1; Figure 1). The mixture of carbamazepine, lacosamide and lamotrigine at the fixed drug dose ratio combination of 1:1:1 protected, in a dose-dependent manner, the mice from tonic-clonic seizures and the experimentally derived $ED_{50\,exp}$ value in the mouse maximal electroshock-induced seizure test amounted to 9.83 ± 1.29 mg/kg (Table 2).

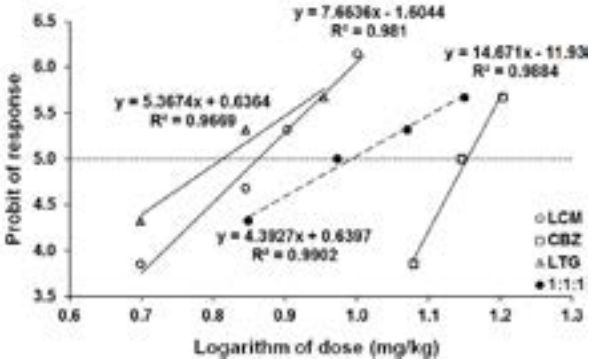

Figure 1. Log-probit dose-response effect analysis of lacosamide (LCM), carbamazepine (CBZ), and lamotrigine (LTG) administered separately and combined together at the fixed-ratio of 1:1:1 in the mouse maximal electroshock-induced seizure model

Doses of carbamazepine, lacosamide and lamotrigine administered separately and in combination at the fixed drug dose ratio of 1:1:1 were transformed to logarithms, whereas the anticonvulsant (protective) effects of the drugs in the mouse tonic-clonic model were transformed to probits. Linear regression equations for carbamazepine, lacosamide and lamotrigine and their combination are presented on the graph; where y – is the probit of response; x – is the logarithm (to the base 10) of a drug dose or a three-drug mixture dose; and R^2 – is the coefficient of determination. Points constructing lines reflect numbers of groups of animals (8 mice per group) used in this study.

With type I isobolographic analysis of interaction it was found that the $ED_{50\,exp}$ value for the combination of carbamazepine, lacosamide and lamotrigine did not significantly differ from the corresponding additively cal-

Table 1. Effects of carbamazepine, lacosamide and lamotrigine administered separately in the mouse tonic-clonic seizure model

Drug	ED_{50}	n	Test for parallelism	S.R.	f ratio S.R.	
Carbamazepine	14.25 ± 0.79	16	Carbamazepine vs. Lacosamide	1.154	1.126	non-parallel
Lacosamide	7.27 ± 0.77	16	Carbamazepine vs. Lamotrigine	1.313	1.228	non-parallel
Lamotrigine	6.50 ± 0.80	24	Lacosamide vs. Lamotrigine	1.137	1.244	parallel

Data are median effective doses (ED_{50} values in mg/kg ± S.E.M.) of the antiepileptic drugs administered systemically (i.p.) in the maximal electroshock-induced seizure test in mice. n – total number of animals used at those doses whose expected anticonvulsant effects ranged between 4 and 6 probits (16% and 84%); S.R. – slope function ratio for the respective two-drug combinations; f ratio S.R. – factor for slope function ratio for the respective two-drug combinations. Test for parallelism was performed according to Litchfield and Wilcoxon[15], as described in more detail earlier.[33]

Table 2. Type I isobolographic analysis of interaction among carbamazepine (CBZ), lacosamide (LCM) and lamotrigine (LTG) at the fixed drug dose ratio of 1:1:1 in the mouse maximal electroshock-induced seizure model

$ED_{50\,exp}$	n_{exp}	CBZ_{exp}	LCM_{exp}	LTG_{exp}	$ED_{50\,add}$	n_{add}	CBZ_{add}	LCM_{add}	LTG_{add}
9.83 ± 1.29	32	5.00	2.55	2.28	9.34 ± 0.38	50	4.75	2.42	2.17

Data are median effective doses (ED_{50} values in mg/kg ± S.E.M.) protecting 50% of animals tested against maximal electroshock-induced seizures. The $ED_{50\,exp}$ value was determined experimentally whereas the $ED_{50\,add}$ was theoretically calculated from the equation of additivity.[16] Doses of particular drugs that comprised the mixture (at the fixed drug dose ratio of 1:1:1) for both, $ED_{50\,exp}$ and $ED_{50\,add}$ values are presented separately. The unpaired Student's t-test was used to statistically analyze the data. n_{exp} and n_{add} are total numbers of animals used at those doses whose expected anticonvulsant effects ranged between 4 and 6 probits.

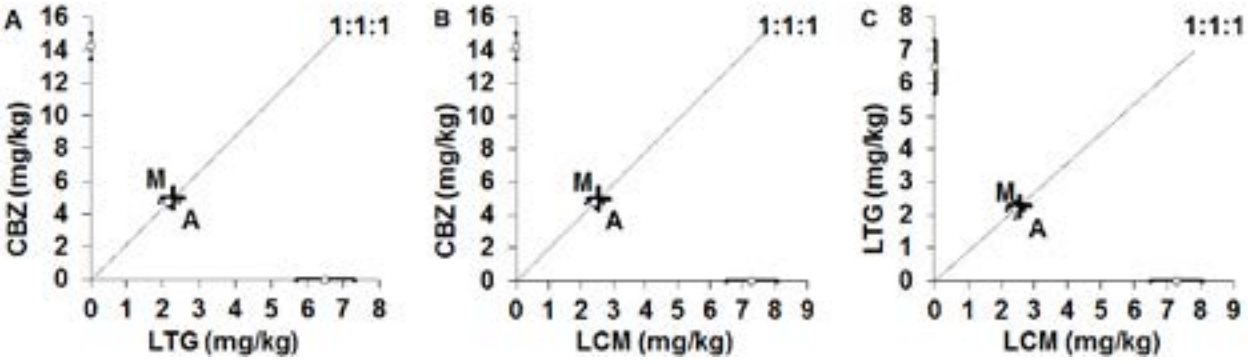

Figure 2A-C. Additive interactions for three-drug mixture of lacosamide (LCM), carbamazepine (CBZ) and lamotrigine (LTG) in the tonic-clonic seizure model in mice

Median effective doses (ED_{50} values ± S.E.M.) for lacosamide, carbamazepine and lamotrigine, that protected 50% of animals from maximal electroshock-induced seizure-induced seizures, are plotted on X-axis and Y-axis. Points M and A on each graph correspond to the experimentally-derived $ED_{50\ exp}$ (± S.E.M.) and theoretically calculated $ED_{50\ add}$ (± S.E.M.) values, respectively. The point M on each graph, reflecting the $ED_{50\ exp}$ value for the mixture of lacosamide, carbamazepine and lamotrigine for the fixed-ratio of 1:1:1, is plotted close to the point A, indicating additive interaction among drugs.

culated $ED_{50\ add}$ value (Table 2; Figure 2A-C), and thus, the interaction among the studied antiepileptic drugs was additive.

Discussion

In this study we found that the combination of three antiepileptic drugs (carbamazepine + lacosamide + lamotrigine) exerted additive interaction in the mouse maximal electroshock-induced seizure model. The obtained results are quite similar to those published earlier and documenting that two other three-drug combinations of lacosamide + carbamazepine + phenobarbital and lacosamide + lamotrigine + phenobarbital offered additive interactions in the mouse maximal electroshock-induced seizure model.[6,9] Only the combination of carbamazepine + phenobarbital + topiramate exerted supra-additive (synergistic) interaction in the mouse maximal electroshock-induced seizure model.[7] Additionally, the results observed in this study for the three-drug combination of carbamazepine + lacosamide + lamotrigine can be compared to those reported earlier for three two-drug combinations of carbamazepine + lamotrigine, lacosamide + carbamazepine and lacosamide + lamotrigine) in the same experimental seizure model. Available evidence indicates that the combination of carbamazepine with lamotrigine exerted sub-additive (antagonistic) interaction in the mouse tonic-clonic seizure model.[21] Unfortunately, no experimental evidence exists providing information on types of interactions for the combinations of lacosamide + lamotrigine and lacosamide + carbamazepine in the mouse maximal electroshock-induced seizure model. On the other hand, the combinations of lacosamide with lamotrigine and lacosamide with carbamazepine produced synergistic interactions in the mouse 6 Hz-induced (psychomotor) seizure model – another experimental model of seizures in mice.[22] However, despite evident differences between the maximal electroshock- and psychomotor 6 Hz-induced seizure models in mice (with respect to the clinical types of seizures), the synergistic interactions of lacosamide + lamotrigine and lacosamide + carbamazepine observed in the 6 Hz model, cannot be compared with our results because of some methodological problems.[22] More specifically, a crucial problem is associated with the anticonvulsant activities of the tested antiepileptic drugs, i.e., lamotrigine and carbamazepine in the 6 Hz model. It is widely accepted that conventional sodium channel blockers, including carbamazepine, phenytoin, lamotrigine are virtually ineffective (inactive) in the mouse 6 Hz model.[23] In contrast, Shandra and coworkers have determined the median effective doses (ED_{50} values) for lamotrigine, carbamazepine and phenytoin in the mouse 6 Hz model, which were 85 mg/kg, 48.1 mg/kg and 67 mg/kg, respectively.[22] However, these ED_{50} values were high enough to simultaneously produce impairment of motor coordination (acute adverse effects) in mice when subjected to the rotarod test.[22] It was found that lamotrigine in a dose of 85 mg/kg impaired motor coordination in 95% of the animals tested. Likewise, carbamazepine at a dose of 48.1 mg/kg and phenytoin in a dose of 67 mg/kg impaired motor coordination in 50% of the mice subjected to the rotarod test.[22] Of note, the experimentally-derived median toxic doses (TD_{50} values) for lamotrigine, carbamazepine and phenytoin, as denoted in our previous study in the rotarod test in mice were 31.8 mg/kg, 53.6 mg/kg and 61.7 mg/kg, respectively.[24] In the chimney test – another animal model assessing ataxia and impairment of motor functions in mice, the TD_{50} values for lamotrigine, carbamazepine and phenytoin were 28.7 mg/

kg, 53.3 mg/kg and 85.0 mg/kg, respectively.[21] Since the ED_{50} values for lamotrigine and carbamazepine determined by Shandra et al. in the 6 Hz test are higher than and/or similar to the TD_{50} values as documented in the rotarod and chimney tests, we should not compare them together. Thus, considering the above-mentioned facts, the question arises whether the observed protection from 6 Hz-induced seizures in mice receiving sodium channel blockers (lamotrigine, carbamazepine and phenytoin) in high doses (as documented by Shandra et al.) was mediated by the anticonvulsant mechanisms of action of the drugs or was related to the acute adverse effects produced by the drugs. Obviously, ataxia, flaccidity and any types of impairment of motor functions in animals may mimic the antiepileptic drugs-mediated anticonvulsant response to the 6 Hz-induced stimulation. Thus, the synergistic combinations of lacosamide with carbamazepine and lacosamide with lamotrigine observed in mice in the 6 Hz test, cannot be directly translated to the results observed in the maximal electroshock-induced seizure model. This was the reason not to take into account the results obtained by Shandra et al., when comparing them with our data.

On the other hand, lacosamide dose-dependently protected the animals from electrically-evoked seizures (i.e., maximal electroshock- and 6 Hz-induced seizures) after single exposition of the mice to electric current with different parameters of amplitude and intensity. It is worth mentioning that lacosamide, despite its sodium channel blocker properties protected the animals from 6 Hz seizures, while lamotrigine, carbamazepine or phenytoin did not. The ED_{50} value for lacosamide, as denoted in the 6 Hz model, ranged from 10.1 mg/kg [22] to 6.5 mg/kg [25], while in the mouse maximal electroshock-induced seizure model the ED_{50} value for lacosamide was 9.4 mg/kg.[26] Of note, the ED_{50} of lacosamide in both acute experimental models of epilepsy did not differ significantly. Simultaneously, the TD_{50} value for lacosamide as determined in our previous study was 33.77 mg/kg (i.e., 3–5-times higher than the ED_{50} value).[26] Finally, it may be concluded that the addition of the third drug lacosamide to the two-drug mixture comprised lamotrigine and carbamazepine can ameliorate the antagonistic effects exerted by the mixture of lamotrigine and carbamazepine in the mouse maximal electroshock-induced seizure model.

It should be stressed that two main reasons prompted us to select the combination of carbamazepine, lacosamide and lamotrigine to this isobolographic analysis. First, all the studied antiepileptic drugs in combination (carbamazepine, lamotrigine and lacosamide) are clinically efficacious against generalized tonic-clonic seizures and partial-onset convulsions in epilepsy patients.[27] Second, the general criteria of rational selection of antiepileptic drugs for combination, based on different molecular mechanisms of anticonvulsant action of the investigated drugs, were fulfilled.[13] As regards carbamazepine and lamotrigine, the drugs inhibit use-dependent voltage-gated sodium channels.[28] In contrast, lacosamide affects the slow inactivation of voltage-gated sodium channels without changing their fast inactivation.[28]

Generally, all the three-drug combinations tested in the mouse maximal electroshock-induced seizure model, including the combination of carbamazepine + lacosamide + lamotrigine, were associated with a substantial reduction of doses of particular drugs in mixture. The reduction of drug doses is essential from a clinical perspective because it allows to diminish side effects accompanied these multi-drug therapies.[13] Adverse effects occurring in epilepsy patients are usually the principal cause of withdrawal and discontinuation of antiepileptic drugs.[29] In this study we found that lacosamide, lamotrigine and carbamazepine combined together in doses corresponding to their $ED_{50\ exp}$ produced no side effects in animals challenged with the grip-strength test (assessing skeletal muscular strength in animals), passive avoidance task (evaluating acquisition and remembering processes in mice) and chimney test (assessing motor coordination in mice) (results not shown). All three behavioral tests used in this study firmly confirmed that the triple therapy did not produce any harmful adverse effects and the combination could be used clinically without any additional worries about patients' lives. On the other hand, all three used behavioral tests were sensitive enough to detect any side effects reported in animals receiving the antiepileptic drugs in combinations. For instance, we have documented earlier that the combination of tiagabine with valproate significantly impaired motor coordination in the chimney test.[30] Additionally, the combinations of vigabatrin with clonazepam or valproate significantly disturbed long-term memory in mice subjected to the standard variant of passive avoidance task.[31] As regards the grip-strength test, it was found that some antiepileptic drugs (in a dose-dependent manner) reduced skeletal muscular strength in mice.[32]

Finally, it can be concluded that the combination of carbamazepine + lacosamide + lamotrigine was expected to additively inhibit tonic-clonic seizures in experimental animals subjected to the maximal electroshock-induced seizure test. If the results from this study were translated to clinical conditions, the epilepsy patients inadequately treated with the antiepileptic drugs in monotherapy would profit from the combination of carbamazepine + lacosamide + lamotrigine.

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Conflicts of interest statement

The author has no conflicts of interest to disclose.

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ORIGINAL PAPER

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Health behaviors of patients after breast cancer surgery in the Podkarpackie voivodeship

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ABSTRACT

Aim. An evaluation of lifestyle changes (physical activity, diet) in patients after breast cancer surgery.

Materials and method. 200 women after breast cancer surgery were surveyed. The respondents were asked whether the surgery caused a change in their diet and physical activity. An analysis was performed concerning the education, place of residence and age of the respondents.

Results. Prior to being diagnosed with breast cancer, about one third of the respondents were concerned about their diet and physical activity. After the surgery more than a half of the respondents were concerned about a healthy lifestyle. Women below 50 years old with higher education, who live in a city, were concerned about their diet and physical activity both before and after surgery.

Conclusions. As a result of the breast cancer surgery, lifestyle changes were most often found in women aged 50-69 years old with higher education who lived in a city. Statistical relevance of the results was noted.

Keywords. breast cancer, health behaviors, diet, physical activity.

Introduction

Breast cancer is the most common aggressive tumor in women in Poland as well as in the world.[1,2] According to the National Cancer Register, within the last 35 years breast cancer morbidity has tripled.[3] The basic means of treatment is a surgical procedure, if needed supplemented with a chemotherapy or radiotherapy.[4,5] The process of treating breast cancer is a traumatic experience for any woman which is why it requires inclusion of physical and psychological rehabilitation.[6] As a part of this post-surgery care a patient is recommended to adopt a number of healthly behaviors to facilitate recuperation but also to eliminate, or at least limit, risk factors which may cause a relapse. Among the most recommended ac-

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tions are physical activity and diet.[7] The purpose of this work is to analyze to what extent breast cancer treatment caused the respondents to change their lifestyle.

Materials and methods

Using a questionnaire, a group of 200 women, aged 32-83 years old (average age 63) were surveyed. Each of the respondents had undergone a surgery to treat cancer lesions in the breasts. A mastectomy was performed in 73% of patients, and the saver type treatment in 27% of the surveyed women. The respondents were asked whether the surgery caused a change in their diet and physical activity. A healthy lifestyle was defined in the survey as eating lots of vegetables and fruit, limited consumption of animal fats and sugars and avoiding foods containing preservatives, avoiding eating salt and very salty foods and consumption of wholegrain bread. While physical activity was defined as walking outside, cycling, doing gymnastics, swimming or other recreational sports activity. The analysis took into consideration the age, education and the place of residence of the respondents. Individual groups had equal number of respondents. The assessment of the results used a method of statistical analysis using elements of descriptive statistics. Statistical relevance was defined as value $p<0.05$. Statistical calculations were carried out using the Statistica 12.5 software pack.

Results

Lifestyle of the respondents was analyzed prior to the diagnosis and after the surgery. Test results are presented in Table 1.

An analysis of physical activity among the respondents was carried out which consisted of a comparison of how much exercise they would do before and after surgery. The analysis accounted for education, place of residence and the age of the respondents. Also the statistical relevance of those changes was evaluated. Test results are presented in Table 2.

Having analyzed the groups of women with a particular education background, it was stated that prior to being diagnosed with breast cancer, more attention was paid to physical activity by women with higher education (54.90%) and secondary (50%). It can be observed that most women with primary education did not care about their physical activity. In case of the respondents with vocational education it was 74.51% and with primary education 81.82%.

There is a noticeable correlation between physical activity and the level of education. That is, the higher the education of the respondents, the higher their physical activity, both before and after surgery. It was found that the higher the education the greater the difference in favor of increasing physical activity after the surgery.

Concerning the place of residence, it was noted that both before diagnosis and after the surgery, the respondents living in the city were concerned with performing physical activity more (45.54% vs. 67.33%) than those living in the countryside (30.30% vs. 35.35%). Among the respondents living in the city, the percentage of women who began to exercise more after the surgery increased by 21.79%. This increase is not statistically relevant. Among the women living in the countryside only

Table 1. A comparison of health behaviours of the respondents (in %)

	YES	NO
Did you exercise prior to the diagnosis?	38.00	62.00
Did you exercise after the surgery?	53.50	46.50
Did you care about your diet prior to the diagnosis?	33.50	66.50
Did you care about your diet after to the diagnosis?	55.00	45.00

Table 2. A comparison of physical activity before and after the surgery, considering the education, place of residence and age of the respondents (results in %) + = p<0.05 -=p>0.05

		Did you exercise prior to the diagnosis?		Did you exercise after the surgery?		
		YES	NO	YES	NO	p
Education						
	Higher	54.90	45.10	80.39	19.61	+
	Secondary	50.00	50.00	62.96	37.04	+
	Vocational	25.49	74.51	31.37	68.63	-
	Primary	18.18	81.82	27.27	72.73	+
Place of residence						
	Countryside	30.30	69.70	35.35	64.65	-
	City	45.54	54.46	67.33	32.67	+
Age						
	<50	57.14	42.86	61.90	38.10	-
	50-69	37.76	62.24	53.85	46.15	+
	>69	27.78	72.22	36.11	63.89	-

a small increase of 5.05% was noted and this was not statistically relevant either.

Before the surgery, the women who most often cared for their physical activity were those aged below 50 years old (57.14%). A decrease in an interest in keeping fit is noted along with an increase of the respondents' age. Among the women aged 50-69 years old only 37.76% of the respondents showed interest in physical fitness, and this percentage was even lower (27.78%) for women who were over 69 years old. Similar percentages can be observed also after the surgery. Comparing the situation from before the diagnosis to that after the surgery, it can be observed that the highest increase of physical activity (16.09%) was noted in the group of women aged 50-69 years old. The second highest increase percentage (8.33%) occurred in the group of women aged over 69. The least frequent (4.76%) group to change their lifestyle were women aged below 50 years old. However, only the increase in the age group 50-69 years old shows statistical relevance.

The respondents' eating habits and diet were analyzed and compared before and after surgery. The analysis took into consideration age, education, and the place of residence of the respondents. Test results are presented in Table 3.

As a result of the analysis of the correlation between the eating habits and the age of the respondents, the following results were concluded: prior to breast cancer diagnosis over half (52.38%) of the surveyed women aged under 50 cared about maintaining a healthy diet. In the age group 50-69 years old, it was only 31.47% of the respondents and in the group of women aged over 69 years old it was only 30.56%. After the surgery, the women aged under 50 still cared about their diet (66.66%). A little lower (55.94%) percentage of women aged 50-69 years old paid attention to their eating habits, and it was much rarer in case of the group aged over 69 years old (30.56%). The women who changed their lifestyle as a result of breast cancer were those from the age group 50-69 years old (24.47%). Respondents from the age group over 69 years old and below 50 (14.28%) changed less frequently. The statistical relevance was noted in case of the age groups of 50-69 and over 69 years old.

Discussion

Physical activity and a healthy, balanced diet are among the factors contributing to the recuperation of patients after a surgical procedure. They are also among the factors which help in preventing the recurrence of a disease.[8] Before the treatment every patient receives information about what diet to follow and what exercises to perform. Those elements are introduced to the patient's lifestyle in the hospital even before the surgery[9]. However, it may also be stated that despite therapeutic actions there are still many patients who do not follow the recommendations. [10,11]

The effects of the surgery on the physical activity of the patients were analyzed in four publications. In a survey carried out with a group of 77 women from Lower Silesia it was concluded that 81% of the respondents cared about their physical activity after breast cancer surgery.[12] In this work a lower percentage (53%) was noted. A study carried out by Bożena Karczmarek-Borowska in the Mielec Amazon Club included 60 women aged from 30 to 68 years old and it showed that physical activity was cared about by women aged below 50 years old. However, such a correlation with respect to place of residence and education was not confirmed.[13] The former observation is identical to the one presented in this work. In contrast, the results of our own work contradict the quoted results as they noted a high positive statistical relevance (i.e. an increase of physical activity) for the respondents living in the city and for the age groups of 50-69 and over 69 years old.

Table 3. A comparison of eating habits before and after the surgery, considering the education, place of residence and age of the respondents (results in %) + = p<0.05 -=p>0.05

		Did you care about your diet prior to the diagnosis?		Did you care about your diet after to the diagnosis?		
		YES	NO	YES	NO	p
Education						
	Higher	52.94	47.06	86.27	13.73	+
	Secondary	38.89	61.11	57.41	42.59	+
	Vocational	23.53	76,47	41.18	58.82	+
	Primary	15.91	84.09	31.82	68.18	+
Place of residence						
	Countryside	29.29	70.71	45.45	54.55	+
	City	37.62	62.38	64.36	35.64	+
Age						
	<50	52.38	47.62	66.66	33.33	-
	50-69	31.47	68.53	55.94	44.06	+
	>69	30.56	69.44	30.56	55.56	+

In a survey carried out by Ewa Sierko in Podlasie, which included 89 female respondents, it was concluded that physical activity after the surgery was cared about most often by women over 60 years old with vocational education who lived in the city. 41% of the respondents showed a decrease of the physical activity after the surgery.[14] Here our own work confirms only the fact that that there was an increase of physical activity in case of the respondents living in the city.

A conclusion pointing to a lack of change in the physical activity after breast cancer surgery in presented in a publication by Tomasz Ridan of a survey of 80 women from Małopolska. More conclusive results were obtained by Katarzyna Lis in her survey of 40 women from Kielce Amazon Club. She concluded that 90% of the surveyed women were physically active prior to the surgery, and this percentage dropped to 75% after the surgery.[17] The results of both of the cited works are in total opposition to the results of this work. It is also worth comparing the numbers of the respondents in the groups surveyed in the quoted examples. In this work the number of the respondents was 200 and in the other surveys from 40 to 89. This surely had impact on the reliability of the quoted works. It should also be noted that the problem of physical activity may be defined differently. It is necessary to define this notion precisely and to state that it covers recreational physical activity, not connected with family of professional activity, which may happen in case of women who live in the countryside, and in case of women with lower educational background. Apart from that, women whose professional life is dominated with physical activity will be likely to engage in physical recreational activities. These factors surely have impact on the obtained results.

In this case, there are interesting results of a similar survey carried out in the US by Melinda L. Irwin et al. Their group of respondents consisted of 812 women from the states of New Mexico and Washington. There was a 11% increase of the number of women who performed recreational sports activities after the breast cancer surgery. Considering the age of the respondents, a 10.2% increase was noted in the age groups 40-49, a 9.5% increase in the age group 50-59 and a 11.5% increase in the age group above 60 years old. [17] The size of this group was substantial and the notion of physical activity was very clearly defined here as recreational sports activity. An increase was noted in the physical activity in all the age groups on a similar level as in this work. This shows how important it is to follow the adopted testing methodology.

Analogous to changes in physical activity after breast cancer surgery, a survey of eating habits of the respondents was carried out. In a publication by Agnieszka Surwiłło et al., presenting a survey of 100 women, it was stated that 71% of the respondents decided to change their eating habits after surgery. At the same time a slight correlation was observed between the change introduction and the age of the respondents and their education.[18] In this work an increase of only 21.5% was noted for the change of eating habits. Also, statistically relevant increase in the number of respondents caring about their diets was noted for the age groups of 50 and over, and for all education groups. On the contrary, Joanna Kruk shows in her work based on a survey of 470 respondents from Zachodniopomorskie voivodeship that 67% of the respondents cared about their diet after the surgery.[19] A lower, but also substantial, percentage (55%) was noted in this work.

Conclusions

1. The largest (statistically relevant) increase in physical activity after breast cancer surgery was observed in case of women aged 50-69 years old, with higher education, living in the city.
2. The largest (statistically relevant) increase in healthy eating habits after breast cancer surgery was observed in case of women aged 50-69 years old, with higher education, living in the city.

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ORIGINAL PAPER

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Most frequent injuries and their causes in Ultimate Frisbee players

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ABSTRACT

Introduction. Media publicity of sports and increased training have pushed the limits of the human body and have correspondingly led to an increase in the number of sports injuries. Incorrect play techniques, inadequate warm-up and other factors often lead to an increase in the number of injuries in Ultimate Frisbee.

Aim. Assessment of the impact of gender, age and training experience on the incidence of injuries in Ultimate Frisbee.

Material and methods. 110 people aged 16 to 35, regularly practising Ultimate Frisbee were included in the study. Of the 110 participants, 36 were women and 74 were men. The results were obtained by means of a questionnaire prepared by the authors which concerned sociodemographic data and questions about sports injuries. The incidence of injuries was analyzed in terms of the training experience, gender and age of the respondents. Statistical analysis was performed using STATISTICA 13.1.

Results. Our research showed a relationship between sex and the site and type of injury. Age affects the main cause of the injury, and training experience influences the site and type of injury ($p < 0.05$). The largest group of respondents were people training Ultimate Frisbee at least 3-4 times a week (62.73%).

Conclusion. Sex and the training experience have a significant impact on the site and type of injury. The main cause of the injury depends on age; in the study group the most common cause of injury occurred when respondents were not complying with the rules and technique of the game.

Keywords. injury, Ultimate Frisbee, sport

Introduction

The contemporary occurrence of injuries in sports are common phenomenon and difficult to avoid, even in the case of taking up only recreational activity. A constant chase after records, the desire to compete in sports and achieve better results leds to an increase in the number of injuries.[1]

One of the sports in which a high level of injury occurs is American football. In Poland, it gained popularity in the second half of the twentieth century. According to Walczak et al., the most frequent injury site in this sport is the knee joint which is the most complicated structure of the human motor organ. This is mainly due to its specificity; it is mainly running and contact with

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numerous falls, turns and clashes with the opposing team player.[2] Waldzinska et al. found that in tennis the most frequent injuries occur in hip joints, wrist and ankles.[3] According to Ridan et al., athletes practising rock climbing most often suffer upper limb trauma.[4]

Prevention of musculoskeletal diseases, traumas and sports injuries is of key importance for sporting events and the athlete's career. Properly organized and planned control over sport injuries during the training process as well as during sport events are a valuable source of information pertaining to prophylaxis preventing injury. Thanks to them, it is possible to create new methods, means and techniques to prevent injuries in sport.[5] The incidence of injury depends on many factors: the type of sports practiced, level of competition and sport rivalry, the level preparation, requirements set by trainers for athletes and the standard of the health care system for the athlete.[5,6]

Ultimate Frisbee is a kind of contactless team sport with a flying disc (frisbee) which combines elements of team games such as football, volleyball, rugby and basketball. The match is played on a pitch of 100 by 37 meters between two seven-person teams. The goal of the game is to score a point that will be gained when a player from the same team catches a frisbee in the opponent's endzone. The match ends when one of the teams scores 17 points.[7,8] Ultimate Frisbee is a sport in which trauma is classified at the highest degree. Physical effort associated with this sport is characterized by high endurance, intensity and the ability to carry out heavy and long-term training without a rapid loss of biological reserves and energy of the body. The main reason for the emergence of sports injuries in this discipline is direct training, that is a match on the pitch of two teams fighting to score in the zone. Constantly increasing popularity of Ultimate Frisbee leads to an increase in the number of sports injuries.[9]

Despite the ever growing interest in this sports discipline, the number of scientific reports that characterize the type and cause of injuries in Ultimate Frisbee sport is significantly limited.[10,11] The aim of the study was to assess the impact of gender, age and length of sports training on the type, location and cause of injury in athletes who regularly train Ultimate Frisbee.

Material and methods

The research was carried out in south-eastern Poland in the period from April to June 2016. Thirty six women and 74 men participated in the study. The results were obtained by means of the questionnaire prepared by the authors, which concerned sociodemographic data and questions about sports injuries. The inclusion criteria were: belonging to a sports club, having the current consent of a sports medicine doctor for practicing sport, expressing a written consent for participation in the study. The exclusion criteria were: suffering the injury within 3 months from the examination, having current injuries and experiencing minor injuries not requiring a break in the training process in the period immediately pre-

Table 1. The characteristics of the study group

	Women (n = 36)	Men (n = 74)	Total (n = 110)
Age in yrs [± ; SD]	23.95 ± 3.62	23.33 ± 3.61	23.52
Weight in kg [± ; SD]	64.00 ± 8.12	73.89 ± 7.89	70.94 ± 7.57
Height in cm [± ; SD]	165.3 ± 9.04	176.96 ± 9.12	172. 93 ± 8.24
BMI [%]			
Normal	100.00	81.08	87.27
Overweight	0.00	18.92	18.92
Obesity	0.00	0.00	0.00
Training experience [%]			
1-12 months	41.67	66.22	58.18
More than a year	58.33	33.78	41.82
Training frequency in a week [%]			
1/2×	16.67	17.57	17.27
3-4×	61.11	63.51	62.73
More than 4×	22.22	18.92	20.00
Participation in competition [%]			
yes	80.56	79.73	80.00
no	19.44	20.27	20.00
Injury due to play [%]			
yes	100.00	100.00	100.00
no	0.00	0.00	0.00
Injuries preventing from playing [%]			
yes	100.00	100.00	100.00
no	0.00	0.00	0.00

ceding the examination. All subjects received information about the study and its course and expressed their written consent to participate in them. The procedures applied were in accordance with ethical standards and the principles of the Helsinki Declaration.

Quantity and indicators of the structure were given for the qualitative variables. In order to compare parameters between the studied subgroups, the Pearson chi-square test was used. Statistical analysis was performed using the STATISTICA 13.1. The result of the statistical test is the test probability (p), which small values indicate the statistical significance of the considered dependence. In this article it was assumed that:

1. when $p < 0.05$, there was a statistically significant relationship
2. when $p < 0.01$, there was a statistically highly significant relationship
3. when $p < 0.001$, there was a statistically very highly significant relationship

Results

The study involved 110 people practising Ultimate Frisbee; 36 women (mean age 23.95 ± 3.62 yrs) and 74 men (mean age 23.33 ± 3.61 yrs). The largest group of the respondents were people who practised Ultimate Frisbee for less than 12 months (58.18%); 80% of the respondents took part in various types of competitions and matches. The subjects most often participated in trainings 2-4 times a week (62.73%). All athletes participating in the study suffered an injury during training or competition, and its degree made it impossible to continue practising sport until the injury was healed. Table 1 presents the characteristics of the study group.

Table 2. Relationship between gender and the site, type of injury and the main cause of injury

Variable	Woman		Man		p
	N	%	N	%	
Head injury					
Back of the head	2	66.67	12	20.69	p= 0.26
Nose	0	0.00	12	20.69	
Ear	0	0.00	14	24.14	
Teeth	1	33.33	20	34.48	
Upper limbs injuries					
Shoulder	0	0.00	3	33.33	p= 0.19
Elbow, forearm	3	37.50	2	22.22	
Wrist	0	0.00	1	11.11	
Metacarpals and phalanges	5	62.50	3	33.33	
Trunk injury					
Ribs	32	88.89	67	90.54	p= 0.78
Abdomen	4	11.11	7	9.46	
Spinal injury					
Cervical spine	2	5.55	0	0.00	p= 0.06
Thoracic spine	23	63.89	41	55.41	
Lumbosacral spine	11	30.56	33	44.59	
Lower limbs injuries					
Hip joint	4	11.11	2	2.70	p= 0.16
Knee	9	25.00	28	37.84	
Shin	15	41.67	34	45.95	
Ankle and metatarsals	8	22.22	9	12.16	
Phalanges	0	0.00	1	1.35	
Most frequent injury					
Dislocation	0	0.00	17	22.97	p= 0.00
Sprain	17	47.23	37	50.00	
Wound	3	8.33	6	8.11	
Muscle and ligament rupture	13	36.11	0	0.00	
Muscle strains	3	8.33	14	18.92	
Main reason of the injury					
Wrong technique of play	21	58.33	46	62.16	p= 0.03
Too intensive training	4	11.11	19	25.68	
No proper warm-up	11	30.56	8	10.81	
Inadequate sport equipment	0	0.00	1	1.35	

Table 3. Relationship between age and the site, type of injury and the main cause of injury

Variable	Age 16–25 yrs		Age 26–35 yrs		p
	N	%	o	%	
Head injury					
Back of the head	12	23.53	2	20.00	p= 0.97
Nose	10	19.61	2	20.00	
Ear	12	23.53	2	20.00	
Teeth	17	33.33	4	40.00	
Upper limbs injuries					
Shoulder	1	7.69	2	50.00	p= 0.26
Elbow, forearm	4	30.77	1	25.00	
Wrist	1	7.69	0	0.00	
Metacarpals and phalanges	7	53.85	1	25.00	
Trunk injury					
Ribs	77	91.67	22	84.62	p= 0.29
Abdomen	7	8.33	4	15.38	
Spinal injury					
Cervical spine	2	2.38	0	0.00	p= 0.70
Thoracic spine	48	57.14	16	61.54	
Lumbosacral spine	34	40.48	10	88.46	
Lower limbs injuries					
Hip joint	4	4.77	2	7.69	p= 0.32
Knee	31	36.90	6	23.08	
Shin	38	45.24	11	42.31	
Ankle and metatarsals	10	11.90	7	26.92	
Phalanges	1	1.19	0	0.00	
Most frequent injury					
Dislocation	13	15.48	4	15.38	p= 0.09
Sprain	43	51.19	11	42.31	
Wound	8	9.52	1	3.85	
Muscle and ligament rupture	6	7.14	7	26.92	
Muscle strain	14	16.67	3	11.54	
Main reason of the injury					
Wrong technique of play	52	61.91	15	57.69	p= 0.02
Too intensive training	21	25.00	2	7.69	
No proper warm-up	10	11.90	9	34.62	
Inadequate sport equipment	1	1.19	0	0.00	

Statistically significant differences were found between the groups with respect to the results concerning the site of the injury (injury of the spine), type of injury and the reason for the injury ($p < 0.05$). The most frequent injury sites among women and men were: ribs (women - 88.89%, men - 90.54%); thoracic spine (women - 63.89%, men - 55.41%); shin (women - 41.67%, men - 45.95%). Women most often suffered sprains (47.23%) and muscle and ligament ruptures (36.11%). In men, the most common type of injury was sprain (50.00%) and dislocation (22.97%). Both in women and men the main cause of the injury were wrong technique of play (Table 2).

In the group of people aged 16-25, the most frequent sites of injury were ribs (91.67%) and the thoracic spine (57.14%). 61.91% of the respondents indicated that the main reason for the injury was incorrect technique of play; 25.00% opted for too intense training; 11.90% reported lack of a proper warm-up as the main cause of the injury. 57.69% of the subjects aged 26-35 got injured due to failure to comply with the proper technique of the play, while 34.62% of the respondents were not properly prepared for training due to lack of proper warm-up. Too intensive training was indicated by 2 people. Statistically significant differences were found between age groups and results concerning the main cause of the injury ($p < 0.05$) (Table 3).

Our research showed that the most common site of injury in people with training experience shorter than 12 months was the head area (teeth injuries - 50.00% of the respondents). In contrast, athletes with training experience longer than 12 months most often suffered nose and back of the head injuries (8 athletes). The most common site of injury in both groups were ribs, spine (thoracic and lumbosacral section), lower limbs (shin and knee). The majority of athletes surveyed indicated that the most common type of injury was sprain

Table 4. Relationship between training experience and the site, type of injury and the main cause of injury

Variable	Training experience ≤ 12 months		Training experience ≥ 12 months		P
	N	%	N	%	
Head injury					
Back of the head	6	16.67	8	32.00	p= 0.01
Nose	4	11.11	8	32.00	
Ear	8	22.22	6	24.00	
Teeth	18	50.00	3	12.00	
Upper limbs injuries					
Shoulder	2	15.39	1	25.00	p= 0.41
Elbow, forearm	5	38.46	0	0.00	
Wrist	1	7.69	0	0.00	
Metacarpals and phalanges	5	38.46	3	75.00	
Trunk injury					
Ribs	57	89.06	42	91.30	p= 0.69
Abdomen	7	10.94	4	8.70	
Spinal injury					
Cervical spine	2	3.13	0	0.00	p= 0.15
Thoracic spine	33	51.56	31	67.39	
Lumbosacral spine	29	45.31	15	32.61	
Lower limbs injuries					
Hip joint	5	7.35	1	2.17	p= 0.00
Knee	17	25.00	20	43.48	
Shin	36	52.95	13	28.26	
Ankle and metatarsals	5	7.35	12	26.09	
Phalanges	5	7.35	0	0.00	
Most frequent injury					
Dislocation	13	20.31	4	8.70	p= 0.02
Sprain	33	51.56	21	45.65	
Wound	7	10.94	2	4.35	
Muscle and ligament rupture	3	4.69	10	21.74	
Muscle strain	8	12.50	9	19.56	
Main reason of the injury					
Wrong technique of play	42	65.63	25	54.35	p= 0.40
Too intensive training	13	20.31	10	21.74	
No proper warm-up	9	14.06	10	21.74	
Inadequate sport equipment	0	0.00	1	2.17	

(subjects aged 16-25 - 51.56%, subjects aged 26-35 - 45.65%). Statistically significant differences were found between the groups with respect to the results concerning the site of the injury (head and lower limbs injuries) and the reason for the injury ($p < 0.05$) (table 4).

Discussion

Every year, several million injuries are registered in the United States while practicing sports at professional, recreational and school level. In Poland, there are no statistical data on the number and type of injuries suffered by athletes. Undoubtedly, sports injuries are an inseparable element of sport, and their type and character are closely related to the specificity of the discipline being practiced.[12,13]

Ultimate Frisbee is a non-contact sport that combines elements of various team games. This sport is rapidly gaining popularity among young people (in 2011 the number of people practicing Ultimate Frisbee in the United States was 947 thousand.)[8] Currently, 46 clubs are registered in Poland and national teams are appointed in various discipline categories. Poland is 23rd in the Word Flying Disc Federation (WFDF) ranking among 47 countries.[14]

Proper playing technique, well-developed motor features and a high level of fitness and sport form prevent injury, both in Ultimate Frisbee and in other sports. This discipline is characterized by a high risk of injury, which is why the training process should be based on endurance and speed exercises and improvement of the ability to react quickly to the situation posing threat of injury. Gender, age, training experience, fitness level and physical and mental requirements that are placed on the player pose a real risk of injury. However, there

is limited information on trauma in Ultimate Frisbee in clinical trials.[10,15,16]

Our research showed that 100% of athletes surveyed suffered an injury as a result of playing Ultimate Frisbee, similar data was obtained by Reynolds et al. indicating that among the respondents, 100% suffered musculoskeletal injuries while practising the same sport discipline.[9] Based on questionnaires we indicated that the most common type of injury were sprains, dislocations and muscle strains. The General Practitioner Clinical Assistant Rheumatology reports are similar.[7]

The authors showed that less experienced athletes, with training experience shorter than 12 months, were more likely to suffer injuries than people with a higher level of training and longer training experience. Similar results obtained Peterson et al. who examined the relationship between gender, training experience and the incidence of injury in football players. The authors found a two-fold increase in the occurrence of injuries among younger athletes with shorter training experience and with a lower level of skills compared to more trained athletes. Chomiak et al. also showed that the shorter the training experience, the greater the risk of injuries.[17,18] This indicates the relationship in Ultimate Frisbee and other sports with a similar nature to this sport that low training experience has an effect on the frequency of injury in athletes.

The results of our research indicate that the most common cause of the injury was an incorrect game technique. In the studies by Yen et al. the frequency of injury was also associated with improper tactical and technical preparation. The results suggest that one of the main measures to prevent injury is the proper education of young people's about game technique and control of the training and play of people with longer training experience.[10] The analysis showed that the most common injury was the trunk (the majority of respondents had a rib injury and the thoracic spine). There are no scientific reports on this subject in current literature. In our study, the most common trauma to the lower limbs was knee and shin injury. The results of the research carried out by Yen et al. on a group of 107 athletes indicate, however, that the most common trauma to the lower limbs was shin and knee injury.[10,13]

Our research shows that men are more likely to experience injury in Ultimete Frisbee than women. This may be due to the fact that in our research a larger number of respondents were men. Li et al. obtained different result showing that women were more likely to suffer sports injuries in this discipline, because it is related to the interaction between the movement strategy, body composition and human physiology. Women generally have lower body fat, less musculature and greater loosening of connective tissue, which additionally contributes to injury.[19-23]

In the face of frequent sports injuries in Ultimate Frisbee it is necessary to take preventive measures with respect to athletes who have never suffered injury or whose injury occurred but the treatment process was successful and they could return to further training. It is important to emphasize the importance of correct, fast and effective treatment process and athlete rehabilitation after the injury.

Conclusion

1. The most common type of trauma experienced by athletes training Ultimate Frisbee is sprain and dislocation.
2. Gender affects the type of injury and the main cause of the injury. Men are more likely to be injured in Ultimate Frisbee than women.
3. Age affects the main cause of the injury. People with short training experience are more likely to suffer injuries than people with a higher level of training and longer training experience.
4. The length of the training experience affects the place of injury and the most common type of injury.

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ORIGINAL PAPER

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Nutritional behavior of pregnant women from the Podkarpacie province

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ABSTRACT

Introduction. Healthy nutrition is very important during pregnancy for both a baby and a mother. Modification of metabolic and hormonal processes i.e. metabolic programming occurs already at the prenatal stage. This process significantly affects the baby's health and eating habits at a later age. The diet of a pregnant woman should supplement the demand for energy, nutrients, vitamins and minerals. An expecting woman needs to also avoid products that are contraindicated during this period, such as raw milk, eggs or meat.

Aim. Assessment of nutritional behavior of pregnant women from the Podkarpacie province.

Materials and method. 228 women living in the Podkarpackie province were enrolled in the study. Surveys were collected via the Internet. An anonymous questionnaire developed by the authors was used.

Results. Women's eating habits are primarily influenced by education. Most women had knowledge about proper nutrition and awareness of its impact on the health of the baby. A worrying fact was a very low intake of dairy products. 44% of women consumed dairy products only once a day. Fruit and vegetables consumption was also low (40% of the respondents ate only from 100 to 200 g during the day).

Conclusions. Although part of the eating habits of pregnant women is correct, nutritional education should be introduced in this group, especially related to the adequate supply of dairy products, fruit and vegetables to supplement the necessary vitamins, minerals and protein.

Keywords. pregnancy, diet, eating habits

Introduction

During pregnancy, it is important to provide the body of a pregnant woman with all the necessary nutrients, minerals and vitamins. The energy value of the diet should also be properly planned. Deficiency or excess of nutrients can lead to permanent modifications of the body's hormonal and metabolic processes. Deficiencies, combined with a variety of gene expression during prenatal period change metabolism and the development of physiological processes. The processes that occur at the time of intrauterine development have an impact on the formation of diet-related dis-

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eases (obesity, cardiovascular disease, metabolic syndrome) in adulthood.[1-3]

The energy requirement in the first trimester is identical to that before pregnancy. In the second trimester, the demand increases by 360 kcal per day, in the third trimester by 475 kcal compared to the pre-pregnancy requirement.[4] The amount of protein increases by 0.3 g/kg of body weight (bw) per day; the highest need occurs in the second half of pregnancy.[5,6] According to Polish nutrition standards, pregnant women should have 1.2 g / kg bw protein intake throughout the day.[6] Recommended products are mainly lean meats, dairy products, and fish. During pregnancy, the amount of carbohydrates should be 55-60% of the daily energy requirement, while the amount of sugars added not more than 10%. Whole-grain products need to be included in the menu. Fats in the diet of a pregnant woman should be provided in an amount of 20-35% of the daily energy requirement. During pregnancy, the need for EFA (essential fatty acids) increases: omega 3, α-linolenic acid (ALA) in an amount of 0.5% of the daily energy requirement, docosahexaenoic acid (DHA) in an amount of 200 to 300 mg and acid eicosapentaenoic acid (EPA) 250 mg / day.[6-11] The daily requirement for water is about 300 ml higher than before pregnancy, and the daily fluid intake should be around 2300 ml.[6,12-15]

Supplementation during pregnancy

It is important to plan the supplementation in the right amount and proportion in relation to the demand for given ingredients.[5-14,16-18] Insufficient supply as well as too high doses of supplements may cause fetal defects.[16,19-21]

Folic acid derived from food is absorbed in the gastrointestinal tract from 50 to 90%.[16,22] Supplementation of this ingredient should be included at least 3 months before the planned pregnancy and continued in the first trimester in the amount of 0.4 mg per day. Insufficient amount of folic acid may cause fetal neural tube defects.[23,24] The next essential ingredient is iron. The amount of iron provided daily should be 18 mg before pregnancy, from 26 to 27 mg during pregnancy, and in the case of confirmed microcytic anemia from 60 to 120 mg.[25] During the pregnancy, the need for iodine also increases. WHO (World Health Organization) recommendations are 250 μg / day for pregnant women and breastfeeding mothers. Not only iodine deficiency, but also excess, above 500 μg / day, leads to impaired thyroid function in a newborn.[26] An essential component is also cholecalciferol (vitamin D3). Demand for vitamin D3 is primarily covered by skin biosynthesis. To a small extent, the ingredient is supplied with food. The dose of vitamin D3 in pregnant women with inadequate supply along with diet and low skin synthesis should range from 800 to 1000 μg per day.[7,27]

Food to avoid during pregnancy

During pregnancy, some food products are counter indicated because they can be a source of bacteria that easily penetrate through the placenta. Examples of such products are mainly: soft cheeses, e.g. oscypek, camembert cheese, blue cheese. Such food can cause premature delivery or miscarriage. Listeriosis in a baby causes ophthalmic diseases, CNS (Central Nervous System) and hearing diseases.[4,28,29]

Aim

The aim of this study was to assess the nutritional behavior of pregnant women
from the Podkarpackie province. The influence of the physiological condition (trimester of pregnancy, puerperium) and education on eating habits was also assessed.

Material and method

The survey was conducted in the Podkarpackie province in 2017 using the anonymous survey developed by the authors. The survey consisted of 39 questions on basic data. The demographics included questions about age, place of residence, education and physiological status (trimester of pregnancy, puerperium). The remaining questions referred to the conditions occurring during pregnancy, the knowledge of the respondents on the topic of nutrition in pregnancy and supplementation and their current dietary habits.

The inclusion criteria were: a woman of procreative age, informed consent to complete an anonymous questionnaire, confirmed pregnancy or puerperium (up to 6 weeks after childbirth), living in the Podkarpackie

Table 1. Characteristics of the study group

Parameter	Percentage			
Place of residence	**countryside**	**town**	**city**	
	36%	8%	56%	
education	**vocational**		**secondary**	**higher**
	5%		29%	66%
Physiological status	**I trimester**	**II trimester**	**III trimester**	**puerperium**
	11%	17%	20%	52%
Type of pregnancy	**Single**		**Multiple**	
	99%		1%	

Province. The exclusion criteria were the lack of the patient's consent, lack of pregnancy, delivery earlier than 6 weeks, living outside the Podkarpackie Province.

Finally, the study involved 228 women with an average age of 28.03 ± 3.88 years. Among the respondents, 52% were women in puerperium (up to 6 weeks after birth), 20% of women in the third trimester of pregnancy, 17% - in the second, while 11% in the first. Single pregnancies accounted for 99%, while multiple pregnancies were less than 1%. Fifty six percent of women lived in the city, 36% in the countryside, and the remaining 8% in the towns. The largest number of respondents (66%) had higher education and 22% had secondary education. The lowest number were pregnant women with vocational education (5%) (Table 1).

The Pearson Chi-square test was used for statistical analysis. The statistical analysis was performed with EXCEL and Statistica 13 softwares. P <0.05 was assumed as the significance level. Values below the level of significance were considered as values reflecting the correlations between data.

Results

Sixty five percent of the 228 women surveyed did not suffer from any diseases that may appear during pregnancy. The most common condition indicated by the respondents was anemia (14%) followed by the response "others", in which the respondents answered: hypothyroidism, fetal hypotrophy, constipation, fibroids, incompetent cervix, proteinuria, oedema, placenta previa, venous thrombosis, recurrent urinary tract inflammation. Women with gestational diabetes accounted for 6% of the respondents and 3% had hypertension (Tab 2). It was observed that 57% of the respondents complained of digestive problems, such as nausea or vomiting. However, there was no statistically significant relationship between the occurrence of nausea and the amount of meals consumed during the day (p = 0.082) (Figure 1).

Among the respondents, 79% paid attention to their nutrition during pregnancy and tried to eat healthy, while 21% of the respondents did not change their diet and did not pay attention to it (Table 3). During pregnancy, some products should be strictly excluded as they may pose a risk to the fetus and 85% of the respondents avoided such products, 13% did not know what products are risky, 2% consumed such products despite their known danger. A statistically significant relationship (p <0.001) between education and avoidance of products counter-indicated during pregnancy was found (Table 4). Seventy five percent of the respondents declared increased appetite for some products. Most often they were sweets and fruits. A smaller percentage were

Table 2. Conditions accompanying pregnancy

Condition	n	%
Gestational diabetes	14	6
Anaemia	32	14
Hypertension	8	3
None	152	65
Others	27	12
Nausea	130	57

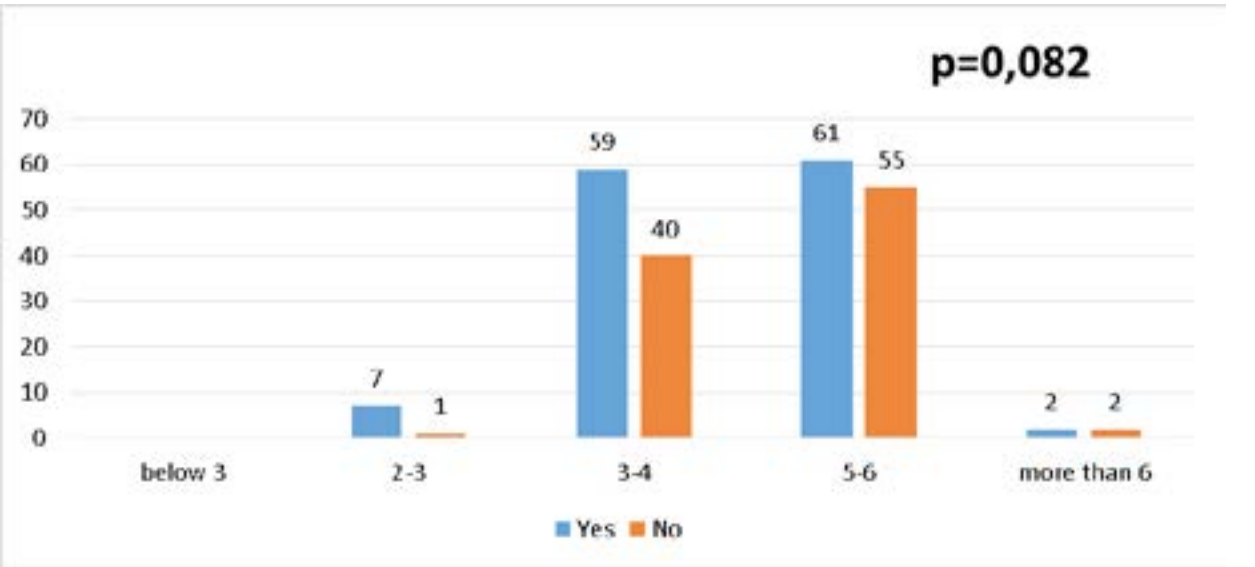

Figure 1. Incidence of vomiting and / or nausea and the amount of meals consumed

fast food and salty snacks. Among pregnant women and women who recently gave birth, 43% of the respondents declared consuming dairy products once a day and 41% 2-3 times a day. Only 7% of dairy consumption was at the level of 3 to 4 servings a day. Analyzing the quality of consumed products, it appears that only 14% of the respondents consumed whole grain products. In the case of meat, lean meat was selected in 92% of cases. However, 4% of the respondents did not eat it at all. In order to provide the right amount of omega 3 in the diet, 78% of the subjects consumed fish at least once a week. Among 40% of the respondents, the intake of vegetables and fruit during the day was between 100 and 200 g and in the amount of 200 - 300 g in the case of 30% of the respondents. The intake of both vegetables (p = 0.307) and fruit (p = 0.092) during the day by the examined women did not differ significantly in terms of physiological status. The analysis of collected data showed that water is the most frequently chosen fluid (71% of the respondents). Liquids were usually drunk in quantities of 1.5 to 2 liters. (Table 3)

Among pregnant women or those who have recently given birth, 35% sweetens drinks with 1-2 teaspoons of sugar, while 34% do not sweeten at all. A statistically significant relation was demonstrated between the level of education and sweetening drinks (p <0.001) (Figure 2).

Pregnant women and those during puerperium from the Podkarpackie province are mostly aware of the fact that nutrition in their state affects the fetus, over 60% of the respondents indicated such an answer. Some

Table 3. Selected nutritional behaviors of the respondents

Type nutritional behavior [%]					
The impact of pregnancy on changing eating habits	Yes			No	
	79			21	
Avoiding products not indicated during pregnancy	yes		no	I do not know what are these products	
	84.6		2.6	12.7	
Number of meals consumed a day	Less than 3	2-3	3-4	5-6	More than 6
	0	4	43	51	2
Eating between meals	yes			no	
	81			19	
Types of food eaten between meals	sweets	"fast food"	Salty snacks	fruit	other
	28	1	12	54	6
The type of carbohydrates consumed	Of white flour		Of wholemeal flour		different
	36		14		50
Type of meat consumed	lean meat (e.g. turkey, chicken, rabbit, pork)		fat meat (pork, bacon, goose, duck)		I don't eat meat
	92		4		4
Frequency of consuming fish	Once a week	Twice a week	Several times a week	I don't eat fish	
	69	9	1	21	
Frequency of consuming eggs	Once a week	Several times a week	Several times a month	I don't eat eggs	
	35	39	14	12	
Frequency of consuming legumes	Once a week	Several times a week	Several times a month	I don't eat legumes	
	32	11	38	20	
Frequency of consuming dairy products	Once a day	2-3 times a day	3-4 times a day	More than 4 times a day	I don't eat dairy products
	43	41	7	1	7
Amount of vegetables consumed a day	Less than 100 g	100 – 200 g	200 – 300 g	300 – 400 g	More than 400 g
	13	40	30	10	7
Amount of fruit consumed a day	Less than 100 g	100 – 200 g	200 – 300 g	300 – 400 g	More than 400 g
	7	31	31	17	14
Amount of water consumed per day	Less than 0, 5 l	0.5 – 1.l	1.5 – 2.l	2 – 3.l	More than 3 l
	1.80	27.60	46.90	21.50	2.20

Table 4. Impact of the respondents' education on selected nutritional behaviors

		Education			
		Vocational [%]	Secondary [%]	Higher [%]	p
Avoiding counter indicated products	Yes	2.7	21.0	66.6	p <0.001
	No	0.4	0.9	1.3	
	I don't know	1.3	7.0	4.4	
Types of food eaten between meals	Sweets	4.9	16.8	0.9	p =0.127
	Fast food	0.4	0.0	0.0	
	Salty snacks	3.1	5.3	1.3	
	Friut	15.9	25.2	2.0	
	Other	4.9	19.0	0.0	
Number of meals consumed a day	Less than 3	0.0	0.4	0.0	p = 0.005
	2-3	0.9	2.2	0.4	
	3-4	3.1	15.4	25.0	
	5-6	1.3	10.5	39.0	
	More than 6	0.0	0.4	1.3	

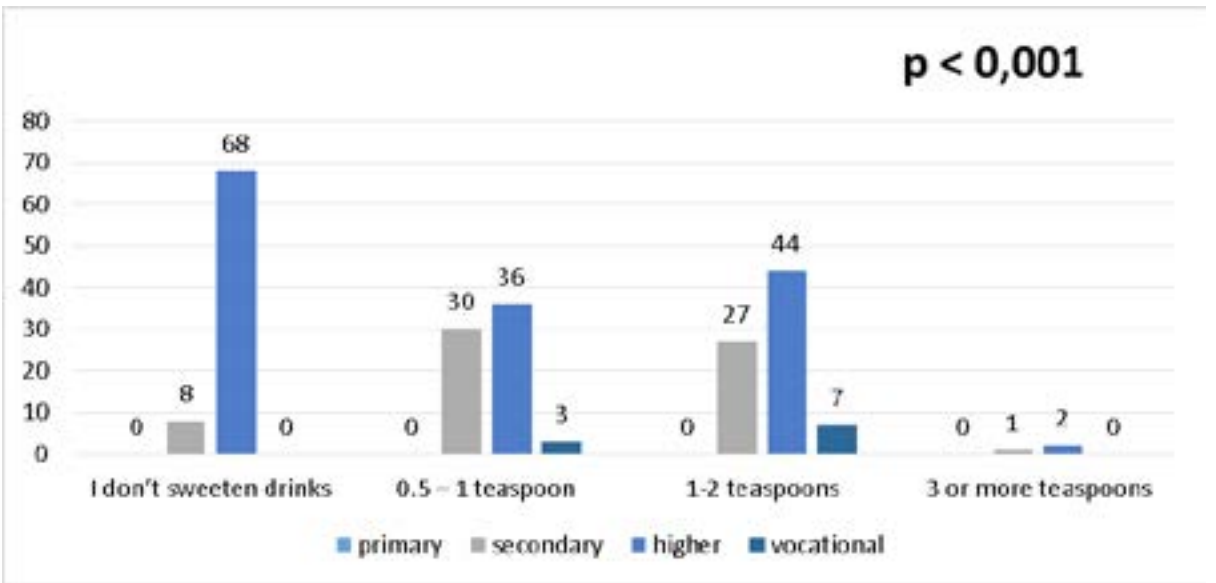

Figure 2. The amount of sugar added to drinks and the level of education

Table 5. Influence od diet during pregnancy on baby's health status and supplementation in pregnancy

Variable	Yes [%]	No [%]	I don't know [%]
Diet during pregnancy and the impact on the baby's health status	63	9	28
Supplementation used	73	29	–
Supplementation with omega 3	63	38	–

of the respondents (28%) do not have knowledge on this subject. However, 9% of them think that nutrition during pregnancy has no impact on their baby (Table 5). The analysis of selected answers shows that 73% of the women used supplementation during pregnancy, 27% of the respondents answered negatively. The use of supplementation among the studied women did not differ significantly in terms of their education (p = 0.086). The supplementation with omega acids was used by 62% of the women, while 38% did not use it at all.

Discussion

The health status of a pregnant woman affects normal development of the fetus. However, various conditions may occur during pregnancy. Among women from the Podkarpackie province, the most common ailments were anemia, hypertension, and gestational diabetes.

In Poland, the incidence of anemia during pregnancy is as much as 18.6-41.4%. The most common cause is iron deficiency, less frequently folic acid or vitamin B12 deficiency. In a study by Grochal et al. of 1653 pregnant

women hospitalized at the SPZOZ hospital in Rawa Mazowiecka, as much as 14.82% had anemia.[30] In a study by Wójciak et al. among women aged 19-44, who undertook any slimming activities during pregnancy, an increased incidence of anemia was found.[31]

In Cífková et al., hypertension occurred in 5-10% of the pregnant women. Arterial hypertension can lead to complications such as: placental abruption, organ failure, prematurity, intrauterine growth restriction and even death.[32,33]

Maciąg et al. examined the knowledge about nutrition in hypertension among the pregnant women from the Independent Public Complex of Health Care Institutions in Sandomierz at the department of gynecology and obstetrics. The study included 60 women, only 22% of whom had correct knowledge that consumption of caffeine, alcohol, the use of excessive amounts of salt, low intake of calcium-rich products or smoking affects blood pressure.[34]

Gestational diabetes is (GDM) one of the more common conditions occurring during pregnancy. The consequences of this disease are very dangerous, because they threaten the health of the future mother and her baby. Pregnancy complications associated with this condition include intrauterine deaths, premature birth, high birth weight of the baby, fetal hypoxia or malformations. In pregnant women with GDM, the risk of developing type 2 diabetes is much higher, over 50% compared to healthy people. The study conducted in about 6,000 pregnant women in various parts of Poland demonstrated that the problem of GDM affects approximately 3.4% of the pregnant women, however, it varies in individual e.g.: 2% -Toruń or 3.9% - Kartuzy.[35]

Nausea and vomiting are typical, however, unpleasant ailments during pregnancy. In the studies of Gadsby R. et al. and Lacroix S. et al. vomiting occurred in 50% in early pregnancy ceasing in the second and third trimester of pregnancy, while nausea occurred in 25%.[36] This condition referred to as hyperemesis gravidarum affects 0.3-1.5% of pregnant women.[37] It is associated with strong, persistent vomiting, body weight loss below 5%, electrolyte disturbances, ketonuria and dehydration.[36] Among the respondents from the Podkarpackie province, 57% suffered from nausea and vomiting, especially at the beginning of pregnancy. This is probably related to high levels of chorionic gonadotropin. The biggest problem during these ailments was the smaller amount of meals consumed, particularly meat.

During pregnancy, products that can be a source of bacteria are inadvisable. They penetrate easily through the placenta and in addition, women expecting a baby have 20 times less resistance compared to other adults. Pregnant women from the Podkarpackie province in the majority (85%) were aware that the intake of certain products during pregnancy is inadvisable. Myszkowska-Ryciak et al. studied 50 women aged 21-36 and found that their knowledge about nutrition during pregnancy and the intake of macro and micro-components is fragmentary.[12] Ziema et al. studied the level of knowledge about toxoplasmosis among pregnant, midwives, medical students and obstetricians. The study covered 310 people, including 109 pregnant women. The lowest knowledge among the respondents was among pregnant women.[29] In the Dubiel study on nutritional knowledge among 102 women, 93% declared they knew the forbidden products during pregnancy. They mentioned mainly: raw eggs, raw meat, fish and blue cheese.[38]

Pregnant women from the Podkarpackie province chose white cereal products interchangeably with whole meal ones (50%). Thirty eight percent consumed only whole meal products, while 15% consumed only white cereal products. In Hyżyk's study 42% of the respondents chose whole meal wheat bread.[39] According to Myszkowska-Ryciak et al., the respondents believed that sweets are a good source of complex carbohydrates, which was consistent with a small knowledge on nutrition.[12]

Women living in the region of Podkarpacie mostly chose lean meat (92%) such as turkey, chicken, and rabbit. According to Godal et al. the respondents consumed a large amount of red meat (up to 40%). Fish consumption is important during pregnancy, because they are a source of well-absorbed protein and the main source of very important n-3 fatty acids. Nowadays it is very hard to buy fish uncontaminated with heavy metals, dioxins or polychlorinated biphenyls. Those from a safe source usually involve a high price, which unfortunately makes them less available to the majority of consumers. The pregnant women who do not eat fish should use DHA supplements. Ensuring their correct amount in the diet affects the reduction of the probability of premature birth, the higher weight of the fetus, its normal psychological development and vision, and also reduces the number of postpartum depression episodes. Pregnant women should supplement 500 mg of DHA daily with the first month of pregnancy in case of low consumption of fish and other sources of DHA. Pregnant women with a high risk of premature labor should supplement 1000 mg DHA / day. A suitable source of DHA is that which is obtained by a special biotechnology method from algae of the Schizochytrium genus, which do not allow the pollution of seawater to break into their structure. The women from Podkarpacie, despite rare fish consumption - once a week (70%), declared DHA supplementation (60%).

The respondents showed a low intake of dairy products. Forty four percent ate dairy products once a day, 40%: 2-3 times a day. Less than 2% above 4 times a day. In the study by Hyżyk et al. the woman questioned

also had very low intake of dairy products, only 16% of them consumed dairy products more than once a day.[39] Myszkowska-Ryciak showed that pregnant woman consumed too little calcium. Moreover, up to 40% thought that during pregnancy one should not drink milk. Only 46% of women suggested that dairy products are a good source of protein.[12] In the study of Godala et al. 25% declared dairy consumption a few times during a day.[38] The respondents living in the Podkarpackie region were characterized by low intake of vegetables and fruit. The most frequently marked quantity of vegetables consumed was 100-200 g (40%). Fruit consumption was at 100-200 g by 30% and 200-300 g also by 30% during the day. Godal et al. determined that 51% of the pregnant women declared fruit consumption several times a day whereas 30% - vegetable intake. Fruits and vegetables were consumed mostly in raw form (50%).[38] Hyżyk et al. examined fruit and vegetable consumption among respondents in the winter, the results indicated too little consumption of these products.[39] Szczepaniak et al. concluded that pregnant women consumed too small portions of fruit during a day - usually from 1-2 servings.[38]

In the study, 50% of the respondents suggested that they consumed the right amount of water from 1.5 to 2 liters during the day. About 30% drank 0.5-1 liters daily. The most frequently chosen liquids were mineral water (71%), then fruit tea, herbal tea (14%), coffee and black tea (12%). Godal et al. found that 67% of the women also choose to drink water the most, 45% of women declared to consume black tea daily. During the pregnancy, about 15% gave up coffee during pregnancy, while every fourth examined drank one cup a day.[38]

63% of the respondents from Podkarpacie considered that nutrition has an impact on the health and eating habits of their baby. However, 28% of the women did not have knowledge on this subject. Nutritional education is important at the time of the preconception. It is important to pay attention to nutrition during planning and pregnancy. In the Kozłowska-Wojciechowska et al. study, the knowledge of pregnant women about the nutrition at this time and its impact on the baby was estimated as an average.[40] The study also shows that 85% believe that the future mother's diet affects baby's birth weight. According to Myszkowska-Ryciak et al. two thirds declared that they had sufficient knowledge about nutrition in pregnancy.[12,40] Every pregnant woman should think about supplementation preferably after consulting the gynecologist. The diet should be the basic source of vitamins and minerals. Ingredients that are often found in supplements for pregnant women are: folic acid, vitamin D3, iodine, omega-3 acids and iron due to their high demand and too little of it in the diet. Most future mothers (78%) from the Podkarpackie region used supplementation with vitamin and mineral preparations for pregnant women. The deficiency of certain vitamins or minerals may have serious consequences for the fetus or mother. The respondents examined by Kozłowska-Wojciechowska et al. considered deficiency of iron (87%), calcium (78%) and folic acid (75%) as the most dangerous.[40] In the Myszkowska-Ryciak study the greatest deficits were iron and calcium.[12] In 1998 in order to prevent the neural tube defects in the fetus, a 0.4 mg folic acid dose was established for women in the preconception period and up to the 12th week of pregnancy. In Poland in 2007, folic acid was only taken by 35% of women before pregnancy, 84% of pregnant women and 12% of unplanned pregnancies. The introduction of iodine-enriched salt reduced the number of abortions, premature births and hypothyroidism in newborn babies. Pregnant women who do not eat healthy should take vitamins and minerals with appropriate supplements.[41] It should be remembered, however, that the excess of some vitamins can also be dangerous for a baby.

Conclusions

1. The respondents avoided products that were not recommended during pregnancy.
2. The respondents chose the right kind of meat.
3. Despite the low consumption of fish, the surveyed supplemented omega-3 fatty acids.
4. The examined pregnant women consumed a very small amount of dairy products during the day. The consumption of more than 4 portions of dairy products was declared by less than 2% of women. The most frequent amount consumed (44% of women) was one portion of dairy products a day.
5. Prior to pregnancy and during pregnancy, supplementation intended for pregnant women should be used. Most women from the Podkarpacie region were aware of this. Taking appropriate supplements was declared by 74% of women.

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ORIGINAL PAPER

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Assessment of disability and quality of life in elderly people in institutional care

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ABSTRACT

Introduction. Increasing incidence of disability among elderly people results in a growing need for long-term care.

Aim. The aim of the study was to assess the disability and quality of life in people over 60 living in institutional care.

Material and methods. The study group included a group of 100 people residing in social welfare homes in south-eastern Poland. The WHODAS 2.0 questionnaire was used to assess disability and the WHOQOL-Bref questionnaire was used to assess the quality of life.

Results. The majority of the respondents had difficulties in getting around (47.94), participation in society (34.29) and self-care (32.40). The lowest level of disability was found in the domain of getting along with other people (6.67). The highest level of quality of life was observed in the environmental domain (63.62), and the lowest in the social domain (37.10). A relationship was found between disability and the quality of life in the study group. Difficulties in terms of getting around and self-care, as well as participation in society had a negative impact on the quality of life.

Conclusion. The residents of social welfare homes were characterized by moderate disability and a good quality of life. The results obtained indicate the domains of functioning that require the greatest support for the residents of social welfare homes. The implementation of programs to improve the performance of basic and complex activities of daily living (ADL) may improve the functional status and quality of life in these people.

Keywords. disability, elderly people, long-term care

Introduction

Recently, a dynamic progress of ageing has been observed in societies. In Poland, the percentage of people over 65 amounted to 13.5% in 2014. According to the forecast of the Central Statistical Office (CSO), this percentage will reach 34.5% in 2050. It is predicted that the number of European citizens aged at least 65 will increase from 18.9% in 2016 to 29.5% in 2060, while the citizens at least

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80 years old - from 4.6% to 12%.[1,2,3] The development of medicine resulting in the elongation of elderly people's lives, as well as the growing number of families with a small number of children contribute to this fact.[4] The phenomenon of longer life of elderly people is not always associated with the extension of health and independence - according to statistics, people over 65 make up nearly 41% of all persons with disabilities in Poland.[5] This results in a systematic increase in the need for long-term care.[6] According to the Ministry of Health, in 2012, 42% of people aged 75 years and over 56% of those aged over 75 used long-term care services. According to statistical forecasts, this number will double in the next 20 years.[7] According to Eurobarometer surveys from 2007, the majority of Europe's population will require long-term care at some stage of their lives.[8] The observed changes in population structure are a challenge for national and local authorities to provide seniors decent living conditions and its proper quality. [9,10]

In recent years, a positive change has occurred in the approach to health and rehabilitation of elderly people. The actions undertaken are directed not only to support the patient's health needs, but also emotional and social aspects.[10,11] This results in the growing interest of many researchers in the subject of functioning and disability of elderly people. According to de Melo Trize et al., the degree of fitness of the elderly is influenced, i.e. by co-morbidities, level of physical activity, lifestyle and pain.[12] Studies by Katta et al. showed that the main determinant of disability are limitations in mobility and performing basic ADL.[13] Li and Conwell emphasize significant impact of cognitive impairment on the increase of functional disability in the elderly people.[14] Helvik et al. showed that a large percentage of the elderly people placed in institutional care facilities have a deterioration in the ability to perform ADL, which is mainly related to the severity of dementia symptoms, co-morbidities and emotional disorders.[15] Kozicka and Kostka recognized additionally age, strength of the handshake and nutritional status as the most important determinants of functional fitness in the people.[16] The quality of life is inseparably connected with functional capacity, because as many sources conclude, healthy life and fitness still remain the main determinants of high quality of life.[17,18,19] Mollaoğlu et al. showed that the main factors determining the quality of life include mobility.[17] Yümin et al. included the possibility of maintaining balance, as well as age, marital status and education level among main determinants of quality of life.[20] Accompanying the old age, multi-morbidity, which often causes limitations of physical capacity and dependence on others, reduction of funds to finance treatment or depression resulting from lack of support from relatives are only a few of the problems that the elderly people have to deal with. Each of them can contribute to a significant deterioration of their quality of life.[18,21,22]

The majority of previous studies on the functional fitness of the elderly were based on the use of the ADL and IADL scale and did not give a full picture of the functioning of these people in everyday life. Therefore, there is urgent need to carry out a multi-aspect analysis of the situation of the elderly people based on the International Classification of Functioning, Disability and Health (ICF) in order to assess difficulties associated with functioning in everyday life, especially in the old age.[10,11] A tool to assess disability developed by WHO on the basis of ICF is the WHODAS (World Health Organization Disability Assessment Schedule 2.0) questionnaire.[23] It is a tool used by more and more researchers from different countries, and the research carried out so far has confirmed its high psychometric sensitivity in assessing the level of disability of various populations.[23,24,25] The application of the WHODAS 2.0 questionnaire in the surveys of people covered by institutional care provides the possibility of a multidimensional assessment of factors affecting the functioning of the residents of social welfare homes.[26] This tool is considered complementary to the WHOQOL-Bref assessing satisfaction with quality of life. In connection with the above, the analysis of the level of disability and the quality of life of elderly people covered by institutional care was performed. In Poland, this is the first disability assessment of the elderly people covered by institutional care with WHODAS 2.0.

Aim

The aim of the study was to assess the disability and quality of life in people over 60 living in social welfare homes in south-eastern Poland.

Material and methods

The study group consisted of 100 people, aged 60-96, residing in randomly selected social welfare homes in the Podkarpackie province. The residents of 4 social welfare homes were included in the study. There were 69 women and 31 men among the respondents. WHODAS 2.0 and WHOQOL-Bref questionnaires, as well as a questionnaire containing sociodemographics and health status were used in the study.

The level of disability of the respondents was assessed using WHODAS 2.0. The questionnaire enables the assessment of the functioning of people in the last 30 days in six domains of life: understanding and communicating, getting around, self-care, getting along with people, life activities and participation in society. This analysis does not include the domain of life activity, which analyses the difficulties in performing daily activities related to the maintenance of the household, such as: cooking, cleaning, shopping, taking care of oneself and personal belongings. Answers to the questions were

classified in a five-point scale in which, along with the increase in the score obtained, the severity of the problem increases (no problem - 1 point, extremely big problem - 5 points). After summing up the results obtained in each of six domains and converting them to the 0-100 point range, it is also possible to assess the overall disability level, in which 0 points means no disability and 100 points - total disability.[23] In order to determine the general level of disability and disability in individual domains of WHODAS 2.0, the scale consistent with the ICF guidelines was used: no disability (0-4%), slight disability (5-24%), moderate disability (25-49%), severe disability (50-95%), very severe disability (96-100%). [27]

The WHOQOL-Bref questionnaire was used to assess the quality of life, which allows to obtain a profile of quality of life on the basis of the analysis of the last 14 days in four domains: physical, psychological, social and environmental. Answers to the questions asked are classified in a five-point scale, and the interpretation of the obtained results has a positive direction. This means that the greater the number of points scored in each of the assessed domains, the better the quality of life of the subject. The questionnaire also contains 2 questions regarding the individual's general perception of quality of life and individual's general perception of one's own health, which concern the last 30 days and are analysed separately. In order to obtain results in a form comparable to WHOQOL-100, the obtained results are converted on a 100 point scale, in which 0 points means a very poor quality of life, and 100 points a very good quality of life.[28]

Statistical analysis

Statistical analysis was performed using the STATISTICA 13.1. Quantity and indicators of the structure were given for the qualitative variables. Basic measures of descriptive statistics were determined for quantitative variables. In addition, linear correlation coefficients were determined between the results of the WHODAS 2.0 questionnaire and the results of the WHOQOL-Bref questionnaire. Statistically significant correlations were found at $p<0.05$.

Results

The study included a group of 69 women and 31 men between 60 and 96 years of age, their average age was 78 years (SD = 8.81). The BMI (Body Mass Index) of the subjects was also calculated. Half of them (50%) were characterized by normal BMI, 30% were overweight and 15% obese. The mean BMI in the study group was 24.65 (SD = 4.6). Most of the respondents (65%) used orthopaedic aids for everyday functioning. Most patients used a walker (24%) or a wheelchair (22%). 19% of the respondents moved with a crutch or a stick. The incidence of falls in the study group during the last year was also determined. It occurred in more than three-quarters of the respondents (78%). Vast majority of the elderly people (74%) declared that in their everyday life they are visited and helped by their families (Table 1).

Table 1. Characteristics of the study group (n = 100)

Feature	Percent (%)
Sex	
Women	69.00
men	31.00
BMI	
Underweight	5.00
Normal	50.00
Overweight	30.00
Obesity	15.00
Orthopaedic aids used	
A crutch or a stick	19.00
A walker	24.00
A wheelchair	22.00
Does not use any orthopaedic aids	35.00
Falls during last year	
yes	78.00
no	22.00
Visits and help of the family	
yes	74.00
no	26.00

Table 2. Incidence of chronic diseases diagnosed by a doctor

Chronic diseases	Percent (%)
Coronary heart disease	30.00
Hypertension	44.00
Atherosclerosis	14.00
Stroke	2.00
Diabetes	31.00
Osteoporosis	28.00
Osteoarthritis of the peripheral joints	20.00
Osteoarthritis and back pain	25.00
Rheumatic disease	30.00
Allergy	4.00
Cancer	1.00
Asthma	4.00
COPD, emphysema	2.00
Incontinence	40.00
Migraine	11.00
Depression	15.00

The most frequent chronic diseases in the study group were arterial hypertension and incontinence. These diseases were diagnosed in 44% and 40% of the respondents, respectively. Almost one third of the people suffered from conditions such as diabetes (31%), coronary heart disease (30%) and rheumatic disease (30%). The fewest respondents indicated the occurrence of chronic respiratory diseases, cancer and stroke. These diseases were diagnosed in less than 5% of the study group (Table 2).

We found that the highest degree of disability of the residents of social welfare homes occurs in the domain

related to getting around (47.94), participation in society (34.29) and self-care (32.40). The lowest degree of disability was found in the domain of getting along with people (6.67) and understanding and communicating (13.65) (Table 3).

The analysis of the results obtained showed that in the majority of the studied domains prevailed people with mild and moderate disabilities. The highest percentage of the respondents with moderate disabilities was found in the domain of participation in society (60%). Most people had problems with getting around because in this domain the highest percentage of seniors was characterized by severe (31%) and very severe (14%) disability. A very severe degree of disability has also been demonstrated in the domain of self-care (3%) (Table 4).

In the study group, the highest percentage were the elderly with good quality of life (42%). A slightly smaller percentage (31%) of the respondents assessed their quality of life as neither good nor bad. A comparable percentage of the respondents assessed their quality of life as very good (15%) and bad or very bad (12%).

Almost half of the respondents were satisfied or very satisfied (49%) with their health condition. On the other hand, 34% were dissatisfied or very dissatisfied. The remaining part of the respondents (17%) indicated the answer "neither satisfied nor dissatisfied".

Table 3. Results of the WHODAS 2.0 questionnaire

Domains of disability	Mean	SD	Median	Min	Max	Lower quartile	Upper quartile	Asymmetry coefficient
understanding and communicating	13.65	12.37	10.00	0.00	50.00	5.00	20.00	1.00
getting around	47.94	32.42	43.75	0.00	100.00	21.88	75.00	0.30
self-care	32.40	29.72	20.00	0.00	100.00	10.00	45.00	0.89
getting along with people	6.67	12.31	0.00	0.00	41.67	0.00	8.33	1.50
participation in society	34.29	14.82	33.33	0.00	70.83	25.00	41.67	0.46

Table 4. Incidence of individual degrees of disability in the assessed domains

Domains of disability	no disability (%)	slight disability (%)	moderate disability (%)	severe disability (%)	very severe disability (%)
understanding and communicating	21.00	58.00	19.00	2.00	0.00
getting around	5.00	20.00	30.00	31.00	14.00
self-care	16.00	37.00	22.00	22.00	3.00
getting along with people	74.00	5.00	21.00	0.00	0.00
participation in society	1.0	21.00	60.00	18.00	0.00

Table 5. Results of the WHOQOL-Bref questionnaire

Domains of quality of life	Mean	SD	Median	Min	Max	Lower quartile	Upper quartile	Asymmetry coefficient
Physical health	51.32	10.08	50.00	31.00	75.00	44.00	63.00	0.14
Psychological	57.07	12.21	56.00	25.00	94.00	47.00	69.00	0.08
Social relationships	37.10	11.63	44.00	6.00	56.00	28.00	44.00	-0.34
Environment	63.62	11.21	63.00	44.00	100.00	56.00	69.00	0.41

Table 6. Assessment of the relationship between the degree of disability and the quality of life

Results of WHODAS 2.0	Results of WHOQOL-Bref			
	Physical health	Psychological	Social relationships	Environment
understanding and communicating	-0.29	-0.36	-0.30	-0.28
getting around	-0.42	-0.35	-0.06	-0.27
self-care	-0.40	-0.35	0.02	-0.21
getting along with people	-0.19	-0.29	-0.16	-0.13
participation in society	-0.41	-0.42	-0.14	-0.37

The residents of social welfare homes rated the quality of their life in the domain of environment (63.62) the highest. The lowest quality of life was found in the domain of social relationships (37.10). The quality of life in the physical and psychological domains was assessed at an average level (51.32; 57.07 respectively) (Table 5).

The relationship between the level of disability in particular domains measured by WHODAS 2.0 and the level of quality of life in individual WHOQOL-Bref domains were assessed (Table 6).

There was a statistically significant moderate negative relationship between the physical health domain of quality of life and getting around, self-care and participating in society, as well as between the psychological domain of quality of life and participation in society. The remaining correlation coefficients were statistically significant but indicated a low strength of dependence between the analysed domains or turned out to be statistically insignificant.

Discussion

The phenomenon of aging is a progressive and irreversible process, leading to a decrease in fitness and psychophysical efficiency. The increase in the number of elderly people in the society makes it necessary to look for effective strategies aimed at maintaining the independence in everyday functioning for as long as possible.

In course of the analysis, the highest level of disability was demonstrated in the domain of getting around (mean = 47.94, SD = 32.4). In this part, activities such as standing, moving around the house, getting out home and walking a long distance were assessed. Similar results obtained by Silva et al. who examined 504 people over 60 years of age. They found a very high degree of difficulty in activities such as standing for long periods in 30% of the respondents, and walking for longer distances up to 38%.[29] The analysis carried out by Veiga et al. showed the highest degree of disability in the domain of getting around.[30] Katta et al. who assessed the disability of Indian residents from rural areas also showed the greatest difficulties in the field of getting around and self-care.[13] Jerez-Roig et al. who examined 280 residents of nursing homes over 60 years of age found functional decline in 54% examined persons in the 2-year follow-up. The maintained level of fitness was observed in 33% of the respondents, and in only 14% of them the level was higher.[31] Den Ouden et al. found in their research that the residents of nursing homes lead inactive lifestyle. The authors also emphasized the need to organize forms of physical activity by staff in order to maintain an adequate level of fitness and minimize the risk of progressing disability in mentees.[32]

Based on our own analysis, it was found that a high level of disability also occurred in the domain of participation in society (mean = 34.29, SD = 14.82). Within this domain, the activities in the local community were assessed, overcoming barriers and obstacles occurring in the external environment, and other problems, such as the sense of personal dignity. Donmez et al. in their research, which included 36174 people above 60 years of age living in society, also showed the highest percentage of people characterized by problems in participation in society.[33] Veerhak et al. who assessed the level of disability of patients with depression found the highest level of disability of the respondents in the domain of participation in society and life activities.[34]

Our research shows that the next in terms of disability was the domain related to taking care of oneself, personal hygiene, dressing up, eating and staying alone at home (mean = 32.40, SD = 29.72). A study by Rocha et al., which included 329 residents of long-term care centers with dementia showed that 89.4% of them had very high degree of disability in the field of self-washing and 78.4% in self-dressing. The authors also emphasized the existence of a negative correlation between the level of cognitive impairment and disability in the study group.[35] Dotchin et al. who assessed the relationship between the degree of disability and severity of dementia showed that the strongest influence on the occurrence of cognitive deficits have limitations in the area of self-care.[36]

The analysis showed the lowest level of disability in getting along with people (mean = 6.67, SD = 12.31). In the studies conducted by Almazán-Isla et al. the domain of getting along with people was the area of the lowest disability in both the elderly women and men.[37] Sinalkar et al. who conducted research on a group of 227 people over 65 living in rural areas in India showed no disability in terms of getting along with people in 78% of women and 63.3% of men.[38] The results obtained in this area were the best in relation to the results obtained in the remaining domains of the WHODAS 2.0 scale.

In the surveyed group of residents of social welfare homes in the Podkarpacie region, the highest level of quality of life was found in the environmental domain, in which housing, financial conditions, a sense of security and the ability to pursue one's own interests were assessed. The lowest level of quality of life was demonstrated in the social domain, in which satisfaction with personal relationships, support received from relatives and intimate life was examined. The quality of life in the psychological and physical health domains was on an average level. Similar results in the assessment of the quality of life was found by Pawlarczyk et al. who conducted research among people living in social welfare homes and patients of the psychogeriatric daily department in Poznan.[39] Kuan-Long et al. who examined 465 people living in 62 institutional care centers in Taiwan also found the worst quality of life of the respondents in the social domain.[40] Similarly, the lowest result in this

domain was found by Serbian researchers who assessed the quality of life of 200 residents of the Senior House in Novi Sad.41 Şenol et al. examined the quality of life of 136 residents of nursing homes aged over 65 years using the modified WHOQOL-OLD quality of life, assessing the quality of life in six domains. The best results were obtained in the domain of intimacy and cognitive functions, and the worst in the domain of autonomy. The overall mean score obtained in the study group amounting to 43.4 was estimated as a low level of overall quality of life.[42]

Based on the results of our own research, it was found that in the overall assessment of quality of life contained in the first question of the WHOQOL-Bref questionnaire, majority of the respondents (42%) rated their quality of life as good and neither good nor bad (31%). Extreme responses defining the level of quality of life as very good and very bad were indicated by 15% and 12% of the respondents respectively. Almost half of the respondents (49%) declared that they were satisfied with their state of health, 17% chose the answer "neither satisfied nor dissatisfied". The percentage of people dissatisfied and very dissatisfied with their health stood at 34%. Dias et al. who assessed the quality of life of the residents of long-term care centers in Rio de Janeiro obtained similar results. Very good quality of life was declared by 10% of the respondents, 40% of the respondents described the general quality of their life as good, the same percentage (40%) of the respondents assessed their quality of life as neither good nor bad, and 10% as bad. Half of the respondents (50%) declared that they were satisfied with their state of health. Neither satisfied nor dissatisfied was chosen by 20% of the respondents. Very high satisfaction and dissatisfaction with one's health condition were declared by 5% and 15% of the respondents.[43] Bodur et al. compared the quality of life of people living in home and institutional environment. Their research did not show differences in the perception of the quality of life of both groups in the physical and psychological domains. The residents of institutional care centres, however, were characterized by a lower level of quality of life in social and environmental domains compared to people living in family homes.[44] According to Zych and Karakaya, the quality of life of the elderly people staying in institutions is lower compared to the elderly people living with families.[45,46] These results provide a starting point for the further development of research into factors affecting the quality of life of long-term care patients.

In the study group of the residents of social welfare homes in the Podkarpacie region, it was found that along with the increase in disability, the quality of life is reduced. A particularly strong relationship was found between the physical domain of quality of life and limitations in the areas of getting around, self-care and participation in society, as well as between the psychological domain of quality of life and disability in the field of participation. Similar dependencies were found Tazaki et al. who examined 321 elderly people and their carers living in different environments. They showed a negative correlation between disability in terms of standing for more than 30 minutes, washing, dressing and getting along with people, and a decline in the quality of life in the physical domain of the elderly people living in family homes.[47] Ramaprasad et al. in their research included a group of 205 elderly people suffering from mental illnesses showed that the lower level of disability obtained on the basis of the WHODAS 2.0 scale analysis, the higher the quality of life assessed on the WHOQOL-Bref scale.[48] Mwanyangala et al. studied 5131 people over 50 with discussed scales. The authors showed that with age, the level of disability increases and the level of quality of life decreases. They also observed that in each age group the level of quality of life was higher in men, while a lower level of disability was in the group of women.

The results of research showing the greatest limitations in terms of getting around and self-care in the elderly people staying in institutional care centres may suggest the need to expand the programs of rehabilitation and organized seniors' physical activity. This is confirmed by the results of research conducted by Acree and Manini, according to which an increase in the level of physical activity of elderly people has an impact on increasing the level of their functional capacity and quality of life. Therefore, it is necessary to ensure an adequate level of physical activity to elderly people living in an institutional environment.[50,51]

Conclusion

The aging of the society and social changes that increase the number of people placed in institutional care centres make this social group more and more often object of the research. Moderate level of disability and a good level of quality of life were found in the residents of social welfare homes, with the greatest limitations in everyday functioning associated with getting around. It was also shown that the increase in the level of disability correlated with a decrease in the quality of life. The results obtained indicate the domains of functioning that require the greatest support. The development and implementation of programs improving the performance of basic and complex activities of everyday life, as well as the organization of various forms of activity for seniors in social life may improve their functional status and quality of life.

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ORIGINAL PAPER

Bartłomiej Kamiński

Surgical voice rehabilitation performed by means of voice prosthesis post laryngectomy

Otolaryngology Ward of Maria Skłodowska-Curie District Hospital in Skarżysko-Kamienna, Poland

ABSTRACT

Introduction. In 1972, in Poland, Professor Erwin Mozolewski presented a pioneering thesis concerning the creation of intubated voice fistula in a group of 24 patients. It was undoubtedly the prototype of today's voice prosthesis.

Materials and method. The study involved 33 men after total laryngectomy due to advanced squamous cell carcinoma, treated in the Otolaryngology Ward of the District Hospital in Skarżysko-Kamienna between the years 2012–2017, who were implanted with a voice prosthesis Provox II and Provox Vega.

Results. During the analyzed period, 127 voice prosthesis were replaced in 33 patients. This paper focuses on complications connected with the implantation of voice prosthesis. The most common reason for replacement of a voice prosthesis was fluid leakage through the voice prosthesis channel – 95 cases. Spontaneous prolapse of the voice prosthesis occurred in 11 patients, and after re-insertion of the prosthesis, the correct fistula voice was obtained. The voice prosthesis was replaced due to difficulty in creating the prosthetic speech in 8 patients. A much more serious complication is the occurrence of leakage around the voice prosthesis. In the examined group, leakage around the prosthesis occurred in 5 patients. An inflammatory plaque was formed around the prosthesis, which was removed in case of significant prosthetic cover or at the request of an alarmed patient – in 4 patients. The prosthesis protruded and rotated in the trachea and hung on a fragment of mucous membrane of the trachea in 1 patient.

Keywords. laryngeal cancer, voice prosthesis, tracheoesophageal fistula

Introduction

Only humans use articulated speech, and, thanks to this ability, we are capable of expressing our thoughts, emotions and needs. We acquire speech in early childhood and use accompanies us throughout our lives. Loss of voice is not only a physical but also a mental and social injury. The history of voice and speech rehabilitation is connected with the first operation of the removal of the larynx due to cancer, which was performed in 1873 in Vienna by Teodora Bilroth. In the 20th century, the rehabilitation of voice and esophageal speech was the only natural method of obtaining a substitute form of using voiced speech. In 1972, in Poland, Professor Erwin Mozolewski presented a pioneering thesis concerning the rule of creating intubated voice fistula in a group of 24 patients. It was undoubtedly the prototype of to-

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day's voice prosthesis. Despite the very good results, this method was not widespread due to the economic situation in our country resulting in a lack of industry interest in cooperation and commercial production.[1] Only a few years later, in 1980, Singer and Bloom described their experiences, and their prostheses were commercially successful and became a breakthrough in speech rehabilitation in patients after complete laryngectomy.[2] In the Department of Otolaryngology of the District Hospital in Skarżysko-Kamienna, the primary implantation of the voice prosthesis is routine in the case of complete laryngectomy due to large malignant tumors and has been used since 2012. In this study, the type of complications associated with surgical voice rehabilitation using Provox voice prostheses was assessed.

Materials and methods

The study involved 33 men after total laryngectomy due to advanced squamous cell carcinoma, treated in the Otolaryngology Ward of the District Hospital in Skarżysko-Kamienna, between the years 2012-2017, who were implanted with a voice prosthesis Provox II and Provox Vega. In 32 patients, the vocal prosthesis was implanted initially during total laryngectomy, and one patient was implanted with the secondary prosthesis. All the subjects were men aged 47 to 83 (average age 66.3). During the above-mentioned period of time, 127 voice prostheses were replaced in 33 patients. This study presents an analysis of the complications after the establishment of a voice prosthesis.

Results

No early complications were observed in the form of prolonged healing, the occurrence of inflammatory reaction around the voice prosthesis or other serious complications described in the literature in the studied group of patients.

Among the late complications, the most common were leakage of saliva and fluid through the canal of the voice prosthesis, the widening of the fistula's channel with leakage around the voice prosthesis, formation of granulation tissue around the prosthesis, spontaneous prolapse of the voice prosthesis and protrusion and rotation of the prosthesis.[3-5]

An undoubted advantage of voice prostheses is the possibility of replacing them under local anesthesia. All replacements were carried out under such anesthesia.[6]

The most common reason for the replacement of voice prostheses was the leak of fluids through the voice prosthesis canal - 95 patients. The above complication can hardly be called a complication; it should rather be treated as natural wear of the prosthetic valve by the Candida fungi growing on its surface. In one of the patients the replacement of the prosthesis for this reason occurred after one month of using it, and at the same time, with another patient, the replacement of the voice prosthesis took place after 36 months of using it.

Spontaneous prolapse of the voice prosthesis occurred in 11 patients and, after re-insertion of the prosthesis, a correct fistula voice was obtained. In the examined group of patients, the prolapse of the prosthesis always occurred outwards; there was no loss of the voice prosthesis and its aspiration to the respiratory tract.

A much more serious complication is the occurrence of leakage around the voice prosthesis - as observed in 5 patients. Each time the prosthesis was removed, a nutrient tube was established for a period of 1 to 3 days and, after the shrinkage of the fistula, the prosthesis was inserted again. From the moment of the introduction of the prostheses with an additional XtraSeal collar, with a small leakage around the voice prosthesis, such a prosthesis was applied without the need to shrink the fistula canal. In one case, I had to remove the XtraSeal vocal prosthesis because of the discomfort of the patient in the form of difficulty in swallowing solid foods.

In 8 patients, the replacement of the voice prosthesis was due to the difficulty in creating prosthetic speech. I recognized that despite the lack of leakage of fluids, it was worth replacing the prosthesis and each time a satisfactory return of the prosthetic speech was obtained.

In 4 patients, inflammatory plaque was observed around the prosthesis, which was removed in the case of significant prosthetic cover or at the request of an alarmed patient.

One patient had spontaneous movement of the voice prosthesis to the light of the tracheoesophageal fistula with obstruction of the esophageal end. It was necessary to remove the voice prosthesis and, in the absence of fluid leakage through the fistula canal and lack of speech creation, the fistula was left for spontaneous healing. After 3 months the patient underwent secondary implantation of the voice prosthesis, obtaining a correct fistula voice.

In one patient there occurred a prosthetic protrusion, its rotation in the trachea and hanging on a fragment of mucous membrane. The prosthesis was hanging from a fragment of the mucous membrane of the trachea. The prosthesis was removed by cutting out the mucous membrane on which it was hanging and, after the shrinkage of the tracheoesophageal fistula, the prosthesis was put on again, with a good effect in the form of fistula speech. I have not encountered a description of such a case in the literature.

None of the patients had severe complications described in the literature in the form of aspiration pneumonia, esophageal perforation, deep neck abscesses, mediastinitis or necrosis of esophageal or tracheal tissue.

The average time of retention of the voice prosthesis was 7–8 months.

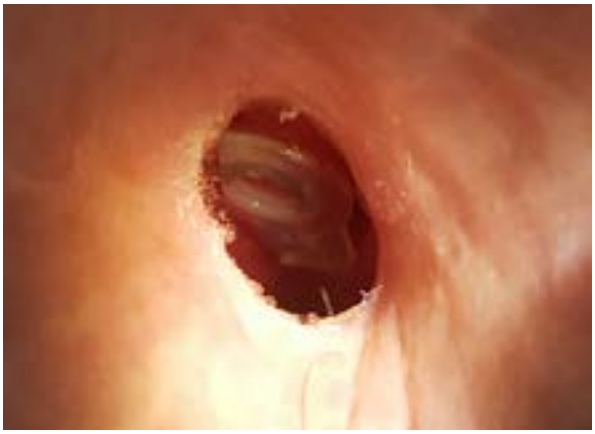

Photo 1. A correctly placed voice prosthesis on the back wall of the trachea

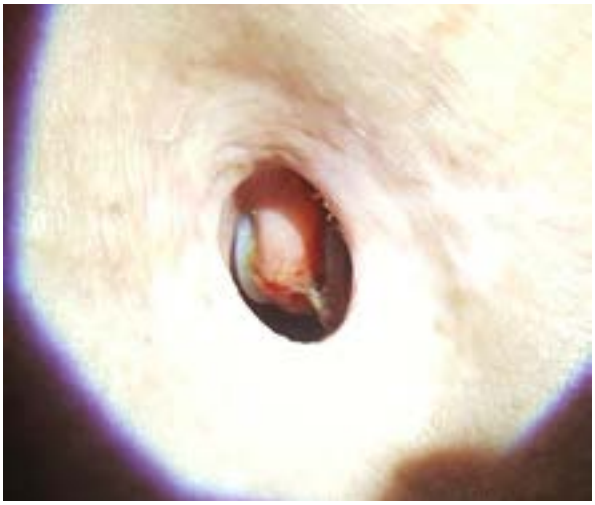

Photo 2. An extended vocal prosthesis onto the tracheal lumen; both collars of the prosthesis are visible, hanging from the fragment of the mucous membrane

Discussion

Surgical speech rehabilitation in patients after complete removal of the larynx requires very close cooperation between the doctor and the patient - not only in the rehabilitation of speech but also with proper care of the prescribed voice prosthesis - and requires constant patient control until the end of life. It is known that the patient, after implantation of the prosthesis, will sooner or later need to have it replaced. Also, a patient with a voice prosthesis should be aware that if the prosthesis falls out, the patient will have to contact a doctor who will be able to treat the patient, preventing covering of the fistula and aspiration of food to the respiratory tract. The patient must be aware that any difficulties in creating prosthetic speech require urgent medical consultation in order to prevent the prosthesis from protruding into the lumen of the tracheoesophageal fistula with the closure of the esophageal end. Therefore, the decision about implanting the voice prosthesis must be thoroughly analyzed by the patient and the doctor. In the otolaryngology ward in Skarżysko-Kamienna, before the operation of complete laryngectomy and implantation of the voice prosthesis, the patient always talks to three thyristectinians who use a voice prosthesis. I believe that such meetings and conversations are a great psychological stimulus for the patient to fight cancer and show that, despite mutilation, you can rehabilitate the fistula and continue to enjoy life. Laryngectomates also admit that such conversations are a great support for them and they would like to take part in such meetings and talks in the future. The exchange of mutual experiences of people using the voice prosthesis also affects the patient's awareness as to when they can wait and when they should be immediately see a doctor.

One of the commonest complications of surgical speech rehabilitation using the Provox system is the leakage of the prosthetic valve and the leakage of the digestive tract towards the trachea. Many authors confirm the occurrence of this complication and the majority of them agree that there is no rule as to the timing of the proper operation of the voice prosthesis.[7-9] In the analyzed material, the prolapse of the voice prosthesis from the fistula channel was observed. Loss of the prosthesis occurred when the prosthesis fell outside the body; no aspiration of the prosthesis to the respiratory tract was noted. One of the most serious complications is the widening of the fistula canal around the voice prosthesis and leakage around the prosthesis[10-12]. Most often, the prosthesis was removed and a nutritional drain was placed in order to shrink the fistula canal. After introducing prostheses with an additional XtraSeal flange, my own experience in applying them around for the leakage around the prosthesis are very good, and less often I applied a drainage tube with small fistula enlargements. Only one patient experienced discomfort when swallowing using a prosthesis with an additional collar. The formation of granulation tissue around the prosthesis is a rare complication and the granulation tissue is most often removed surgically.[13-15] I have not found any case in the literature of the protrusion of the voice prosthesis to the light of the trachea and its hanging on the mucous membrane. To remove the prosthesis, a fragment of the mucous membrane on which the prosthesis was hung was removed, and after the insertion of the nutrient tube and the shrinkage of the fistula canal, the voice prosthesis was re-established.

Conclusions

1. Surgical voice and speech rehabilitation using a voice prosthesis is an effective method that allows for creating an understandable voice and efficient communication of the patient with the environment.
2. Complications after implantation of the voice prosthesis are usually of a local and temporary nature;

however, it is always necessary to consider the possibility of severe complications.

3. Success in surgical speech rehabilitation with the use of voice prostheses requires close cooperation between the doctor and the patient.

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REVIEW PAPER

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Macro and micronutrient deficiency in inflammatory bowel diseases

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ABSTRACT

Introduction. Inflammatory bowel disease (IBD) is group of global range inflammatory conditions. There has been a regular increase in the number of IBD cases. Patients exclude whole food groups from their diet fearing the emergence of disease symptoms or due to learning from unreliable sources. Doing so, they might deepen the already existing vitamin deficiencies which occur along with the shortage of many minerals. These deficiencies might intensify the disease process or cause a new one. The most common deficits pointed out by numerous researchers concern vitamin D, calcium, cobalamin, folic acid and iron. It is well worth introducing selenium, zinc and ascorbic acid into a diet because of their immunomodulating effect. Important aspect of the healing process is a personalized diet which is designed to compensate for, or prevent vitamin and mineral deficiencies.

Aim. The purpose of the study was to review the literature about vitamin and mineral deficiency in Inflammatory Bowel Diseases.

Materials and method. Analysis of literature

Key words. Crohn's disease, IBD, ulcerative colitis, vitamins

Introduction

Inflammatory bowel disease, such as ulcerative colitis and Crohn's disease, constitute chronic illnesses of global range. The gradual increase of newly diagnosed cases has been observed in the developed countries, whereas in newly industrialized countries, the incidence is rising rapidly.[1,2]

Crohn's disease (CD)

The disease process might occur in every part of the gastrointestinal tract, whether it is the oral cavity, stomach, intestines or rectum. Most often the symptoms occur in the last part of the small intestine and the initial part of the large intestine (the colon). The inflammatory process involves all the layers of the intestinal wall. The areas of intestine that are affected by the disease are sep-

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arated by normal, unaffected segments. The symptoms may be minor or acute, and they depend on the location of inflammation and the severity of the condition. The most common symptoms that patients mention include abdominal pain, diarrhea with visible blood, loss of appetite, ulceration of the oral cavity, nausea, vomiting and dysphagia. Approximately 40% of the patients are also diagnosed with fever during the relapse of the disease. CD often leads to weight loss which results both from the symptoms and the restriction of nutrient absorption.[3] The disease has periods of remission and recurrence.

Ulcerative colitis (UC)

The inflammation occurs in the large intestine and/or the rectum. What makes it different from CD is that only the intestinal mucosa structure is affected. The most common symptoms are abdominal pain, a sensation of urgent need to defecate and diarrhea with blood and mucus (which discriminates UC from irritable bowel syndrome). Similarly to CD, there can occur such symptoms as weight loss, fever and loss of appetite. The disease has periods of remission and recurrence.

Complications

In both CD and UC, there may be complications. The most common are osteopenia, osteoporosis, arthropathy, liver and bile ducts diseases, nephrolithiasis, eye and skin diseases and growth retardation in children.[3]

IBD Causes

Currently, a few factors influencing the occurrence of UC and CD can be distinguished.

Genetic factors

There are many genes which influence the body's immunological responses such as the intestinal barrier, the body's ability to fight against pathogens or the effects of oxidative stress.

First-degree relatives with positive family history of CD are more likely to develop the illness. In 2001, the NOD2 gene located on chromosome 16 was identified. It can be found in three polymorphisms and it has been associated with CD. NOD2 encodes a receptor for peptidoglycan which is found in bacterial cell walls. It is more common among patients of European origin rather than those of Asian or Afro-American descent. NOD2 polymorphism alone is not enough to trigger CD. Therefore, other factors are believed to be highly influential.[4] Genes ATG16L1 and IRGM also play crucial role. They are linked directly to autophagy, i.e. the removal of micro-organisms and dead cellular components. Approximately 160 genetic loci have been associated with susceptibility to IBD.[5,6]

Disturbed intestinal microflora

Microorganisms that live in the intestines constitute a complex ecosystem. More than one thousand species of bacteria living in the gastrointestinal tract have been identified. The environment they inhabit changes dynamically. Normal microflora helps the digestive process, synthesis of some vitamins and supports the development and functioning of the immune system. Composition of gut microflora develops throughout life. It can be influenced by environmental factors, dietary habits and lifestyle. Intestinal dysbiosis, i.e. a condition when the beneficial bacteria in the GI tract are outnumbered by the pathogenic ones, can also influence the development of IBD.[7,8] The main role is attributed to *Proteobacteria*, precisely to *Escherichia coli* (AIEC). It is more often found in patients suffering from CD than in healthy parts of the population. Some researchers suggest that AIEC plays an important role especially in the development of UC.[9] It has been shown that the number of *Clostridium leptum* and *Clostridium coccoides* is lower in patients with IBD. Both of them contribute to the production of butyrate which is the main source of energy for colon cells. Butyrate also inhibits the production of proinflammatory cytokines.[8,10]

Environmental factors

Chronic stress, trauma in the early life and depression have an impact on the condition of the immune system. Acute stress is one of the factors that may contribute to the relapse of IBD or intensification of the symptoms in its active form. Low mood and strong emotional tension are most often related to every-day school or work responsibilities or financial problems. Stress-related recurrence of the disease depends on individual characteristics of a patient, their experience and stress coping strategies. [11] A change in the intestinal microflora appears when a body reacts to strong, chronic stressors. It becomes less favorable. An increase in IL-6 concentration is also noted. [3,12]

Both in prevention and during various periods of IBD, it is important to stay physically active and maintain proper length and quality of sleep. Introducing low-intensity exercises reduces the symptoms of depression and improves the quality of life. It also lowers the disease activity.[13,14] Ineffective sleep hinders the efficiency of immune system. Both prolonged sleep (more than 9 hours) as well as shortened sleep (less than 6 hours) increases the risk of UC recurrence.[15] Patients with an active form of the disease often experience sleep disorders which might lower their mood and quality of life. [12]

Environmental factors also include a poor nutrition. Inadequate diet influences the change of intestinal microflora which in turn contributes to the recurrence or incidence of UC and CD. An infant's GI tract is colonized by bacteria beginning from the very first days after birth. For

this reason, it is worthwhile to breastfeed as it enhances the baby's immune system. The most important components of human milk include immunoglobulin A, growth factors and large number of oligosaccharides which contribute to the concentration of lactic acid bacteria in the intestines. However, it is just as important to select proper food later in life. It has been shown that the Western diet, which is rich in saturated fatty acids and trans fatty acids, and contains many high energy and processed foods, with little amount of vegetables and fruit, may influence the development and exacerbation of IBD. It has been proven that high dietary intake of myristic acid, which is one of the saturated fatty acids, may contribute to the occurrence and exacerbation of UC. Above all, it can be found in palm and coconut oil. Further study is essential to show its influence on IBD. [16-18] The dietary ratio of (n-6) to (n-3) polyunsaturated fatty acids is also crucial. High n-6 and low n-3 dietary intake may increase the risk of UC and CD. N-6 fatty acids demonstrate proinflammatory activity. The predominant *n*-6 fatty acid is arachidonic acid. It undergoes a lot of changes caused by COX-2 which lead to the development of prostaglandins (PGD2) in the mast cells and the initiation of inflammation. [19] Food additives also influence the exacerbation of IBD. Researchers point out that some of them may change the intestinal microflora and thus lead to inflammatory response. [20] However, it is essential to conduct some more research on the matter. Yet another factor predisposing to the development of IBD is the low intake of dietary fiber. Its high consumption lowers the risk of CD incidence. Soluble fibre is frequently mentioned by the authors as its most important fraction. The main sources of soluble fiber are vegetables and fruit. It is beneficial to the body as it is food for gut bacteria. It also shortens gastrointestinal transit time which limits the incidence of diarrhea. Researchers pay attention specifically to the fruit which may significantly reduce the risk of IBD. [21]

Causes of vitamin and mineral deficiencies in IBD

The cause of macro- and microelement deficiencies in patients with CD and UC is a multifaceted issue. It can result from an inflammatory process, medications, surgeries or an unbalanced diet.

Dose adjustment in IBD depends on the activity of the disease and localization of inflammatory condition. Nonsteroidal anti-inflammatory drugs are most commonly used, e.g. sulfasalazine and mesalazine. Other drug classes are corticosteroids and immunosuppressive drugs including cyclosporine and methotrexate. Folic acid deficiency is often observed after drugs administration, especially after methotrexate and sulphonamides which are the acid's antagonists.[22] Medications may also inhibit calcium absorption and contribute to the development of hemolytic anemia.

Some cases require surgical intervention. Depending on the clinical situation of a patient, surgical treatment can be emergency, urgent or elective.[23] Malabsorption syndrome can be caused, among others, by partial bowel resection in patients with complicated disease as it influences malnutrition as well as vitamin and mineral deficiencies.

Another cause of deficits is inadequate nutrition. Patients exclude whole food groups from their diet for fear of causing the relapse of the disease. Most often, it is a matter of ignorance in the subject of nutrition in IBD. Such behavior may come from the fact that many people gather information from social media where they can exchange remarks concerning their condition. [24,25] Most often, knowledge acquired in this way, i.e. from other patients or from the Internet, is not verified in terms of reliability. Such restriction in food may lead to serious vitamin and mineral deficiencies. [26]

The most important vitamins and minerals in IBD

Vitamin D and calcium

The basic function of vitamin D is to maintain adequate calcium and phosphate homeostasis. It promotes calcium and phosphate absorption in the gut. The most active form of vitamin D is D - 1,25 (OX)2D3. It influences calcium absorption the most. Vitamin D stimulates the immune system. Intracellular vitamin D receptor binds to 1,25 (OH)2D3 and supports monocyte division. Moreover, it lowers the risk of autoimmunization. Calcium, on the other hand, is indispensable to maintain bone and teeth health. It controls many enzymes, and it takes part in nerve conduction and normal muscle contraction. Vitamin D mediates the maintenance of acid-base balance.

Vitamin D deficiency may be one of the environmental factors predisposing to autoimmune diseases. Recent studies prove that this deficit leads to higher incidence of IBD and aggravation of its symptoms. More importantly, the deficiency is also present in CD patients even in the periods of remission and irrespective of the disease localization. According to this, proper dose of vitamin D may lower the frequency of incidence of these diseases.[27] Insufficient vitamin D reduces calcium absorption which in turn contributes to decreased bone mineral density and more frequent fractures.[27,28] Patients with IBD are more at risk of developing osteoporosis than the overall population which may have several causes. One of the most significant factors is the disease activity, especially its severity and duration. The next factor concerns the medications. Treatment used in IBD may negatively influence the regrowth of bone tissue. Finally, calcium and vitamin D deficiency is most often mentioned by the researchers as the contributing factor. [29,30]

Both in support therapy and prevention of osteoporosis in inflammatory bowel disease, it is crucial to provide proper amounts of these nutrients in diet. Vitamin D can be found, above all, in fatty fish and eggs. Many researches imply that its supplementation is advisable in IBD. It is especially important in patients who take steroids. Diets rich in vitamin D prevents bone mass loss in IBD.[31] Much of it is synthesized in the skin under the influence of sunlight rays. It is worth mentioning that there is no medical history of vitamin D toxicity when it is obtained from sun exposure. The skin is incapable of producing excessive amounts of it which would lead to hypervitaminosis D. [32] However, it is advisable not to expose the skin to solar radiation for too long. It might lead to sunburns which can initiate skin cancer.[33]

It is worth to enrich the diet in calcium which can be found mainly in dairy products such as kefir, cottage cheese, natural yoghurt, and also leaf vegetables and eggs. Milk is not suggested to patients with IBD because of its high lactose concentration. Patients often exclude dairy products from their diet for fear of emergence of the disease symptoms. It is lactose that may be the cause of flatulence and diarrhea after eating dairy products. Despite a number of lactose free products available on the market, people choose not to consume them as they are afraid to experience these ailments.

Vitamin D levels should be monitored in patients with IBD. In case of deficiency, supplements should be introduced.

Vitamin C

Ascorbic acid influences the body in a variety of ways. It is an immunomodulatory compound present in leukocytes. This is one of the reasons why its amount drastically decreases during an infection and demand for it increases. Vitamin C is a strong antioxidant. It neutralizes reactive oxygen species through the process of hydrogenation. Ascorbic acid causes an influx of neutrophils into the localization of infection and thus enhances the antibacterial response.[34] Moreover, it plays important role in carbohydrate metabolism, melanin synthesis and the improvement of the capillary endothelial barrier.

Levels of vitamin C are lower in people with IBD, both in its active form and in the periods of remission. [35] It may influence the reaction of immune system during infection.

Patients resign from fruit and vegetables out of fear of emergence of the IBD symptoms. This may lead to ascorbic acid deficiency which causes scurvy. Although it is rare nowadays, strict diet without vitamin C supplements increases the risk of developing this condition. It is most often observed in children, elderly people and those suffering from malabsorption syndrome. It is not easy to diagnose scurvy in its early stage. If not treated, the disease may have serious consequences, such as heart failure. Supplements are available to restore optimal vitamin C levels quickly.[36]

It is advisable to introduce parsley, berries (without the seeds), potatoes and citrus fruit in the diet of IBD patients as they are good sources of vitamin C. It is worth noticing that vitamin C is unstable. Its amount can be decreased by such factors as oxidation process, high temperature and a basic pH environment. Fruit and vegetables should be stored properly not to decrease vitamin C levels.

Vitamin B12 and folic acid

Vitamin B12 (also called cobalamin) and folic acid are indispensable to form blood morphotic elements such as erythrocytes and leukocytes. Cobalamin takes part in fatty acid and carbohydrate metabolism, whereas folic acid is involved in amino acid metabolism. Their deficits may lead to hematopoiesis disorders – megaloblastic anemia. These deficiencies may also cause alterations in the intestinal mucosa structure and nervous system disorders.

Insufficient concentration of cobalamin is one of the most often diagnosed deficits in IBD. Vitamin B12 is absorbed along small intestine which is one of the reasons why its deficiency is more common in patients with CD than those with UC. Patients after ileum resection are especially prone to it. Additionally, lower concentrations of vitamin B12 and folic acid are related to the active form of the disease when compared to the patients in remission.[44,45] Folic acid deficiency is observed in patients treated with sulfasalazine.[46,47] Researchers indicate that this deficit is more often diagnosed than vitamin B12 deficiency.[48,35] Furthermore, folate insufficiency may increase the risk of colorectal cancer in patients with IBD.[49,50] Researchers suggest screening for vitamin B12 and folate deficiency. Healthy nutrition should aid treatment of the deficits. The best source of cobalamin recommended for patients with IBD is meat (rabbit, lean beef, veal), fish, poultry and chicken egg yolk. Folate-rich foods are, above all, green leafy vegetables such as lettuce, parsley, and also citrus fruit, meat, kefir and whole grain cereal products. About 50% of folate present in food is bioavailable. Folic acid is sensitive to high temperature and sunlight.

Iron

The main role of iron concerns oxygen transport. It is indispensable for oxidase formation which regulates cellular respiration processes, and for catalase activity in erythrocytes, leukocytes and liver. Iron is absorbed in duodenum and the initial part of the small intestine. For this reason, its deficits may significantly worsen in patients with CD after the resection of those parts of the GI tract. The main iron deficiency symptoms are pallor

of skin, fatigue, impaired concentration and weakened immune system. The mineral possesses immunomodulatory properties which is highly important for patients with IBD. It reduces the risk of infection because of its antibacterial activity. It also influences lymphocyte proliferation. [34,37] IBD patients are often diagnosed with microcytic anemia. [38] The deficit may result from prolonged bleeding, malabsorption syndrome and unhealthy dietary choices.[39] The accompanying anemia may negatively affect the patients' quality of life and their job. [40]

Patients often exclude red meat from their diet. It may result from previous experiences and symptoms caused by it as well as from other patients advice. [25] Researchers often point out that such dietary modifications (exclusion of heme iron) are usually not consulted with any doctors or dieticians.[41] It is worth while to follow an iron-rich diet in order to support oral or intravenous supplementation. A well-balanced meal may enhance iron absorption. It has been proven that drinking orange juice after the meal facilitates this process, whereas tea or coffee can inhibit it.[42] Iron absorption may be reduced, among others, by phytic acids and phosphates. On the other hand, vitamin C and amino acids, such as histidine and lysine, enhance its intake. Many products eaten on a daily basis contain nonheme iron (from plant products) which show better resorption than heme iron (from animal products). In order to enhance iron absorption it is advisable to combine food products such as meat, fish, poultry and yolk together with ascorbic-acid-rich foods. [43] It can be found in parsley, berries (without the seeds), kale and citrus fruit.

Zinc

Zinc is an essential mineral that plays a great role in the immune function of the body. It strengthens the monocyte endothelial adhesion which facilitates the immune system. Zinc also influences the NK cells function and phagocytic activity of macrophages. It affects the biological membrane stability which may limit infections and reduce the risk of IBD recurrence. Serum zinc levels decrease during infection which suggests its direct influence on the immune system.[8,11] Many enzymes which participate in protein synthesis, contain this mineral. Its deficiency weakens the immune system and may cause skin lesions, appetite impairment and growth retardation in children. In order to modulate the immune system, zinc dosage should be adjusted individually, depending on its current blood serum levels. The levels should be regulated, although it is important not to excess the recommended daily amount as it may negatively influence the lymphocyte activity.[37] It is crucial in IBD since it affects the immune efficiency. Because of the increased requirement of zinc in UC and CD, its levels may be lower, especially in the active forms of the diseases. The main sources of zinc include vegetables and fruit, although its accumulation depends on the amounts of this mineral in the soil. It can also be found in wholemeal bread, buckwheat groats, meat and dairy products. Animal protein enhances dietary zinc absorption.[12,37]

Selenium

Selenium functions as an immunomodulator. It has strong antioxidant properties as it is a component of glutathione peroxidase which neutralizes hydrogen peroxide. Selenium influences proper immune response to infection. It supports macrophage function and augments NK cells and T-lymphocytes functions. [34,37] It also takes part in systemic protein synthesis.

Selenium deficiency weakens the immune system and leads to impaired cell regeneration. It can also speed up the aging process and increase the risk of poorer mood which may result in depression.

Selenium can be found in grains and cereal products, nuts (especially Brazil nuts), fish and dairy products. Unfortunately, the human body absorbs only half of selenium from food. Its bioavailability is increased by methionine, ascorbic acid and vitamin E.[34,37]

Recommendations for vitamin, macro and microelement supplementation

According to the latest guidelines and recommendations of *European Crohn's and Colitis Organization (ECCO)*, patients with inflammatory bowel disease should supplement 500-1000 mg a day of calcium and 800-1000 IU of vitamin D if the T-score in the densitometry examination is -1.5. It increases the bone density in IBD patients, although further studies are needed to confirm that it reduces frequency of fractures. Irrespective of the densitometry examination results, *ECCO* recommends calcium and vitamin D supplementation in patients treated with corticosteroids and postmenopausal women.[51,52] On the other hand, in its guidelines from 2010, the *American College of Gastroenterology* recommends that the patients who take corticosteroids for longer than three months should supplement 800 IU of vitamin D and 1000-1500 mg of calcium a day.[53]

ECCO guidelines from 2015 indicate two recommended ways of iron administration in case of severe anemia. Intravenous iron administration is advised as both effective and well-tolerated by the patients. Depending on the preparation used, the Organization recommends: 20 mg/kg body weight of intravenous ferric carboxymaltose infusion lasting 15 minutes (maximum dose 500-1000 mg), 7mg/kg body weight of ferrous sulfate (maximum dose 200-300 mg).

In case of mild anemia (defined by the *World Health Organization - WHO* as a hemoglobin level 11.0-11.9 g/dL in women and 11.0-12.9 g/dL in men) and if patients

tolerate the preparation well, iron can be administered orally. Then, the maximum dose is up to 1000 mg per 24 hours.[54]

ECCO recommends regular tests of cobalamin and folic acid levels (more often than once a year) as their deficits also occur frequently. In case of deficiencies, it suggests supplementation according to the generally applicable standards.

Conclusions

Vitamins and minerals constitute important nutrients. Balanced diet may reduce the risk of IBD and its recurrence. Proper nutrition has a positive impact on a patient's quality of life. Dietary information should be scientifically proven and reliable. It is worth to check the levels of vitamins and minerals, especially knowing the most common deficiencies. It is also recommended to include in the diet products containing calcium, vitamin D, cobalamin, iron and folic acid. Many researches also mention zinc, selenium, magnesium, vitamins K and A, and the B-group vitamins deficiencies.[46] For this reason, diet should be varied, balanced and personalized.

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REVIEW PAPER

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Non-specific low back pain – what does it exactly mean? A proposed redefinition and classification of the problem

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ABSTRACT

Introduction. Analysis of the medical literature shows that non-specific low back pain is a multifaceted affliction. Determining the unequivocal definition and classification of the ailment could be somewhat difficult. The following review presents a multiplicity of common low back pain nuances. The paper also shows necessity of unification of the definition and clarification, for placing non-specific low back pain among other musculoskeletal disorders.

Aim. The author will attempt to provide the answers to basic questions about non-specific low back pain. In its form, the paper will have similarities to the prospect study with narrative review features. Although the reader should remember that the article is neither a result of expert team efforts nor non-specific low back pain leading authority opinion. Therefore the suggestions should be interpreted with necessary distance and scientific scepticism.

Material and methods. Proper publications were searched in PubMed and EBSCO scientific articles databases, using terms: 'non-specific low back pain' or 'non-specific low back pain', 'definition', 'diagnostic triage', and 'classification' in different combinations.

Results. As a result of the review, subtle correction of the current non-specific low back pain definition has been proposed.

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Keywords. low back pain, classification, triage, syndrome

Introduction

It is estimated that lifetime prevalence of low back pain (LBP) will occur in more than 80% of the general population.[1,2] Despite the widespread presence of the problem, making a precise diagnosis and indicating adequate treatment is not possible in the vast majority of LBP cases. Spinal complaints with unclear genesis are described as 'non-specific' (n-s) but it should be stated that they form a heterogenic group of disorders, containing patients with different symptoms and responding to therapy in different ways.[3] Effort was taken in this article to clarify the exact meaning of 'non-specific low back

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Participation of co-authors: A – Author of the concept and objectives of paper; B – collection of data; C – implementation of research; D – elaborate, analysis and interpretation of data; E – statistical analysis; F – preparation of a manuscript; G – working out the literature; H – obtaining funds

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pain'. Differentiation of n-sLBP complaints was also described. Moreover, classification was proposed, allowing the elimination of existing inaccuracies in nomenclature and diagnosis.

Aim

The author's intention of this review was to raise *ab ovo* simple questions about common low back pain. Despite existing broad explanations of n-sLBP issue, the most common definition seems to be incomplete. The ancillary purpose of the study was an attempt to specify classification of low back problems based on previously described and accepted propositions.

Description of the subject literature

Due to the chosen form of narrative review, the article does not describe the study's methodology. It neither lacks the fundamentals of scientific research. Appropriate papers were searched in PubMed and EBSCO databases, using appellations: 'nonspecific low back pain' or 'non-specific low back pain', 'definition', 'diagnostic triage', and 'classification' in different combinations. Approving appropriate articles to next phases of the research analysis was achieved by the author's subjective evaluation, taking into account the title, abstract content, date of publication, and profile of the journal, and researcher names. Around sixty articles were analyzed, 75% of which were published after 2000.

Analysis of the literature

Studying historical descriptions of the concept of ordinary low back pain provides a significant body of research and evidence, profiling this particular ailment. A current prevailing tendency to correlate spinal complaints with its 'degeneration' changes probably may have emerged from imaging developments, leading one respected scientist of the early nineteenth century to conclude: 'Intervertebral disc lesions are the most common cause of back pain'.[4] In many countries, taking X-ray, computed tomography, and sometimes magnetic resonance of the spine is actually accepted diagnostic procedure used by specialists for establishing back pain causes. Depending on exacerbation of symptoms, period of disability, and result of medical imaging, the decision about type of treatment is taken (e.g. conservative treatment, surgery, pharmacotherapy, physiotherapy or other way to decrease pain).

Unfortunately, spinal imaging in cases of non-specific complaints, often doesn't explain the underlying mechanism of pain, as shown in research on asymptomatic groups.[5] In the third decade of life 37% of people without symptoms have 'degeneration' changes in their intervertebral discs, and the percentage increases systematically, acquired 80% among people in their fifties, and 96% in 80 year old subjects.[6] This could be regarded as a false positive result of imaging. A current observation confirms the low value of imaging examination for diagnosis, prognosis, and differentiation for non-specific problems of the spine.[5,7,8] Moreover, overuse of imaging is expensive and increases the risk of iatrogenic complications.[9-11] Likewise, an alarming phenomenon is the cascade effect, which within the context of healthcare could be defined as series of events initiated by unnecessary imaging, its unexpected result, and patient or specialist apprehension. The first incident triggers further inadvisable investigations or incorrect treatment with consequences such as increased morbidity and escalated adverse actions.[12] With reference to low back pain, the cascade effect in cases of unfounded magnetic resonance scanning is also associated with long-term economic consequences. Management for patients without imaging allows significantly decreased cost of healthcare in the following twelve months since pain began.[13]

Definition

The formulation 'low back pain' has capacious semantics and refers to indisposition with various aetiology and duration. However, it is not a disease or precise diagnosis. It is rather a symptom or group of symptoms around specific anatomical location.[14] In contrast to the exact disease, aetiology of n-sLBP is unclear but it doesn't mean the complaint has no cause. Signs could be similar in different patients and could react to treatment in an anticipated manner. Therefore, according to medical paradigm, back pain is a syndrome and should be considered as a syndrome, corresponding to some authors.[15,16]

If pain sensations are below the twelfth ribs and above the gluteal folds, low back pain should be considered. Feelings could also radiate along the lower limb.

Due to pain duration low back problems could be subdivided to:

- acute low back pain, lasting less than 6 weeks
- subacute, between 6 and 12 weeks
- chronic, lasting above 3 months.[17]

In cases of recurrent complaints following episodes are separated by at least a six month period without symptoms. Recurrent LBP doesn't include exacerbations of chronic LBP.[18]

Criterion of a pain duration is not an only in reference to spinal problems. Relevant determinants for back pain definition could be also:

- time frame (e. g. last 4 weeks)
- site of low back pain
- radiation to the limb
- inclusion criteria – e. g. exclusion pain related to severe infection or menstruation
- the frequency of symptoms (e. g. every day, sometimes)

– the severity of low back pain (using pain rating scales).[19]

Only some of all low back pain cases have an accurate explanation. They are named 'specific low back pain', which is distinguished from non-specific complaints through diagnostic triage (fr. 'triage' means 'to segregate', 'to sort') proposed by Gordon Waddell.[20] In accordance with triage, there are three groups of patients with low back pain, in which the first two are specific:

1. Patients with radicular syndrome (often due to disc herniation or stenosis of intervertebral foramens) – about 5% of those with low back pain
2. Patients with serious spinal pathology (so called 'red flags', for example fractures of vertebrae, spinal tumours or infections, or cauda equina syndrome) – around 1-2% of suffering from low back pain
3. Patients with n-sLBP – around 85-95% of all low back pain cases.[21]

In professional literature non-specific LBP is defined as pain of the lower back, which is not attributable to a recognisable and known specific pathology (i.e. infection, tumour, osteoporosis, Bechterew disease, fracture, structural deformity, inflammatory disorder, radicular syndrome or cauda equina syndrome).[22-25] This explanation is tautological and creates a vicious circle in defining.[26] It also fails to include other negative sensations beyond pain as tension, rigidity or stiffness for instance. Wherefore, as the following explanation may be more suitable:

Non-specific low back pain comprises every unpleasant sensations occurring between the twelfth ribs and the gluteal folds, with radiation to the limb or without, not attributable to any precise pathoanatomical diagnosis.

They are described also as a 'common' or 'simple' low back pain contrary to less common specific problems of the spine.[23]

It is difficult to overappreciate the homogeneous definition for low back pain in context of statistical analysis and epidemiological research. The accurate, unequivocal and universal elucidation is required to avoid widespread incongruence of epidemiological research on LBP. Collecting epidemiological information about LBP is worth using existing scientific literature suggestions for the standardisation of back pain denotation, which allows further comparison and juxtapositions of prevalence or incidence. Valuable commentary in this subject could be the report from Canadian and British researchers. They presented a heuristic proposal of low back pain definition in two versions: minimal and optimal to help in data collection and comparison.[27]

Towards current medical knowledge there is no certainty about precise sources of discomfort in case of non-specific low back problems.[21,22,28] Miscellaneous possibilities of symptom roots are considered. Complaints may originate from various structures which has sensory innervation for example:

– intervertebral disc (accurately external layers of annulus fibrosus)[29,30]
– spinal ligaments[31,32]
– zygapophyseal joints[33-35]
– back muscles[36]
– sacroiliac junctions[37]
– dura mater of spinal cord.[38,39]

Referred pain as a consequence of internal organ diseases or abnormalities of other tissues having neural supply from lumbar and sacral segments of the spine should also be taken into account.[22,40-42] Other interesting explanation for spinal disorders could include psychosocial conditions, and back pain as a result of modulation in function of the central nervous system.[43,44]

Differentiation

International guidelines for low back pain agree that diagnostic triage is a useful tool in clinical practice.[1,14,45,46] Exclusion of serious spinal pathologies as the first stage of patient segregation, and subsequent examination for the radicular syndrome, enable for appropriate categorization of individuals, complementing the particular disorder definition. However, diagnostic triage has also some disadvantages. So called 'red flags' are used for exclusion of patients with significant pathologies. They are signs and symptoms suggestive of serious spinal pathology.[47,48] Henschke and Maher suggested a combination of 25 alarm manifestations corresponding to dangerous maladies. The same authors note that more than 80% of primary care patients with acute low back pain show at least one symptom detailed in Table 1, although the real proportion of patients with serious changes in their spine was less than 1%.[49] Despite such an overestimation of dangerous spinal diseases, using a complete 'red flags' check list in clinical practice may minimise the probability of a significant pathology omission.[50]

The second group of low back pain patients may represent those with radicular symptoms which are also specific complaints, similar to serious spinal disorders. This group includes radiculopathy cases, radicular pain patients and individuals with real spinal stenosis, collectively named by the term of radicular syndrome. The problems usually arises from an intervertebral disc herniation, facet joint cyst, osteophytes, spondylolisthesis or spinal canal stenosis (acquired or as an effect of degeneration disease of the spine).[51,52] Radicular pain commonly coexists with radiculopathy symptoms.[53] Confusion could make the 'sciatica' diagnosis very popular among specialists, despite the small prevalence of this problem. Furthermore, 'sciatica' is a misleading description as it refers to the signs uncorrelated with sciatic

Table 1. So called 'red flags' corresponding to serious spinal pathologies[49]

Pathology	Red flags
Cancer	– Age at onset less than 20 or over 55 years – Unexplained weight loss (of more than 10 pounds [4.5 kg] in 6 months) – Previous history of cancer – Tried bed rest, but no relief – Insidious onset – Systemically unwell – Constant, progressive, non-mechanical pain – Sensory level (Altered sensation from trunk down)
Infection	– Systemically unwell – Constant, progressive, non-mechanical pain – Recent bacterial infection, e.g. urinary tract or skin infection – Intravenous drug abuse – Immune suppression from steroids, transplant or HIV – Sensory level (Altered sensation from trunk down)
Spinal fracture	– Age over 70 years – Significant trauma (major in young, minor in elderly) – Prolonged use of corticosteroids – Sensory level (Altered sensation from trunk down)
Inflammatory disorder	– Gradual onset before age 40 – Tried bed rest, but no relief – Insidious onset – Systemically unwell – Constant, progressive, non-mechanical pain – Morning back stiffness, 0.5 hours or more – Peripheral joint involvement – Persisting limitation of spinal movements in all directions – Iritis, skin rashes (psoriasis), colitis, urethral discharge – Family history of arthritis or osteoporosis – Pain improves with exercise
Cauda equina syndrome	– Acute onset of urinary retention or overflow incontinence – Loss of anal sphincter tone or faecal incontinence – Saddle anaesthesia about the anus, perineum or genitals) – Widespread (greater than 1 nerve root) or progressive motor weakness in the legs or gait disturbances
Other	– Sensory level (Altered sensation from trunk down)

nerve abnormalities. This may be the common presence of referred pain related to the spine but in most cases it is not a neurogenic radiation, only complaints known as the somatic referred pain.[54,55] The term of 'sciatica' may also well illustrate a patients' signs, which in ligamento-capsular irritation may generate pain sensations radiating even to the foot as far.[56] It should be noted that in some pathoanatomical conditions (e.g. tumour growth), exacerbation of radicular syndrome symptoms may occur.[57] There are a number of signs that may suggest the presence of the radicular syndrome.[58-61] They are listed in table 2.

After excluding specific spinal disorders, there still remains the largest group of non-specific low back pain. No test or examination is known to confirm or exclude non-specific complaints. Therefore, n-sLBP identification occurs by elimination of two previous and definitely fewer groups of spinal problems.

It should be mentioned that the described process is rarely an isolated proposition and other possibilities to confirm n-sLBP exist. Dr Hamilton Hall from Toronto University stated that 'red flags' exclusion doesn't have to be the first stage for categorizing back pain patients, because statistically serious pathologies are rare (about 1-2 cases in a hundred). Instead, patients may be qualified to one of four different pain pattern groups and treated in an adequate manner. In this approach, only when the therapy fails to improve symptoms, then serious pathologies are considered.[15,16]

Conclusion

In summary, n-sLBP concerns the majority of all the symptoms between the twelfth ribs and gluteal folds. According to low back pain characteristics, it seems appropriate to classify the disease as a syndrome, i.e. a set of symptoms with no clear source but occurring as a similar manifestation in different patients, and responding to the treatment in an anticipated and repeated manner.

Multi-structural probabilities for low back pain origins, determine a pronounced disproportion between specific and non-specific patients numbers. Accurate

Table 2. The most common symptoms of the radicular syndrome[58-61]

Symptom/Sign	Radicular pain	Radiculopathy	Stenosis
Leg pain worse than back pain	+		
Sharp, lancinating or deep ache	+		
Pain increasing with cough, sneeze or strain	+		
Dermatomal pain concentration (below knee for L4, L5, S1)	+		
Unilateral leg pain location	+		
Positive provocative tests for dural irritation: PKB (L2-L4), SLR and/or CSLR (L4-S2)	+		
Positive Kemp sign	+		
Numbness or paraesthesia (especially in distal dermatome)		+	
Myotomal weakness or loss of function (e.g. footdrop)		+	
Neurogenic claudication relieved by flexion			+
Older patient, bilateral leg pain or cramping with or without LBP			+
Bilateral leg pain exacerbated by extended posture (e.g. standing) and relieved by flexion (e.g. sitting)			+
Wide based gait			+
Antalgic postures (e.g. stooped standing and walking)			+

PKB – prone knee bend, SLR – straight leg raise, CSLR – crossed straight leg raise

categorisation of patients may significantly reduce the costs of health care related to diagnostic imaging, which is contraindicated in non-specific complaints, and could be even deleterious.

The manner in naming spinal problems by practitioners requires revision due to its consequence for patients, especially for those hypochondriacs and those inclined to catastrophize. It's an ailing group who have an opportunity to recovery faster if not informed of their imaging reports and didn't hear a diagnosis such as 'sciatica' or 'critical stenosis'.

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