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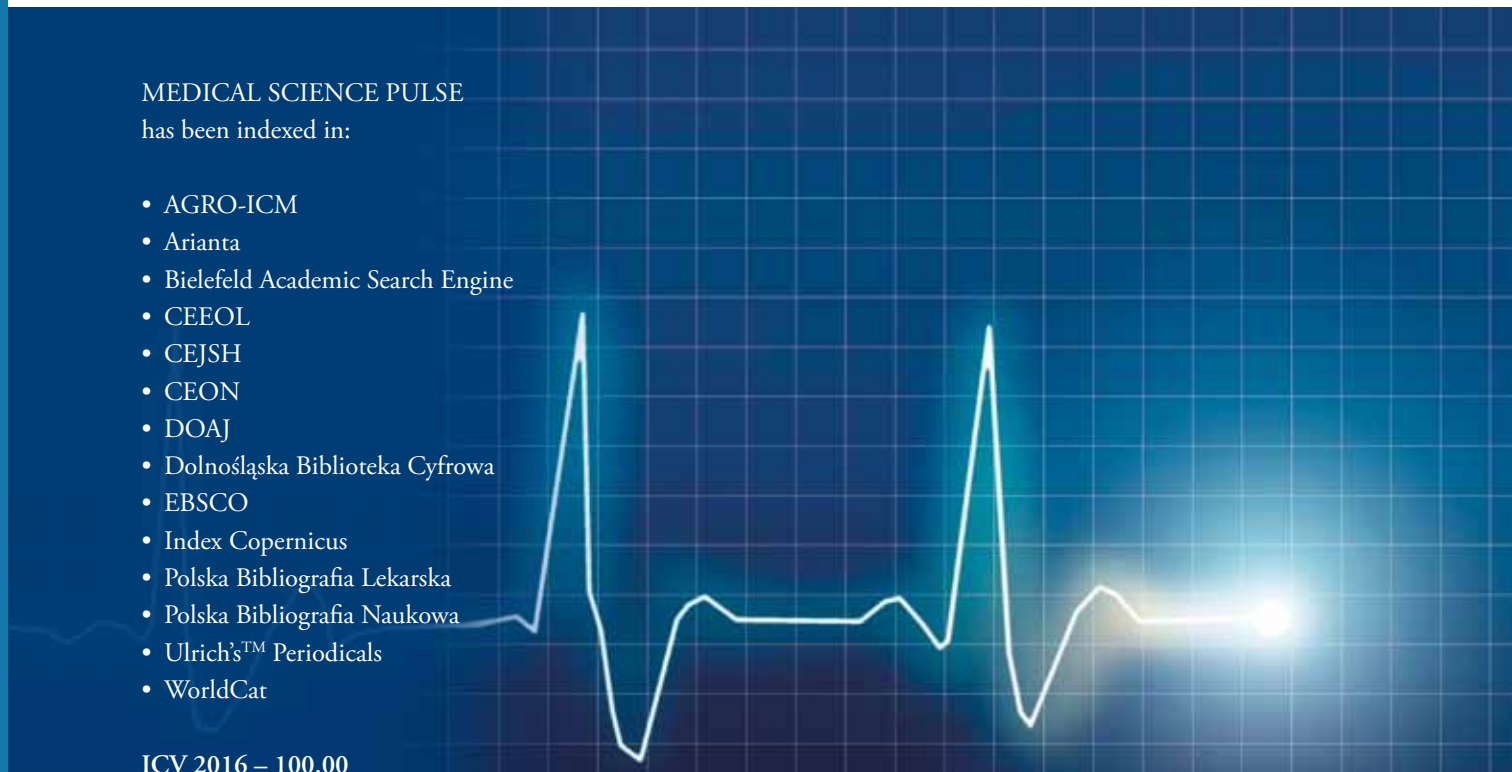

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Contact:
Deputy Chief Editor –
Bożena Ratajczak-Olszewska
Phone: (+48) 77 442 35 46
E-mail: ratajczakb@wsm.opole.pl

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45-360 Opole, ul. Plebiscytowa 82
E-mail: wydawnictwo@impreso.studio
Phone: (+48) 77 550 70 50

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Donata Kurpas MD, PhD, Assoc. Prof.
Editor-in-Chief

Andrei Shpakou MD, PhD
Deputy Editor

Bożena Ratajczak-Olszewska MSc
Deputy Editor

Ladies and Gentlemen, Faculty, Graduates and Students of Universities, Readers and Enthusiasts of *Medical Science Pulse*!

Medical Science Pulse quarterly will soon celebrate 7 years of scientific activity! The journal's mission is to continuously promote and publish research in the field of medical and health sciences. The journal's mission is in line with the current changes in higher education, emphasizing the growing demand for popularization, evaluation and impact of scientific achievements on the knowledge society and economy. Additionally, lecturers, students and graduates receive a new source of scientific medical information that meets the needs of teaching, learning, research and broadly understood professional practice.

To date, the journal has published over 200 scientific manuscripts by authors from almost 100 universities, research centres and health care institutions from Poland and abroad, including Belarus, Ukraine, Ireland, Spain, Great Britain, Slovakia, Hungary, Czech Republic, Russia, Greece, USA, India. 85% of the members of the Scientific Council are from foreign scientific centres, even as distant as China or Japan and 61% of reviewers are also from foreign institutions. All articles are published in English in the Open Access system under Creative Commons licenses. Our language editors, include an English native speaker (PhD in medical sciences) and a statistical editor with a degree in the field. The number of manuscripts submitted to the quarterly is steadily increasing. Communication with the authors and readers takes place through the professional website: medicalsciencepulse.com.

It should be noted that Medical Science Pulse is the only scientific journal in the field of medical sciences and health sciences in the region of Opole and the Opole Voivodeship. Important goals of the editorial office for 2019 include further planned acquisition of valuable scientific papers from renowned centres across Poland and worldwide, constant expansion of the composition of reviewers, increase in the journal's citation index by applying to subsequent indexation and bibliographic databases, increasing the availability of the quarterly's scientific content by maintaining a technologically advanced system for managing the editorial process and dissemination of content on the journal's website, as well as the professional promotion of the journal to the international scientific community. As of 2019, the Medical Science Pulse quarterly will be published only in an electronic version.

The editors of the journal will also continue the cyclical project of organizing international conferences under the patronage of Medical Science Pulse. After the great success of the 5th International MSP conference in May 2018, we warmly invite you to the 6th INTERNATIONAL MEDICAL SCIENCE PULSE CONFERENCE "INTEGRATION OF SCIENCE AND CARE: INNOVATION AND COMMERCIALIZATION" – 23 and 24 May 2019 to Opole Medical School. There will be internationally-recognised scientists from Greece, Russia, USA, Belarus, Great Britain, Bulgaria, lectures, scientific debate, a master class module for scientists to present their own research, specialized workshops. Detailed information can be found on the website: http://e-event24.pl/6th_MSP_Conference/

We would like to thank all the members of the editorial team, members of the Scientific Council, reviewers and authorities of the University for yet another year of successful and intensive scientific and publishing. We would also like to express our gratitude to the authors for their cooperation and willingness to share their scientific papers in the MSP and the readers for

their kind reception and the use our journal to acquire knowledge and promote it further.

With the end of the year we would like to thank all those involved in popularization of science. We wish all of you Merry Christmas 2018 and Happy New Year 2019!

We recommend that you take note of booklet 4 with original works on the following topics: study of oxidative stress in ovarian cancer, prevalence and knowledge of classical cardiovascular disease risk factors among patients with diabetes, assessment of the impact of Hold-Relax and Contract-Relax techniques on the compression pain threshold, evaluation of dietary patterns among men and women over 80 years of age, impact of classic massage on the pressure pain threshold and effects of cavitation peeling and diamond microdermabrasion on selected skin parameters. We encourage also to persue revies on pregnancy, childbirth and puerperium health problems in women after 35 year of age, the pathophysiology of vasovagal syncope, management of the healthcare system in Germany and France and pyoderma gangrenosum – an interdisciplinary approach to the disease.

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STUDY OF OXIDATIVE STRESS IN OVARIAN CANCER

Bhivapure V. Rashmi[1 B]
• ORCID: 0000-0002-6245-8856
Tayade B. Mukund[2 D]
• ORCID: 0000-0002-1844-2339
Dalvi M. Shubhangi[1 A]
• ORCID: 0000-0001-7473-9180
Yeram Neelam[1 C,F]
• ORCID: 0000-0002-5527-1647
Patil W. Vinayak[1 E]
• ORCID: 0000-0001-9774-2307

[1] Department of Biochemistry, Grant Government Medical College and Sir J.J. Group of Hospitals, Mumbai, India

[2] Department of surgery, Grant Government Medical College and Sir J.J. Group of Hospitals, Mumbai, India

A – study design, **B** – data collection, **C** – statistical analysis, **D** – interpretation of data, **E** – manuscript preparation, **F** – literature review, **G** – sourcing of funding

ABSTRACT

Background: Ovarian cancer is the fifth most common form of cancer in the world and is often asymptomatic in its early stages. Development of ovarian cancer-specific biomarkers for the early detection of disease could improve the current dismal survival rate. Evaluation of serum carbohydrate antigen 125 (CA125), alkaline phosphatase (ALP) and oxidative stress in ovarian carcinoma patients may improve the prognosis of the disease through earlier detection.

Aim of the study: The aim of this study was to find the relative risk of ovarian cancer in patients screened for CA125, ALP, Nitric oxide (NO) and Malondialdehyde (MDA) as a marker for lipid peroxidation.

Material and methods: 451 subjects with ovarian cancer were screened for serum CA125 levels using a chemiluminescence analyser, out of which 164 showed values above 21 U/ml. 80 subjects with higher values were further analysed for MDA and NO using spectrophotometry and ALP by fully automated chemistry analyser.

Results: The selected 80 subjects with CA125 values above 74 U/ml had increased ALP, NO and MDA, also showing positive correlation amongst these parameters.

Conclusions: Benefits of CA125 screening vary with age group according to blood CA125 levels. Enzyme ALP levels are elevated with higher values of CA125. MDA and NO indicate oxidative stress and increase as the ovarian marker values increase. Positive correlation amongst the parameters indicates a significant increase in oxidative stress in ovarian cancer. For women with various CA125 levels in different age groups, screening and treatment depends upon individual decision and clinical examination.

KEYWORDS: ovarian cancer, CA125, MDA, NO, ALP

Background

Ovarian cancer accounts for 16% of cancers in females and is the 5th most common form of cancer in the world [1]. Most of these cancers are epithelial in origin [2]. Unfortunately, the majority remain clinically undetected until the late stage and only 25% are detected during stage I, while 75% of women ultimately die of complications associated with disease progression. At present, screening methods include transvaginal ultrasound, smear studies, serum markers and or a combination of these [3]. Ca 125, ALP, MDA, and NO can be used in screening for early malignancy, diagnosis, determining prognosis, monitoring response to therapy, and postoperative surveillance. There is a great need for the development of ovarian cancer-specific biomarkers for early detection of disease [4].

The most widely used marker in ovarian cancer is carbohydrate antigen 125 (CA125), which is elevated in approximately 90% of patients with advanced epithelial ovarian cancer. Serum tumour makers have been used in clinical management for diverse cancers [5,6].

Oxidative stress has been described as a critical factor in tumour development; it is caused by a disturbed balance between production of reactive oxygen species (ROS) and antioxidant defence. ROS are involved in many physiological processes through the promo-

tion of genetic instability, abnormal cell proliferation, and angiogenesis [1,7]. Potential biological targets for free radical attack are lipids, proteins and nucleic acids. Lipid peroxidation causes loss of cell homeostasis by modifying the structure and limiting the usual functions of the cell membrane. Oxidative stress on the cells increases as polyunsaturated fatty acids are degraded to generate MDA, which is a crucial component of the antioxidant system. It forms substantial DNA-Malondialdehyde (MDA) adducts by interacting with cellular DNA. The chance of cell survival diminishes as the integrity of the plasma membrane slowly falls, leading to apoptosis [1,8].

Cancer cells undergo metabolic reprogramming from oxidative phosphorylation to aerobic glycolysis during carcinogenesis. They rely primarily on aerobic glycolysis to sustain proliferation; this phenomenon is known as the "Warburg effect" [9].

Nitric oxide (NO) is a highly reactive free radical which is synthesized by nitric oxide synthase (NOS) in cells. NO functions as a signal transducer regulating multiple physiological and pathological processes. Bacterial endotoxins, inflammatory cytokines, hypoxia and oxidative stress result in high production of NO. NOS and NO have biphasic effects in carcinogenesis, tumour progression and therapy of tumours depending on the concentration and duration of NO exposure in the tumour microenvironment [9].

Alkaline phosphatase (ALP) is a ubiquitous enzyme present in all tissues but is mainly concentrated in the liver, kidney, placenta, and bone. In the musculoskeletal system, ALP plays a role in mineralization of newly formed bone and serum ALP is used to monitor primary bone lesions. In fact, elevated ALP has been reported in severe primary bone lesions, and the possible role of ALP as a tumour marker in ovarian cancer has been suggested [6,10].

The purpose of the present study was to screen ovarian carcinoma patients for CA-125, ALP and oxidative stress to improve the early diagnosis of disease.

Aim of the study

The purpose of the present study was to screen ovarian carcinoma patients for CA-125, ALP and oxidative stress to improve the early diagnosis of disease.

Material and methods

451 subjects were selected from a group of patients with ovarian cancer by simple random sampling and screened for serum CA125 levels from January 2014 to December 2016. The distribution variables were evaluated by a chi-square test. From the screened subjects, 80 cases and 80 controls were selected for the study and the t-test was applied. Blood samples from each subject were collected in plain vacutainers, centrifuged and serum samples were preserved at -80°C. Estimation of CA125 was done by chemiluminescent immunoassay (Chemiluminescent Immulite 1000), MDA and NO by spectrophotometer (V670JASCO) and ALP by fully automated chemistry analyser (ADVIA). Females from O.P.D. and I.P.D. of the Surgery and OBGY (Obstetrics and gynaecology) departments of Grant Government Medical College and Sir J. J. Group of Hospitals, Mumbai were included in the study. Ethical clearance approval was received from the institutional ethics committee and informed consent was obtained from patients prior to the study. Statistical evaluation was done using Minitab 17 software with the t-test using a 95% confidence interval. All the statistical tests were two-sided and $P < 0.05$ was considered statistically significant.

Results

The distribution of screened subjects showed a high incidence of individuals with CA125 levels above 21 U/ml. The screened subjects were grouped according to serum CA125 level and age (tab. 1, 2, 3). Out of the 451 screened subjects, 164 had higher values of CA125. Levels of oxidative stress markers and alkaline phosphatase were obtained in 80 subjects with CA-125 levels above 74 U/ml and 80 controls (tab. 4).

A positive correlation was established amongst CA125, ALP, MDA and NO, and this was significantly increased in the ovarian cancer patients as compared to control subjects. The t- test was applied and the means and standard deviation values of the variables show the data is consistent with the normal distribution (tab. 5 and fig. 1). This study shows that CA-125 and alkaline phosphatase may increase with metastasis.

Discussion

In India, 15% of all gynaecological cancers are ovarian malignancies [11]. CA125 measurement during follow-up can help to select the patients who may benefit from surgery and early therapy. We tested CA125 and ALP as biomarkers and MDA and NO as oxidative and nitrosative stress markers. These markers have potential to improve risk, early detection, diagnosis, prognosis, monitoring and therapy (tab. 1–4). CA125 represents an attractive therapeutic target and numerous groups have been developing approaches to it. For example, antibodies that bind unique or repeat domains of CA125, anti-idiotype antibodies, and anti-

Table 1. Age and CA-125 distribution.

No. of Females	Age (years)	CA125 (U/ml)
Total screened subjects (N = 451)	Median (Min–Max)	
	38 (17–77)	13.3 (0.2–500)
Subjects with high CA125 values (N = 164)	Mean±SD	
	40.29±13.60	157.18±173.85
	Median (Min-Max)	
	39 (17–75)	72.75 (20.4–500)

Table 2. Age Wise Distribution of total screened subjects.

Age Groups (years)	**< 20**	**21–30**	**31–40**	**41–50**	**51–60**	**>60**
No. of Females	22	117	139	101	49	23
Serum CA125 (U/ml)	Mean±SD					
	59.08±115.79	34.01±68.36	40.92±89.24	83.83±161.21	120.62±171.08	125.33±184.06
	Median (Min-Max)					
	10.33 (1.97–500)	13.8 (2.27–500)	12.7 (0.2–500)	11.7 (1–500)	24 (2–500)	22.5 (1–500)
Age (years)	Mean±SD					
	18.77±0.92	26.33±2.79	36.04±2.94	45.10±2.88	55±3.19	68.22±4.87
	Median (Min-Max)					
	19 (17–20)	27 (21–30)	36 (31–40)	45 (41–50)	55 (51–60)	68 (61–77)

Table 3. CA - 125 levels distribution of total screened females.

CA - 125 Levels (U/ml)	**0–20**	**20.1–40**	**40.1–60**	**60.1–80**	**80.1–100**	**100.1–150**	**>150**
Total Females	287	53	25	10	11	17	48
Age (years)	Mean±SD						
	37.37±11.72	38.58±12.54	34.00±11.94	41.60±11.14	39.82±15.61	34.29±12.73	47.38±13.60
	Median (Min-Max)						
	37 (17–77)	38 (19–70)	31 (18–16)	41.5 (25–57)	34 (22–75)	32 (18–60)	49.5 (18–72)
CA125 (U/ml)	Mean±SD						
	9.48±4.46	28.65±6.02	47.25±5.67	72.10±4.30	90.05±5.90	121.12±16.10	396.54±132.42
	Median (Min-Max)						
	8.78 (0.2–19.8)	26.5 (20.4–39.8)	46.1 (40.4–60)	73.55 (62.8–76.4)	90.3 (81.6–99)	116 (101–143)	489.5 (152–500)

Table 4. CA125, MDA, NO and ALP in Control and Ovarian cancer.

Group	**Age (years)**	**CA125 (U/mL)**	**MDA (nmol/L)**	**NO (µmol/L)**	**ALP (IU/L)**
Control (N = 80)	Mean±SD				
	39.39±13.31	4.45±1.59	2.37±0.06	35.50±1.04	89.09±19.06
	Median (Min-Max)				
	38(18–77)	4.85(0.2–6.42)	2.4(2.3–2.5)	35.66 (32.21–37.32)	90(18–141)
Ovarian cancer (N = 80)	Mean±SD				
	43.20±14.58	279.81±176.98	6.03±1.18	57.32±6.91	307.19±66.35
	Median (Min-Max)				
	45 (18–75)	200.5 (74.1–500)	5.52 (4.9–9.7)	58.49 (36–68.8)	297.5 (209–486)

Table 5. Correlations between CA125, MDA, NO and ALP in Control and Ovarian cancer.

Correlation	**Case/ Control**				**Case/ Case**		
	CA125 / CA125	**CA125 /MDA**	**CA125 /NO**	**CA125 /ALP**	**CA125 /MDA**	**CA125 /NO**	**CA125 /ALP**
r-values	0.856	0.015	0.856	0.862	0.747	0.740	0.899
P-values	0.000	0.893	0.000	0.000	0.000	0.000	0.000

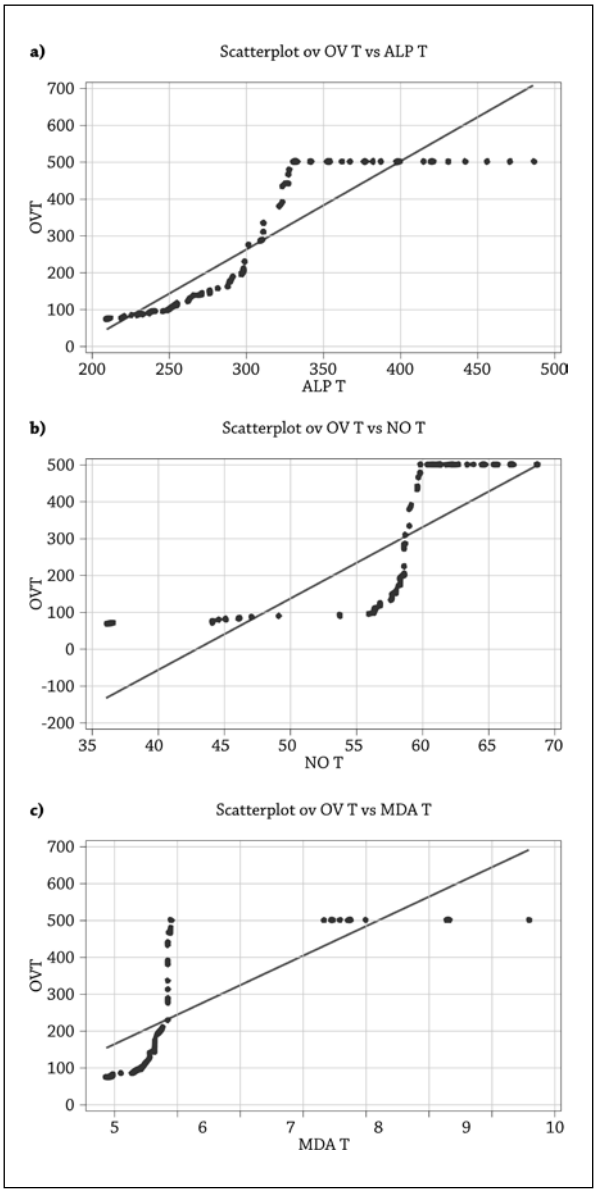

Figure 1. Correlation among (a) CA125/ALP, (b) CA125/ NO and (c) CA125/MDA in ovarian cancer (Note that CA125 is listed as OV on the graphs)

bodies that bind membrane-bound CA125, have been coupled to cytotoxic drugs or fused with cytokines. All these approaches present great potential and should be aggressively pursued, particularly considering ovarian cancer's grim prognosis [12–14].

In this study we found a significant increase in MDA and NO levels (tab. 4) indicating lipid peroxidation in ovarian cancer patients ($p =< 0.001$) compared to healthy controls; this represents oxidative and nitrosative stress in ovarian cancer [11,15]. Severe oxidative stress is not only known to cause DNA damage and mutations of tumour suppressor genes which are initial events in carcinogenesis but also can play an important role in the promotion of multistep carcinogenesis [1,16].

When the MDA level is considered along with CA125, there is a greater correlation with ovarian cancer activity than when CA125 is measured alone. Moreover, the severity of the cancer can only be established by analysis of MDA along with CA125 and histological studies. Elevated MDA, NO and ALP show positive correlations with CA125 as the disease progresses (tab. 5, fig. 1a–c]. These markers therefore signify the progression of cancer; this information helps clinicians decide the therapy accordingly [1].

Conclusion

The present study shows that serum CA125 is higher in the study group compared to controls and is also highly elevated in early stages of carcinoma. These findings indicate that CA125 and ALP are potent markers for early detection of ovarian carcinoma. Increased nitrosative and oxidative stress as indicators of lipid peroxidation are closely connected with the initiation and progression of disease. The study results should be considered as beneficial for the prognosis of ovarian cancer, regardless of the specific pathology and staging of the disease.

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Correspondence address:
Dr. Shubhangi M. Dalvi
Department of Biochemistry,
Grant Government Medical College and
Sir J.J. Group of Hospitals, Mumbai, India
Mobile: +91-9892182028
E-mail: shubhangigg03@gmail.com

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Original papers

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PREVALENCE AND KNOWLEDGE OF CLASSICAL CARDIOVASCULAR DISEASE RISK FACTORS AMONG PATIENTS WITH DIABETES

Józefa Dąbek[1 A,E,G]

Joanna Piotrkowicz[1 C–E]
• ORCID: 0000-0003-0996-7691

Sonia Leśniewska[1 A,B,D]

Dariusz Korzeń[2,3 D,F,G]

Grażyna Bonek-Wytrych[4 B,C,F]

[1] Chair and Department of Cardiology, School of Health Sciences in Katowice, Medical University of Silesia in Katowice, Poland

[2] Department of Anaesthesiology and Intensive Care with Cardiac Monitoring, Leszek Giec Upper-Silesian Medical Center of the Silesian Medical University in Katowice, Poland

[3] Department of Anaesthesiology and Intensive Care, The Municipal Hospital in Ruda Śląska, Poland

[4] Department for Health Care Supervision, Silesian Voivodeship Office in Katowice, Poland

A – study design, **B** – data collection, **C** – statistical analysis, **D** – interpretation of data, **E** – manuscript preparation, **F** – literature review, **G** – sourcing of funding

ABSTRACT

Background: The prevalence of diabetes is increasing annually, and diabetes is associated with an increased risk of developing cardiovascular disease. Diabetes can significantly increase the risk of developing coronary heart disease, stroke, hypertension or ischemia of the lower limbs. Furthermore, the presence of other risk factors including; being overweight or obesity, having hypertension, having excessive stress or having low levels of physical activity also contribute to this risk as well as contributing to disease progression and mortality among patients.

Aim of the study: The aim of this study was to evaluate the prevalence of risk factors for cardiovascular disease among patients with diabetes, and to assess their knowledge in this regard.

Material and methods: In total, 202 patients (121 females, 81 males) aged 25–74 (mean age = 58.7) were assessed in this study, from a Polish primary care setting. Inclusion criteria included a confirmed diagnosis of diabetes and that patients had given informed consent to participate in the study. We utilized a questionnaire to assess knowledge in areas related to cardiovascular disease prevention including; physical activity, diet and lifestyle. For statistical analysis Statistica v.10.0 was used.

Results: The most common cardiovascular disease risk factors included; diabetes (n = 202, 100%), obesity (n = 107; 53.0%) and stress (n = 116; 57.4%). Other contributing factors included; low physical activity (n = 179; 88.6%) and being overweight (n = 176; 87.1%). There were statistically significant differences between the number of risk factors and variables including; sex ($p < 0.001$), age ($p < 0.001$), the level of knowledge ($p < 0.001$) and the duration of the disease.

Conclusions: Patients with diabetes had many risk factors for the development of cardiovascular disease and their knowledge of their disease was shown to be incomplete. The results indicate the need for more extensive health education in this area in order to reduce the number of risk factors and disease development.

KEYWORDS: diabetes, cardiovascular diseases, risk factors

Background

Diabetes is a systemic disease characterized by elevated blood glucose levels due to impaired insulin secretion and / or action. Chronic metabolic disorders and hyperglycemia causes damage to many organs including: eyes, kidneys, nerves, heart and blood vessels [1]. A diagnosis is made by meeting at least one of the following criteria: blood glucose concentration at the level of 200mg/dL or more 120 minutes after the oral glucose tolerance test, a random blood glucose equal to or greater than 200mg/dL with symptoms of hyperlipidemia or a double increase in fasting glucose to a level of 126mg/dL or more [2]. The World Health Organization (WHO) and the American Association of Diabetes

(ADA) have developed a classification system for diabetes, in which we distinguish four types of diabetes: type 1, type 2, other specific types of diabetes and gestational diabetes [3–5].

Both in Poland and in the rest of the world, there has been a steady increase in the incidence of diabetes, which is associated with an increase in the incidence of cardiovascular diseases, cardiovascular disease being a complication of diabetes [6]. It is estimated that in 2011, 360 million people suffered from diabetes, 95% of whom had type 2 diabetes. This number is said to increase to 522 million by 2030, of which more than half will not be aware of their diagnosis [7].

According to the International Federation of diabetes (IDF), all patients with diabetes who are over 40 years old should be considered as being at high risk of developing cardiovascular disease. It has been shown that diabetes also significantly increases the risk of developing other related conditions including; ischemic heart disease, stroke, hypertension or lower limb ischemia. These conditions are caused secondary to direct damage to blood vessels due to uncontrolled glucose levels. In addition, studies have shown that the relative risk of developing ischemic stroke is 2–3 times more common among patients with diabetes than among patients without the disease. This can be due to the tendency of blood to clot as well as reduced vessel patency. A similar mechanism of disease is suggested in lower limb ischemia. In the case of patients with diabetes, this condition is particularly dangerous due to the impairment of collateral circulation [8]. In coronary heart disease, the coronary arteries become narrower, which makes the myocardial function difficult and can result in myocardial infarction.

Diseases of the circulatory system are the most common causes of death in Poland and in the world, being ahead of even those resulting from cancer [9–10]. According to the data published by the Central Statistical Office (GUS), deaths from cardiovascular disease in Poland in 2013 accounted to as much as 45.8% of total deaths. This has remained at a similar percentage for over the last 20 years. It is predicted that in 2050 the number of deaths will increase by over 40,000, as compared to 2013 and will amount to 428,300 [8].

Lifestyle has the greatest impact on the development of cardiovascular diseases and its associated mortality [11]. Studies have shown that a healthy lifestyle reduces the risk of cardiovascular diseases by 50 to 70% [12]. Lifestyle factors that contribute to cardiovascular disease include: inadequate physical activity, smoking, being overweight or obese, having hypertension, abusing alcohol, having increased levels of stress, having a poor diet and having diabetes [13]. Conducting health education initiatives targeting these preventative risk factors would contribute to the elimination of these risk factors and, consequently, to reducing the development of cardiovascular diseases and its respective mortality.

Aim of the study

The aim of the study was to assess the occurrence of risk factors for cardiovascular diseases in patients with diabetes and their knowledge in this respect.

Material and methods

240 questionnaires were distributed, although for final analysis 202 patients were enrolled in the study, including 121 women and 81 men aged from 25 to 94 years (mean 58.7) diagnosed with diabetes in this: 186 (92.1%) with diabetes type 2 and 16 (7.9%) with diabetes type 1. Studies were carried out from March to May 2016. The inclusion criteria included a diagnosis of diabetes and that patients had given their informed consent to participate in the study. The study was carried out in a diabetes, cardiology, primary care clinic and at a physiotherapy department in a medical facility in Katowice. Research was approved by the Bioethics Committee of the Medical University of Silesia in Katowice (KNW/0022/KBI/98/15). We utilized a questionnaire consisting of a questions about the health of the subjects, their knowledge about preventative measures, physical activity, eating habits, risk factors and other behaviors important in the prevention of cardiovascular disease. The type of questions contained in the questionnaire were closed. Points were awarded for the responses of the subjects: 1 point for a correct response and 0 points for a wrong response or "I do not know". Results were given on a scale of 0–10. The questionnaire was anonymous and participation in the study was voluntary. The data was subjected to statistical analysis using the Statistica v.10.0 program. For general characteristics of the studied group of patients, mean, standard deviation, median, minimal and maximal values were calculated. Due to the normal distribution of results for the evaluation of the relationship between selected variables parametric tests were used. The significance level was considered as $p \leq 0.05$.

Results

The characteristics of the studied group of patients with diabetes including age, weight, body height, BMI and the period for which they had been diagnosed with diabetes are presented in tab. 1.

Table 1. General characteristics of the studied group of patients with diabetes.

Study group n = 202					
Variable	**x**	**SD**	**Median**	**Min**	**Max**
Age [year]	58.7	16.39	59	25	94
Body weight [kg]	80.1	15.18	78	46	120
Body height [m]	1.67	9.53	1.68	1.38	1.93
BMI [kg/m^2]	28.41	4.02	28.26	20.72	40.09
Disease duration [year]	9.21	8.63	6.5	1	41

The mean BMI of patients with diabetes would be classified as being overweight at 28.41 kg/m^2. The subjects had been diagnosed with diabetes for an average of 9.21 years with the shortest time being 1 year and the longest being 41 years.

The characteristics of the studied group of patients with diabetes, taking into account the occurrence of cardiovascular diseases are presented in tab. 2.

Table 2. Characteristics of the studied group of patients with diabetes including the occurrence of cardiovascular diseases.

Occurrence of cardiovascular diseases in study group		
Variable Number of group (n; % of group)	**Number of group n = 202**	**% of group 100%**
Hypertension	115	56.9%
Coronary artery diseases	63	31.2%
Arrhythmia	54	26.7%
Dyslipidemia	50	24.8%
Peripheral atherosclerosis	20	9.9%
Myocardial infarction	20	9.9%
Venous insufficiency	15	7.4%
Others	15	7.4%
Heart failure	7	3.5%
Stroke	6	2.9%

Cardiovascular diseases was found in all patients with diabetes. The most frequent were: hypertension n = 115 (56.9%). coronary artery diseases n = 63 (31.2%) arrhythmia n = 54 (26.7%) and dyslipidemia n = 50 (24.8 %).

Tab. 3 presents the characteristics of the studied group of patients taking into account the presence of risk factors for cardiovascular diseases and their knowledge in this regard.

In the study group, the most common risk factors for cardiovascular diseases were: diabetes (n = 202; 100%), being overweight or obese (n = 107; 53.0%) and having increased stress levels (n = 116; 57.4%). In the opinion of the respondents, factors contributing to their cardiovascular disease were: low level of physical activity (n = 179; 88.6%), being overweight or obese (n = 176; 87.1%) and their diabetes (n = 154; 76.2 %).

Fig. 1 presents an analysis of the results taking into account the behaviors that the respondents consider necessary in the prevention of cardiovascular disease.

The most important preventative measures, according to the respondents included: controlling blood pressure (n = 186; 92.1%), using recommended medication (n = 165; 81.70%), optimal cholesterol and glucose control (n = 156; 77.20%), visits to doctor's surgery (n = 152; 75.20%), good nutrition (n = 152; 75.20%) and weight reduction (n = 125; 61.90%). Only every second subject considered physical exercise to be important in the prevention of cardiovascular disease (n = 112; 55.40%).

Knowledge about the risk factors for the development of cardiovascular disease was examined on the basis of patient knowledge of nine basic modifiable risk factors. It was assumed that the patients who knew more than 7 of them had a good knowledge of their disease. Patients who knew 4–6 factors had sufficient knowledge and people who knew 3 or less risk factors had insufficient knowledge. The data is presented in fig. 2.

Table 3. Characteristics of the studied group of patients with diabetes in terms of risk factors for cardiovascular disease and their knowledge in this regard.

Variable Number of group; n. % of group	**Cardiovascular risk factors**			
	factors which the respondents mention as contributing to the occurrence of cardiovascular disease		**risk factors of cardiovascular disease occurring in the studied group**	
	n = 202	**100%**	**n = 202**	**100%**
Low level of physical activity	179	88.6%	30	14.9%
Overweight/obesity	176	87.1%	107	53.0%
Diabetes mellitus	154	76.2%	202	100%
Chronic stress	146	72.3%	116	57.4%
Hypertension	127	62.9%	104	51.5%
Tobacco	118	58.4%	32	15.8%
Improper nutrition	118	58.4%	31	15.3%
Dyslipidemia	111	55.0%	45	22.3%
Alcohol abuse	109	54.0%	16	7.9%
Age	75	37.1%	64	31.7%
Early-family occurrence of cardiovascular diseases	70	34.7%	34	16.8%
Gender	45	22.4%	39	19.3%

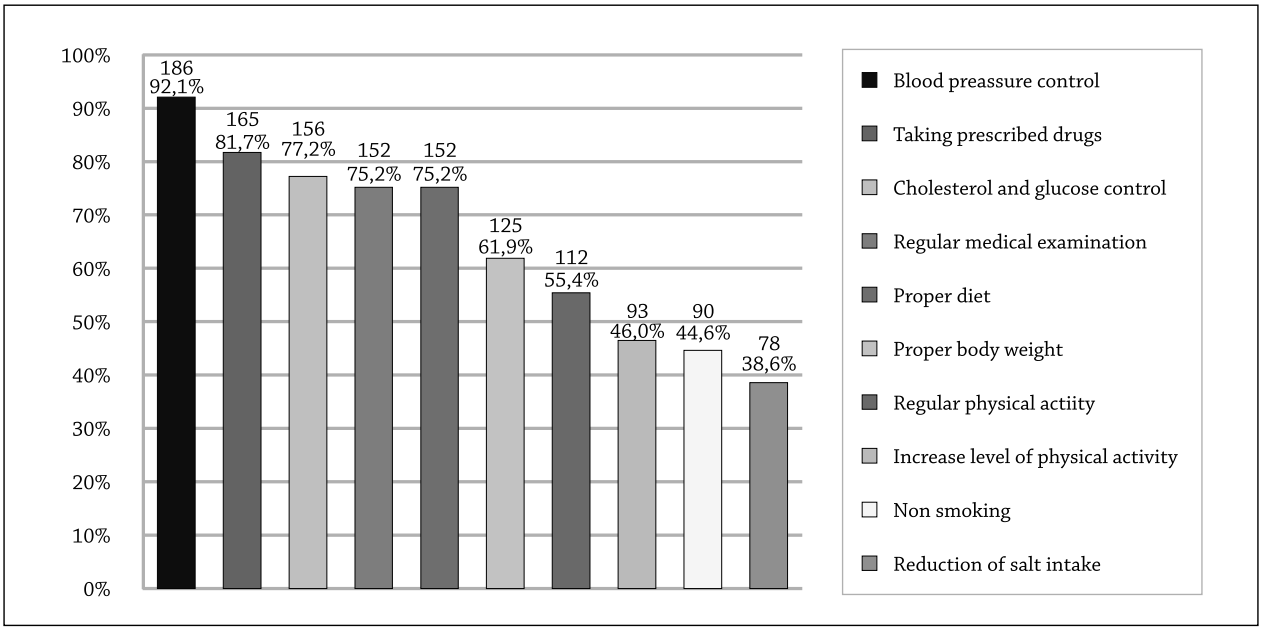

Figure 1. Characteristics of the study group with respect to behaviors considered to be necessary in the prevention of cardiovascular diseases.

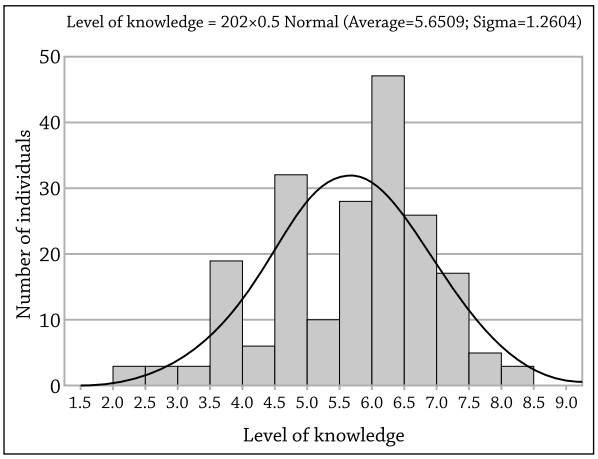

Figure 2. Distribution of results including the knowledge of risk factors for systemic cardiovascular diseases in the study group of patients with diabetes.

Analysis of the knowledge of risk factors for cardiovascular diseases in the study group of patients with diabetes showed that 126 subjects (62%) listed at least 5 risk factors for cardiovascular disease.

Tab. 4 shows the relationship between the number of risk factors present in the examined group of patients with diabetes and such parameters as sex, age, place of residence and the level of the knowledge of the subjects.

Statistical analysis showed a significant relationship between the number of risk factors present and such parameters as: gender ($p < 0.05$), age ($p < 0.05$), the level of the knowledge ($p < 0.05$) and the duration of the disease ($p < 0.05$).

Discussion

Diabetes worsens cardiovascular disease outcomes both in patients with significant disease morbidity and in those who are not burdened with cardiovascular disease [14]. What is more, numerous studies show that the vast majority of diabetic patients die from cardiovascular disease [15–18]. In the majority of cases, diabetes develops as a result of an unhealthy lifestyle, including a high-fat diet and low physical activity which lead to obesity, insulin resistance, hyperinsulinemia and the

Tab. 4. Relationship between the number of risk factors present in the examined group of patients with diabetes and such parameters as sex, age, place of residence and the level of the knowledge of the subjects.

Variable	N-significant Group 1	N-significant Group 2	Average group 1	Average group 2	t	df	*p*
Number of risk factors vs. Gender	202	202	9.282781	5.650	5.816	402	0.001
Number of risk factors vs. Age	202	202	9.213	58.70297	38.063	402	0.001
Number of risk factors vs. Place of residence	202	202	1.05000	1.030	0.358	402	0.721
Number of risk factors vs. Level of knowledge	202	202	9.21871	5.650	5.801	402	0.001
Number of risk factors vs. Disease duration	202	202	5.347	9.218	-6.165	402	0.001

development of type 2 diabetes. These conditions have been described together as metabolic syndrome and it has been shown that cardiovascular disease develops earlier due to this condition. Even before the onset of diabetes, particular attention is paid to hyperglycemia, given the risk of small vessel diseases such as retinopathy, nephropathy or neuropathy.

Diabetes is itself a risk factor that contributes significantly to the development of cardiovascular disease. What is important, is that the burden with other factors, such as being overweight or obese, having hypertension, excessive stress or too little physical activity increases the risk of developing cardiovascular disease, as well as disease progression and mortality. Stamler et al. showed that the risk of cardiovascular diseases in diabetic patients was three times higher than in healthy people. What is more, the mortality rate increased in patients with diabetes along with an increase in the number of risk factors for cardiovascular diseases [19].

Polkowska et al. showed that patients with diabetes were more likely to have excessive body weight and live in families burdened with ischemic heart disease and other risk factors [20–21].

Epidemiological studies show that abnormal body weight is the greatest risk factor for the development of diabetes. This is important due to the fact that as many as to 107 people (53%) were overweight or obese in the study and that 176 people (87.1%) indicated this factor as contributing to the development of cardiovascular disease. Excessive carbohydrate and sugar intake contribute not only to weight gain, but also to impaired glucose control, reduced fructose metabolism, inflammation, insulin resistance, beta-cell dysfunction, increased blood pressure, visceral obesity and atherogenic dyslipidemia [22].

A study by Wing et al. showed that weight loss by 5 to 10% in people with cardiovascular disease and diabetes significantly reduced other risk factors. It was also shown that the greater the weight loss, the lower the risk factor burden. Weight loss affected such risk factors as: blood glucose, arterial pressure, triglycerides, and increased HDL cholesterol without changes in LDL cholesterol [23].

Juultilanen et al. showed a strong relationship between the occurrence of diabetes and the risk of cardiovascular disease in patients. What is more, it was shown that this relationship is stronger among women as compared to men who were burdened with the presence of a greater number of risk factors including hypertension and dyslipidemia. The results are consistent with the results of our study where a significant relationship between the occurrence of risk factors and the gender of the respondents was also demonstrated [24].

The Look AHEAD Research Group study showed that conducting healthy education and introducing an intensive lifestyle change in patients with type 2 diabetes in a four-year follow-up had a beneficial influence in controlling glucose and blood pressure, lowering the body weight of the subjects and improving overall physical condition. The burden of these risk factors was also significantly reduced [25].

The results of our study indicates the need to conduct health education among patients at every stage of their disease in order to eliminate risk factors prevent the development and progression of the disease and reduce the risk of mortality in patients.

Conclusions

1. The most frequent risk factors for cardiovascular disease in the study group of patients with diabetes included: excessive stress and an increased body weight.
2. The knowledge of the studied patients with diabetes with respect to risk factors was not associated with a decrease in their occurrence, because the burden was high both in the patients with newly diagnosed diabetes and those with long-standing diabetes.

The results of the study indicate the need to conduct extensive health education among healthy people in order to eliminate risk factors contributing to the prevalence of diabetes and cardiovascular disease.

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Correspondence address:
Joanna Piotrkowicz
Katedra i Klinika Kardiologii Wydziału Nauk o Zdrowiu w Katowicach
Śląski Uniwersytet Medyczny w Katowicach
Ul. Ziołowa 45/47
40-635 Katowice
E-mail: joanna.piotrkowicz@gmail.com

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ASSESSMENT OF THE IMPACT OF HOLD-RELAX AND CONTRACT-RELAX TECHNIQUES ON THE COMPRESSION PAIN THRESHOLD IN PATIENTS WITH LATERAL HUMERAL EPICONDYLITIS

Szymon Wyszyński[1 A,B,D]
• ORCID: 0000-0003-3340-9411

Sylwia Stiler-Wyszyńska[2 C,D,F]
• ORCID: 0000-0001-5814-0688

[1] Doctoral Studies, Department of Physiotherapy, Faculty of Health Sciences, Medical University of Silesia in Katowice

[2] Department of Biomaterials, Institute of Materials Science, Faculty of Computer Science and Materials Science, University of Silesia in Katowice

A – study design, **B –** data collection, **C –** statistical analysis, **D –** interpretation of data, **E –** manuscript preparation, **F –** literature review, **G –** sourcing of funding

ABSTRACT

Background: The method of proprioceptive neuromuscular paving (PNF) is unique in that it has its own principles of working with the patient. The overriding therapeutic goal during PNF therapy is to work on a lost function that is important for the patient.

Aim of the study: The aim of the study was to assess the impact of Hold-Relax and Contract-Relax techniques on the compression pain threshold in patients with lateral humeral epicondylitis.

Material and methods: The study involved 60 patients aged 47.8±4.3 with inflammation of the lateral humeral epicondyle. There were 35 women and 25 men in the study group. In each examined person it was the first incident of lateral humeral epicondylitis. In each of the probands, subjective and physical physiotherapeutic examination was carried out. 41 left and 19 right limbs were tested. Measurements were made under standard conditions. Among the physiotherapeutic tests performed were: examination of the range of motion, assessment of the compression pain threshold using an algometer, and pain assessment during extension and radial deviation of the wrist with a load. The study of the range of movement was carried out using an electronic goniometer. Then, the subjects were randomly divided into two groups: group "A" in which the Hold-Relax technique was performed on the muscle group that extends and radially deviates the wrist and group "B" in which Contract-Relax was applied to the same muscle group. The therapy lasted 30 minutes and was continued for the next 10 days. In each group, apart from the mentioned techniques, physiotherapy treatments were applied as indicated. After the therapy, the tests that preceded the therapies were repeated. The obtained results were placed in the database and subjected to statistical analysis using the Statistica program.

Results: The mean extent of the extension movement in the radiocarpal joint before the therapy in group "A" was 45.7±4.7 while in group "B" it was 40.1±3.79. After treatment, the mean range of motion increased in the "A" group to 67.46±8.69 and in the "B" group to 71.6±8.3. In both groups, changes were observed at the statistically significant level p = 0.

Conclusions: 1. The use of both the Hold-Relax and Contract-Relax techniques had an impact on the change of the compression pain threshold. 2. The use of Hold Relax and Contract Relax techniques has an impact on increasing the range of motion in patients with lateral epicondylitis.

KEYWORDS: PNF, pressure pain threshold, lateral epicondylitis inflammation

Background

The method of proprioceptive neuromuscular paving (PNF) is unique in that it has its own principles of working with the patient. The overriding therapeutic goal during PNF therapy is to work on a lost function that is important for the patient. In contrast to traditional physiotherapy, muscle strength and range of motion are considered here only as a means to achieve the goal [1–3]. It is worth noting that this method has a group of techniques that are used to stretch and relax muscles. Among these techniques, the technique of Hold-Relax and Contract-Relax stands out [4,5]. It is

worth mentioning that there are no clear guidelines as to the number of repetitions or duration, or the application of a given technique to a given case in order to achieve optimal results.

Unfortunately, there are inaccuracies in the literature in the description of the techniques and methods used in PNF. Techniques which are described the same way do not necessarily correspond to the same method of implementation in different research protocols. PNF includes two main toning techniques: Hold-Relax and Contract-Relax. The first technique is used to work on muscles that have contracted. The therapist resists the isometric contraction of these muscles, then they are allowed to relax [3,6]. The "hold" command is used during this technique. The patient is instructed to maintain a certain position of the joint against the applied resistance. As mentioned before, the goal of this technique is to increase the passive range of motion and reduce pain. This technique is widely used, because the only contraindication to it is the inability of the patient to perform isometric contraction [7–9]. In the Contract-Relax technique, the therapist also puts resistance to the contorted muscle, but in this case, the command the physiotherapist says is, "Pull." In contrast to the previous technique, this may lead to joint movement during its execution. Then, the relaxation phase and the range of motion increase. Additionally, in the case of work on muscle groups located in the torso, rhythmic breathing is indicated [10–12].

The International Association for the Study of Pain defines pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage." Differences in the perception of pain stimuli come from the activation of various types of pain receptors. They also depend on individual psychological factors and the current mental state. Due to the subjectivity of pain sensation it is difficult to determine its intensity with a quantitative scale. In the performed tests, the algometer was used to measure the pain threshold. This method allowed precise determination of the place where the pain threshold was increased and enabled accurate assessment of the effects of the performed therapy. Considering the phenomenon of pain sensation, the differences between pain threshold and pain tolerance should be made clear. Pain tolerance is the maximum intensity of pain that a person can tolerate. It can be influenced by many factors, such as current physical condition, degree of concentration on pain or psychological well-being. The threshold of feeling pain is defined by the intensity of the sensory stimulus perceived by a person as pain. The smallest amount of pressure on tissue which causes pain, is referred to as tissue compression sensitivity. It is influenced by, among other things, musculoskeletal diseases, sex, and mental disorders [13–15].

"Tennis elbow" is a common name for inflammation of the lateral epicondyle of the humerus, or "lateral epicondylitis." There are muscles attached to the lateral epicondyle that perform movements of the wrist. Ailments usually appear in conditions of chronic wrist overload. This situation occurs, for example, in tennis players, when the wrist is hard at work (hence the name of the disease). When lateral epicondylitis occurs, exercises to restore the flexibility and strength of the muscles are indicated; these exercises include, above all, stretching the finger extensors and flexors [16].

Aim of the study

The aim of the study was to evaluate the effect of Hold-Relax and Contract-Relax techniques on the level of compression pain threshold in patients with lateral epicondylitis. The following research questions were asked:

1. Does the use of the Hold-Relax technique and Contract-Relax technique have an impact on changing the pressure pain threshold?
2. Does the use of the Hold-Relax technique and the Contract-Relax technique influence the range of motion in patients with lateral humeral epicondylitis?

Material and methods

The study involved 60 patients at the age of $x = 47.8 \pm 4.3$ with inflammation of the lateral humeral epicondyle. There were 35 women and 25 men in the study group. In each examined person it was the first episode of lateral epicondylitis. In each of the probands, subjective and physical physiotherapeutic examination was carried out. 41 left and 19 right limbs were tested. Measurements were made under standard conditions. Among the physiotherapeutic tests performed were: examination of the range of motion, assessment of the compression pain threshold using an algometer, and pain assessment during extension and radial deviation of the wrist with a load. The study of the range of movement was carried out using an electronic goniometer. Then, the subjects were randomly divided into two groups: group "A" in which the Hold-Relax technique was performed on the muscle group that extends and radially deviates the wrist and group "B" in which Contract-Relax was applied to the same muscle group. The therapy lasted 30 minutes and was continued for the next 10 days. In each group, apart from the mentioned techniques, physiotherapy treatments were applied as indicated. After the therapy, the tests that preceded the therapies were repeated. The obtained results were entered in a database and subjected to statistical analysis using the Statistica program. The Shapiro-Wilk test was used to assess the normality of the distribution. Statistical analysis was performed using the Student's T test for dependent tests, since at least one variable in each group had a normal distribution in each measurement. The level of statistical significance was $p \leq 0.05$.

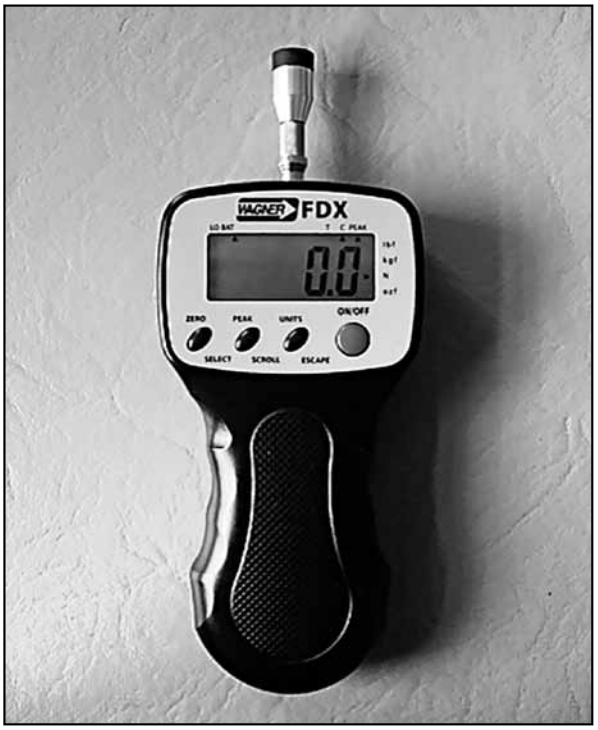

Figure 1. Algometer - device for testing the pain threshold.

An algometer is a measuring device that has a 1 cm^2 head and a button that stops the measurement and resets the measurement (fig. 1). The pain threshold was measured in Newtons [N]. The device was applied with the head to the medial or lateral collateral ligament at right angles. The therapist increased the pressure force onto the tissue being examined. The measurement result was visible only to the therapist, and the measurement itself was stopped by pressing the appropriate key when the patient's pain was signaled. Each measurement was repeated three times to decrease the measurement error. Measurements using an algometer were made at 5 points. The first point was just above the attachment of the extensor muscles to the lateral epicondyle of the humerus. Then, the back of each subject's forearm was divided into 4 equal segments, which allowed us to determine 4 consecutive points on the back side of the forearm. Numbered points were from the proximal to distal in the following order: "2", "3", "4", "5".

Results

The mean extent of extension in the wrist joint before the therapy in group "A" was 45.7±4.7, while in group "B" it was 40.1±3.79. After treatment, the mean range of motion increased in group "A" to 67.46±8.69 and in group "B" to 71.6±8.3. In both groups, changes were observed at the statistically significant level p = 0 (fig. 2).

The mean extent of flexion in the wrist joint before the therapy in group "A" was 42.53±3.52 while in group "B" it was 47.26±4.12. After treatment, the mean range of motion increased in group "A" to 59.23±9.65 and in group "B" to 67.53±7.5. In both groups, changes were observed at the statistically significant level p = 0 (fig. 3).

Pain was felt at point 1 in the "A" group before therapy at a mean of 41.8 N±6.27 N, while in group "B" it

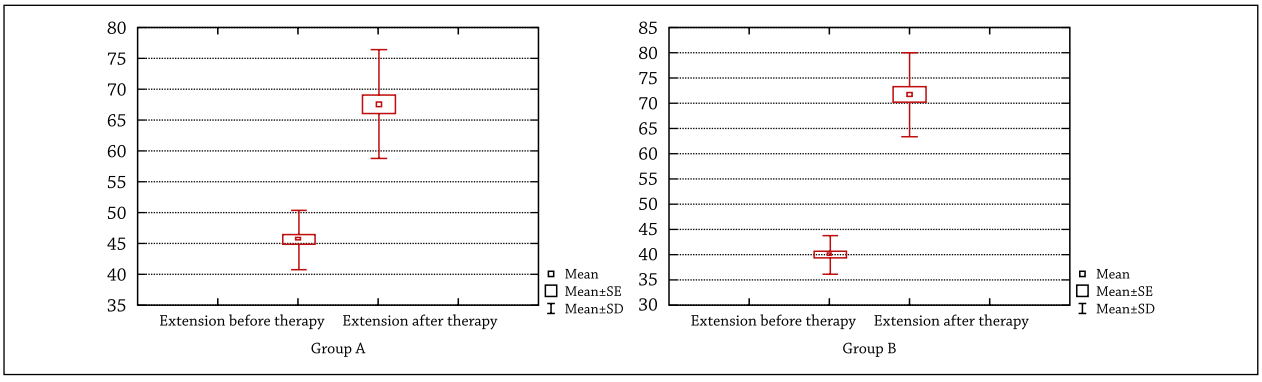

Figure 2. The average extent of the extension movement in the wrist joint expressed in degrees in before and after therapy in both groups.

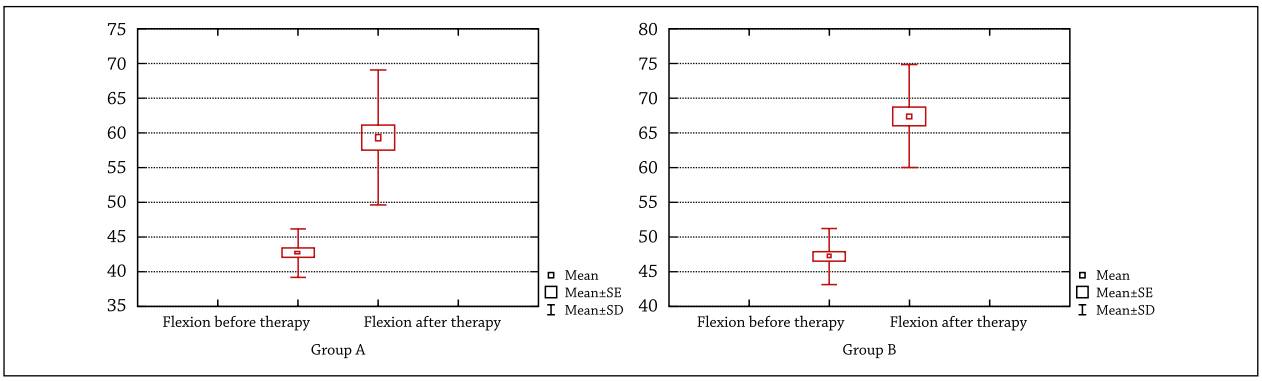

Figure 3. The average range of flexion movement in the wrist joint expressed in degrees before and after therapy in both groups

was 39.1 N±6.6 N. After therapy, more pressure could be applied before pain was felt, so that the mean pressure increased in the "A" group to 64.2 N±10.20 N and in the "B" group to 59.86 N±5.51 N. Both groups showed changes at the statistically significant level p = 0 (fig. 4).

Pain was felt at point 2 in the "A" group before therapy at a mean of 45.13 N±6.28 N, while in group "B" it was 41.1 N±5.44 N. After therapy, more pressure could be applied before pain was felt, so that the mean pressure increased in the "A" group to 59.77 N±6.28 N and in the "B" group to 54.13 N±4.8 N. Both groups showed changes at the statistically significant level p = 0 (fig. 5).

Pain was felt at point 3 in the "A" group before therapy at a mean of 42.27 N±3.32 N, while in group "B" it was 36.9 N±5.03 N. After therapy, more pressure could be applied before pain was felt, so that the mean pressure increased in the "A" group to 55.07 N±10.02 N and in the "B" group to 48.26 N±4.81 N. In the "A" group, changes at the statistically significant level p = 0 were observed. In the "B" group there were also changes at the statistically significant level p = 0.000027 (fig. 6).

Pain was felt at point 4 in the "A" group before therapy at a mean of 36.8 N±3.57 N, while in group "B" it was 32.23 N±6.07 N. After therapy, more pressure could be applied before pain was felt, so that the mean pressure increased in the "A" group to 62.13 N±2.61 N and in the "B" group to 60.67 N±8.31 N. Both groups showed changes at the statistically significant level p = 0 (fig. 7).

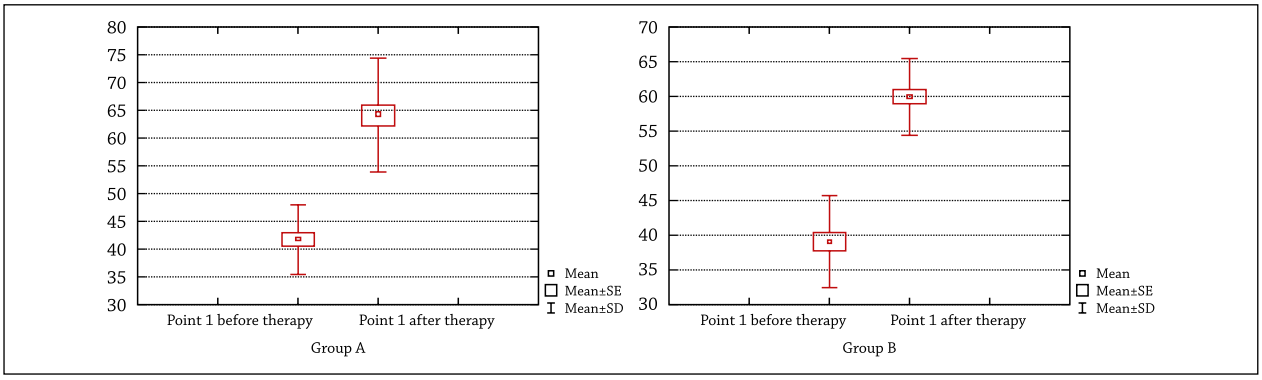

Figure 4. The average pain threshold expressed in Newtons at point 1 before and after treatment in both groups.

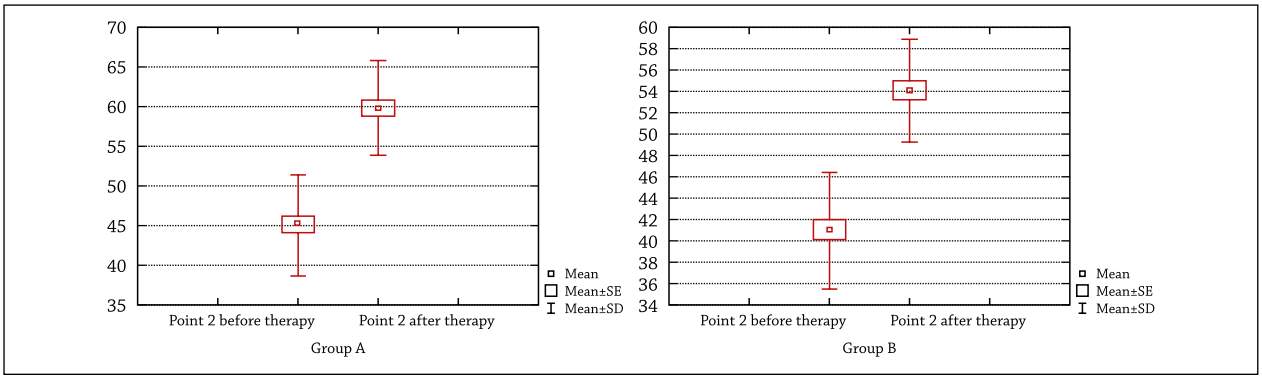

Figure 5. The average pain threshold expressed in Newton in point 2 before and after therapy in both groups.

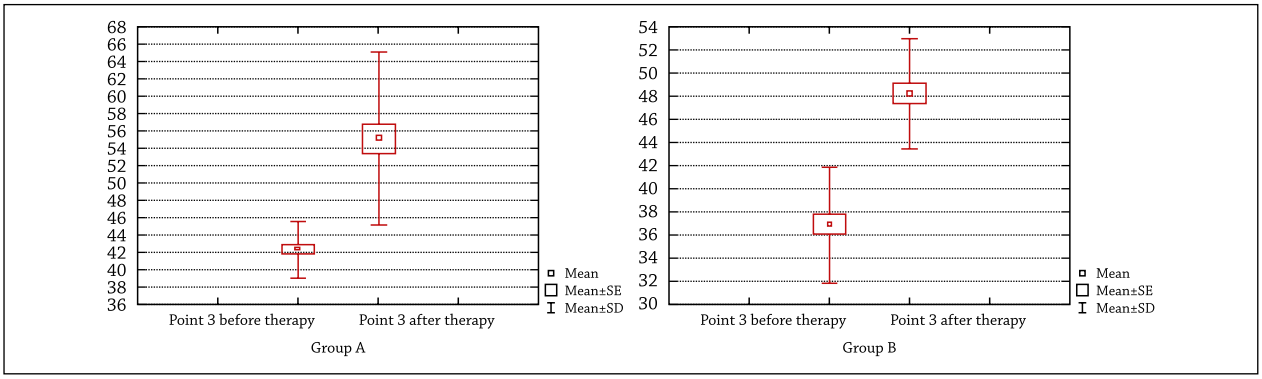

Figure 6. The average pain threshold expressed in Newtons in point 3 before and after therapy in both groups.

Pain was felt at point 5 in the "A" group before therapy at a mean of 31.23 N±3.67 N, while in group "B" it was 44.8 N±6.51 N. After therapy, more pressure could be applied before pain was felt, so that the mean pressure increased in the "A" group to 53.6 N±8.93 N and in the "B" group to 57.67 N±5.7 N. Both groups showed changes at the statistically significant level p = 0 (fig. 8).

The average weight value that patients were able to lift during the extension movement in the wrist joint without pain in the "A" group before therapy was 1.1 kg±0.56 kg and in the "B" group 0.95 kg±0.4 kg. After therapy, the mean amount of weight that could be lifted increased in group "A" to 1.78 kg±0.47 kg and in group "B" to 1.72 kg±0.54 kg. In the "A" group, the changes were statistically significant with a p value of 0.000004. In the "B" group the changes were also statistically significant (p = 0.001374) (fig. 9).

Discussion

In the conducted experiment it was observed that both the Hold-Relax technique and the Contract-Relax technique were beneficial for increasing the range of motion. In addition, after applying either technique there was an increase in the compression pain threshold at all examined points. The weight the proband could lift without pain also increased. The presented research results agree with other research regarding their impact of these techniques on increasing the range of motion [17–19]. However, the duration of contraction and relaxation in Hold-Relax and Contract-

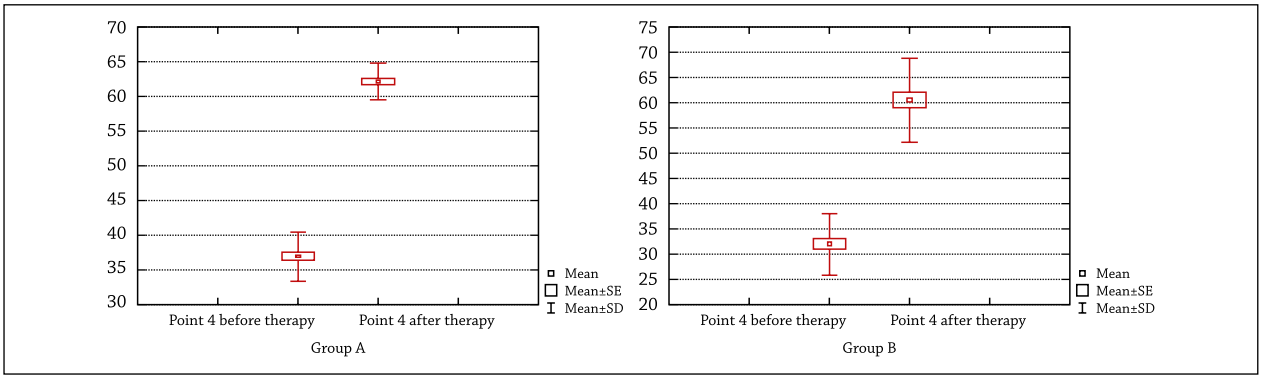

Figure 7. The average pain threshold expressed in Newton in point 4 before and after treatment in both groups

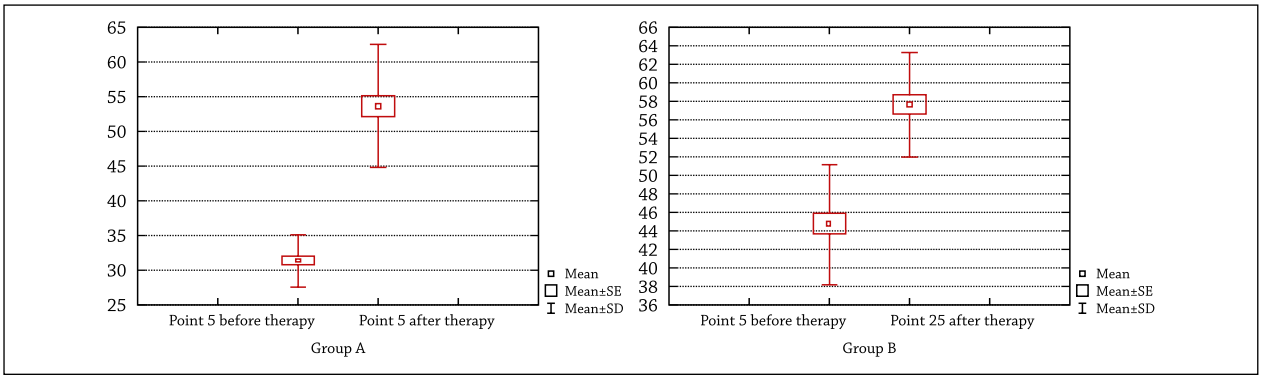

Figure 8. The average pain threshold expressed in Newton in point 5 before and after treatment in both groups.

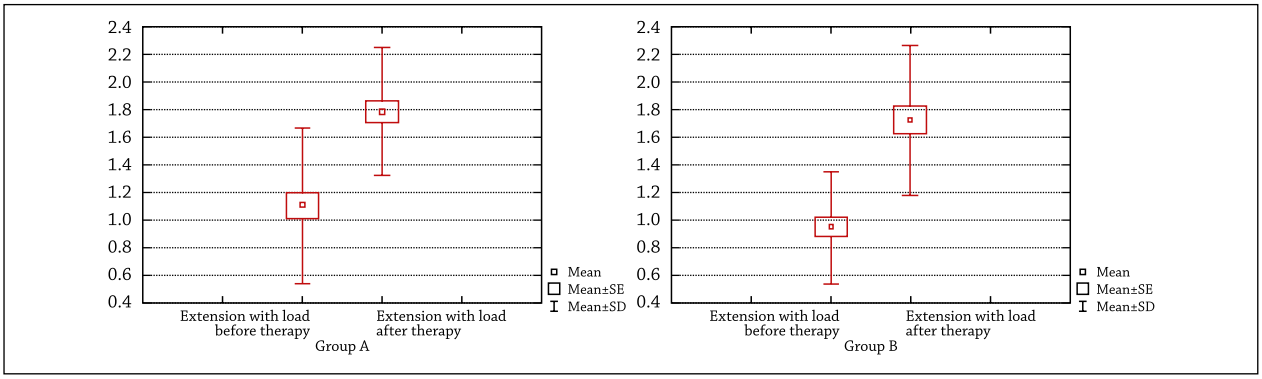

Figure 9. Average weight expressed in kilograms that probands were able to raise without pain before and after treatment in both groups.

Relax techniques remains unclear. The question of the number of repetitions also remains unclear. It is worth mentioning that the device for testing the pain threshold may be used in physiotherapeutic offices to assess the therapy. A quick and accurate examination allows precise determination of the compression pain threshold before and after the therapy. In conclusion, further research should be carried out on a large group of probands that will allow determination of the time needed to contract or relax the muscle and the number of repetitions required to achieve the best results [20]. As shown in the literature, the algometer test is used to plan and monitor the results of therapy. In the tests carried out, measurement of the compression pain threshold was made using the Wagner FORCE TEN FDX algometer. The measurement error of the device is ±0.3%. Due to the subjectivity of pain sensation it is difficult to determine its intensity with a quantitative scale. In the performed tests, the algometer was used to measure the pain threshold. This method allows precise determination of the place where the pain threshold was increased and enables accurate assessment of the effects of the performed therapy.

Conclusions

1. The use of both the Hold-Relax and Contract-Relax techniques had an impact on the change of the compression pain threshold.
2. The use of Hold-Relax and Contract-Relax techniques had an impact on increasing the range of motion in patients with lateral epicondylitis.
3. Further research should be carried out on a larger group of probands. It is also recommended that subsequent studies analyze the duration of contraction and relaxation in both the Hold-Relax and Contract-Relax techniques.

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Correspondence address:
Szymon Wyszyński
Department of Physiotherapy, Department of Physiotherapy,
Faculty of Health Sciences,
Medical University of Silesia in Katowice
E-mail: szym.wysz@wp.pl

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EVALUATION OF DIETARY PATTERNS AMONG MEN AND WOMEN OVER 80 YEARS OF AGE LIVING IN A RURAL AREA OF SOUTH-WEST POLAND

Ewelina Lepsy[1 A–F]
• ORCID: 0000-0003-3663-9888
Grzegorz Żurek[1,2 A,D,E]
• ORCID: 0000-0002-1795-4367
Alina Żurek[3 A,D]
• ORCID: 0000-0002-0047-3516
Magdalena Golachowska[4 A,D–F]
• ORCID: 0000-0003-3391-1006
Gerda Delaunay[5 E,F]

[1] Department of Physiotherapy, Opole Medical School, Poland
[2] University School of Physical Education in Wroclaw, Poland
[3] Institute of Psychology, University of Wroclaw, Poland
[4] Department of Health Sciences, Opole Medical School, Poland
[5] Lifestyle for Health & Harmony, Steyr, Austria

A – study design, **B** – data collection, **C** – statistical analysis, **D** – interpretation of data, **E** – manuscript preparation, **F** – literature review, **G** – sourcing of funding

ABSTRACT

Background: Proper nutrition is an important factor in maintaining health and preventing disease development or progression regardless of age, but is especially relevant for elderly people. Seniors rarely follow nutritional and life-style guidelines, which may correlate with poor health, multiple morbidities, polypharmacy and premature death.

Aim of the study: The aim of this study was to evaluate the nutritional pattern, food choices, knowledge about healthy eating, body mass and health issues among men and women over 80 years of age living in a rural area of south-west Poland.

Material and methods: 100 participants, women and men, aged 79.6–93.3 years, responded to a questionnaire on nutritional choices. Anthropomorphic measurements were also taken.

Results: Only 40% of responders declared drinking 2 litres of water daily. Fruit and vegetables were eaten in inadequate quantities: only 10% of responders declared eating fruit and vegetables at least twice a day. Wholegrain products were regularly chosen by 30%. Dairy products were eaten once daily by 50% of seniors. 45% of the elderly chose meat, including red meat and its products, three to four times a week, and 66% chose fish only once a week. Almost 50% of responders ate only three meals a day. All participants declared suffering from at least one disease (chronic or acute). 45% of seniors had never heard of any nutritional guidelines.

Conclusions: Based on this study most responders do not follow the nutritional guidelines for elderly people. Intake of water, dairy products, fruit and vegetables was inadequate. These food choices by the elderly may impact on their health and well-being.

KEYWORDS: elderly nutrition, nutritional habits, seniors, healthy ageing, rural areas

Background

A close relationship between nutrition and health status exists at any age but is particularly evident for the elderly [1]. Older people often exhibit a lower sense of well-being, body weight which is either too low or too high, multiple complaints (due to the progressive dysfunction of e.g. gastrointestinal tract or immune system) and chronic non-communicable diseases (sarcopenia, hypertension, arthritis, diabetes, COPD etc.). This higher morbidity often results in the need for multi-specialist medical care and a polypharmacy of medication [2,3]. Causes of malnutrition in the elderly can be divided into three main groups: medical factors (e.g. gastrointestinal disorders, loss of appetite, taste

and smell), socio-economic factors (e.g. lack of knowledge, poverty, difficulties in acquiring high quality food products or meal preparation) and psychological factors (depression, dementia, anorexia). Similarly, causes of overeating leading to overweight and obese individuals are: medical factors (side effects of drugs, e.g. steroids, reduced metabolic rate, decreased physical activity), socio-economic factors (choosing more low quality foods, preserving the nutritional pattern from earlier years of professional activity), and psychological factors (boredom, loneliness, anxiety relieved by emotional eating) [4,5].

General nutrition recommendations for the elderly have been published by the World Health Organisation [6] and the nutrition or health Organizations of many individual countries. In Poland recommendations have been published by the Nutrition and Food Institute in Warsaw, and were updated in December 2017 [7]. Nutritional guidance for older people is depicted by a food and physical activity pyramid. The pyramid is intended to provide an easily understood framework, which, if followed, will increase nutritional and health awareness, increase nourishment, help to maintain proper body mass, and limit progression of chronic diseases.

However, the majority of the studies on nutritional guidelines for the elderly have focussed on seniors living in industrialized countries, in the bigger cities, where information about a healthy lifestyle is more easily available (posters and leaflets at pharmacies and medical centres, national programs advertised on posters in the city), and where seniors are generally better educated with access to modern mass media (e.g. internet). Little is known about dietary patterns and the state of health in seniors from rural areas, who have lower income and education, and worse access to information sources.

In this study we investigated a population of seniors aged over 80 years living mostly in rural areas, in their own households, (alone or with their family), in order to assess their nutritional patterns, food choices, the knowledge about healthy eating as well as their body mass and health issues.

Aim of the study

The aim of this study was to evaluate the nutritional pattern, food choices, knowledge about healthy eating, body mass and health issues among men and women over 80 years of age living in a rural area of south-west Poland.

Material and methods

The following inclusion criteria were used for the study:

- age over 80 years,
- no diagnosed cognitive disabilities,
- ability to independently provide logical responses,
- living in their own household, alone or with family.

Each participant was informed about the aim and methods of the study, and gave informed consent participate.

Participants were visited individually in their households and answered questions from the authors' questionnaire about their nutritional choices, lifestyle habits, well-being and diagnosed diseases. Anthropometric and epidemiologic data were also collected.

The study was conducted between April and November 2015 (7 months of data collection) in Opole and Lower Silesian Voivodeship.

The study was approved by the Bioethical Committee of Opole Medical School.

Statistical analysis was performed by the Statistical Analysis Office at AWF in Wroclaw uisng Statistica 9.0.

Results

Participant characteristics

The study cohort consisted of a group of 145 seniors, 98 women and 47 men. However, 45 people were excluded due to distrust, altered consciousness, or cognitive disorders which affected the questioning. Therefore 100 participants were enrolled for the study, 67 women and 33 men, age 79.6–93.3 (82.97±2.91).

The group characteristics (age, height, weight and BMI) are presented in tab. 1. Most of the participants (76%) lived in small villages, and had a basic (60%) or vocational (20%) education.

Nutritional habits

The frequency of consumption of different food products by the study group is depicted in tab. 2.

Table 1. Characteristics of the studied group of participants

Group characteristics	Women (n = 67)		Men (n = 33)		All (n = 100)	
	The arithmetic mean	Standard deviation.	The arithmetic mean	Standard deviation	Min	Max
Age [years]	82.9	2.7	83.0	3.4	79.6	93.3
Height [cm]	157.9	5.5	170.1	4.8	140.0	180.0
Weight [kg]	68.5	9.9	77.4	8.3	31.0	92.0
BMI [kg/m^2]	27.5	3.8	26.8	2.8	13.8	35.6

Table 2. Selected nutritional behaviours in studied group of women and men

Parameters		Women (n = 67)		Men (n = 33)	
		n	%	n	%
Fish	A few times a week	17	25.4	11	33.3
	Once a week	47	70.1	19	57.6
	Never	3	4.5	3	9.1
Red meat	Everyday	8	11.9	5	15.1
	A few times a week	51	76.2	26	78.8
	Never	8	11.9	2	6.1
Fruit and Vegetables	A few times a day	5	7.5	3	9.1
	Once a day	43	64.2	22	66.7
	Rarely	18	26.8	8	24.2
	Never	1	1.5	0	0
Wholegrain bread	Everyday	24	35.8	11	33.3
	A few times a week	23	34.3	16	48.5
	Never	20	29.9	6	18.2
Dairy	Everyday	50	74.6	12	36.4
	A few times a week	12	17.9	12	36.4
	Never	5	7.5	9	27.2
Confectionery	Everyday	39	58.2	20	60.6
	A few times a week	23	34.3	11	33.3
	Never	5	7.5	2	6.1
Mineral water	More than 10 glasses a day	2	3.0	0	0
	6–10 glasses a day	25	37.3	14	42.4
	3–6 glasses a day	39	58.2	19	57.6
	Never	1	1.5	0	0

In this study only 37% of women and 42% of men drank the recommended 2 litres of water per day.

Wholegrain bread was consumed daily by only 30% of women and men.

Only 17% of women and 9% of men ate fruit and vegetables several times per day, while over 60% of both groups consumed them only once per day.

Dairy products were eaten daily by 60% of women and 30% men. 30% of men totally avoided milk products.

Red meat and its products were prepared several times per week by 76% women and 78% men. Fish was served at least once per week by 70% women and 60% men.

More than 50% of both genders ate sweets every day.

Almost half of participants consumed 2–3 meals per day, while 50% of men and 40% of women had more than 3 meals per day.

When asked about the Food Pyramid and nutritional guidelines for seniors, 45% of respondents of both genders didn't know what it was.

Discussion

Nutritional and lifestyle guidelines for seniors, depicted in the form of a Food Pyramid, aimed to present clear and easy to follow meal preparation guidelines for the elderly, in order to maintain good nutritional status, optimal body weight, physical fitness and overall well-being [8].

Our study showed that seniors aged 80+ were not following the proposals and had scarce knowledge of official nutritional guidelines.

Polish diet and physical activity recommendations for seniors are based on World Health Organization guidelines which suggest decreased sugar, salt and fat intake, along with increased intake of fruit, vegetables and fibre. Recent studies show that increase in intake of vegetables and fresh fruits, that are rich in fibre, water, minerals, vitamins and other phytochemicals (e.g. polyphenols) and low in caloric macronutrients, is correlated with a decrease in cardio-vascular diseases, type 2 diabetes and cancer. This can therefore have a direct impact on the prolongation of healthy life [9,10]. In light of this, vegetables and fresh fruits

are at the base of the pyramid and should comprise half of the food products consumed daily; at least 3 servings of vegetables (300g or more), and 2 serving of fresh fruits (200g).

In our study 65% of women and men consumed only one serving of fruit or vegetables daily. Only 20% women and 10% men were eating vegetables and fruit several times per day.

Low intake of fruit and vegetables by seniors can have several causes, including difficulties in chewing, intestinal bloating and flatulence after fresh products, difficulties in meal preparation (heavy shopping bags, effort needed for rinsing, peeling, cutting and cooking), general lack of appetite, or simply lack of good nutritional habits [5].

Another important factor is the intake of adequate liquids. The food pyramid recommends at least 8 glasses (or 2 litres) of liquids per day. Most of this should be comprised of still mineral water, (with not more then 2 cups of coffee or black tea), herbal and other teas and soups. Sweet beverages should be avoided.

In our study 2 cups of coffee or less was consumed by most of respondents (79% women and 66% men), similarly with sweet beverages (in total 16% women and 21% men drink 3 or more glasses of soda per day). However, the majority of respondents drank inadequate amounts of water. Only 40% women and 42% men drink 6–10 or more glasses of water per day, as recommended by national nutritional guidelines.

Drinking an optimal amount of liquids is particularly important for elderly as they are more sensitive to dehydration, they show higher water perspiration through thinner skin, deteriorating kidney function and reduced excretion of gastrointestinal liquids (e.g. saliva, stomach and pancreas juices) [11]. Moreover, during ageing the anterior midcingulate which forms part of the limbic system of the brain becomes less active, resulting in disturbances in thirst recognition [12]. The elderly cannot rely on intrinsic hydration signalling and should consciously remember to drink adequate fluid volumes each day in order to avoid dehydration and its consequences [13].

Nutritional guidelines recommend the consumption of 3 glasses of milk or fermented milk products (e.g. yoghurt, kefir) per day, occasionally partly replaced with sour cream and different types of cheese (e.g. cottage cheese, camembert etc.). In our study only 30% men and 65% women were eating the advised amount of dairy products each day.

It has been shown that fermented milk products are beneficial for health, particularly for the elderly as they contain living acidophilus milk bacteria, or probiotics. These stimulate the immune system and regulate intestinal microbiota balance, as well as providing easy to digest proteins, vitamins and minerals, and butyric acid (SCFA, short chain fatty acid), which nourishes intestinal cells and diminishes intestinal inflammation [14].

National dietary guidelines suggest eating 5–6 small meals per day, every 2–3 hours. Smaller portions are easier to digest, increase metabolic rate and thermogenesis, and may help in maintaining proper body weight [15,16]. However, with age the sensitivity of taste and smell deteriorates, which, together with digestive disabilities, may cause loss of appetite, loss of interest in eating, or even lead to seniors anorexia [5,17].

As shown in fig. 1 many participants in our study consumed only 3 or fewer meals per day (60% women, 50% men). This could put them at risk of micronutrient deficiencies, malnutrition, lack of energy, and sensitivity to infections and organ dysfunction.

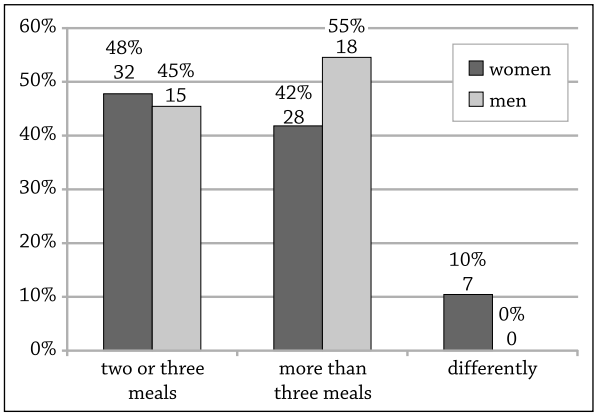

Figure 1. The amount of meals per day in elderly.

Taken together, all of these dietary errors may have contributed to the poor state of health of the study group. All participants declared existing health issues, as shown in tab. 3.

45% of both male and female participants had never heard of the Polish Food Pyramid for Seniors, were not aware of any health guidelines and couldn't describe the

Table 3. Diseases present in group of tested seniors

Diseases		Hyperglycemia	Elevated cholesterol	Hypertension	Arthritis	Osteoporosis	Cardiovascular diseases	Cancer	Stroke
Men (n = 33)	%	18.2	24.2	45.4	39.4	0	33.3	3.0	12.1
	n	6	8	15	13	0	11	1	4
Women (n = 67)	%	20.9	27.3	67.2	55.2	4.5	19.4	3.0	3.0
	n	14	18	45	37	3	13	2	2

basics of healthy eating. This lack of knowledge may be associated with their low education level and/or home location. It has been previously noted that where people live has an impact on nutritional habits in the elderly [18–20]. Previous work has also reported that seniors living in villages or small towns showed more dietary errors and a worse state of health than those living in bigger cities [2].

Our analysis found numerous dietary errors in a group of 100 men and women, aged 80 years or more, and lack of knowledge about food guidelines for seniors. These have the potential to lead to malnutrition, poor health, and a lower quality of life and lifespan.

Education programmes directed to seniors living in rural areas may help in raising nutritional awareness and improving overall health. Further investigation is required to determine the best way of providing this education e.g. alongside routine medical services [21,22].

Conclusions

1. Seniors aged 80 years or more, showed inappropriate nutritional habits including drinking insufficient amount of water, consuming insufficient dairy, fruit and vegetables, and eating too few meals per day.
2. Almost half of participants (45%) had never heard of the Food Pyramid, which may contribute to dietary errors and therefore their state of nutrition and health

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Correspondence address:
Magdalena Golachowska, PhD
Opole Medical School
Katowicka 68, 45-060 Opole
Phone: (+48) 511 868 421
E-mail: m.golachowska@gmail.com

Ewelina Lepsy
Opole Medical School
Katowicka 68, 45-060 Opole
Phone: (+48) 692 121 008
E-mail: klepsy@interia.pl

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IMPACT OF CLASSIC MASSAGE ON THE PRESSURE PAIN THRESHOLD – A PRELIMINARY STUDY

Iwona Wilk[1,2 A,C,E-G]
• ORCID: 0000-0003-4914-8391
Tomasz Matuszewski[2 B]
Magdalena Tarkowska[2,3 B]
Krzysztof Kassolik[1,4 A,D]
• ORCID: 0000-0003-2836-3703
Waldemar Andrzejewski[1,4 D]
• ORCID: 0000-0002-0010-3021
Donata Kurpas[5 E]
• ORCID: 0000-0002-6996-8920

[1] Faculty of Physiotherapy, Department of Cosmetology, Academy of Physical Education, Wrocław, Poland
[2] Complex of Secondary Schools, Wrocław; Field of Study: Massage Therapy Technician, Poland
[3] Department of Traumatic Surgery, Medical University, Wrocław, Poland
[4] Faculty of Physiotherapy, Public Higher Medical Professional School, Opole, Poland
[5] Department of Family Medicine, Medical University, Wrocław, Poland

A – study design, **B** – data collection, **C** – statistical analysis, **D** – interpretation of data, **E** – manuscript preparation, **F** – literature review, **G** – sourcing of funding

ABSTRACT

Background: The pressure pain threshold (PPT) differs by muscle, depends on sex, age, and health status, and alters under the influence of disease. It is interesting to ask how and whether tissue sensitivity changes after the application of therapy.

Aim of the study: The purpose of this study was to assess in healthy individuals the pressure sensitivity of muscles in the torso following a classic massage.

Material and methods: A measurement of the pressure sensitivity of certain muscles of the back (the latissimus dorsi, the trapezius, and the spinal erector) was performed using an algometer before classic back massage and immediately after the procedure. A classic back massage was given to 60 healthy volunteers aged 20–47 years. The massage lasted 20 minutes and the major techniques were performed on selected superficial and deep muscles of the back.

Results: The pressure sensitivity of the muscles decreased after the classic massage. Statistically significant changes were observed in the right ($p < 0.001$) and left ($p = 0.002$) spinal erectors; in the transverse part on both sides ($p < 0.001$), and in the descending part on both sides ($p < 0.001$) of the trapezius muscle; and in the right ($p = 0.008$) and left ($p = 0.004$) of the latissimus dorsi muscle.

Conclusions: Classic massage alleviates tissue sensitivity to pressure in healthy individuals. It can be effective in cases of increased resting muscle tone accompanied by increased tissue sensitivity.

KEYWORDS: muscle diagnosis, pressure pain threshold, massage

Background

The sensitivity of tissues refers to their ability to respond to external stimuli. Tissue sensitivity is inextricably linked to the sensation of pain since, in order to measure sensitivity, we need to determine the moment when the force applied induces pain [1]. Hence, tissue sensitivity to pressure is also described by the pressure pain threshold (PPT), which is the minimum pressure that induces pain or discomfort. A low PPT, as observed in women and people of advanced age, indicates high tissue sensitivity in which even a small stimulus may cause pain receptors to react [2–4]. A high PPT, on the other hand, describes low tissue sensitivity. In this case, a reaction can only be triggered by a strong or long-lasting stimulus [1]. A high PPT is found in young men and is typical of healthy muscles that lack pain symptoms and are not affected by disease [2–5].

The occurrence of pain symptoms is thus accompanied by a change in tissue sensitivity, where the PPT decreases to 2–3 kg/cm^2 or even less [5]. This relation-

ship has been reported in numerous studies [2,5–8]. Using an algometer, Binderpur assessed PPTs in women and men suffering from pain in the cervicothoracic and lumbar regions of the spine, finding differences between healthy individuals and those with chronic pain [2].

Linari-Melfi noted that pain in people complaining of neck problems was related to changes in their tissue sensitivity. People with neck pain showed a greater bilateral decrease in the PPT than those without neck pain [8]. Pain can be, and often is, caused by an abnormal resting tone of muscles and other connective tissue structures, such as fascia. What is more, an altered tone in one connective tissue element can disturb the tone of other the tissues in direct or indirect contact with it. Hence, the pressure sensitivity of tissues that are structurally related may differ. Increased resting muscle tone manifests itself as a higher tissue sensitivity to pressure, and consequently to pain [9–11].

Normalization of the resting tone reduces the tenderness of soft tissues and contributes to the alleviation of pain. Classic massage is a manual procedure involving the manipulation of soft tissues. Massage therapists deal with muscle tension that is typically abnormal and heightened; their goal is to normalize the resting muscle tone. Therefore, a diagnosis pertaining to the tissue is necessary. In classic massage, it is advisable to assess muscle tone and the tissue's sensitivity to pressure, and to determine the quantitative and qualitative aspects of the pain. This enables us to diagnose the problems present in the soft tissues, and thus to choose the appropriate methodology to proceed with. This assessment can also be used to monitor the effectiveness of the therapy.

Pain intensity during massage is assessed by means of one-dimensional pain scales such as the Numerical Rating Scale [12,13], the Visual Analogue Scale [3,12], and the Verbal Rating Scale [14]. It is also possible to use multidimensional scales, such as the Roland Morris Disability Questionnaire [15], the standard Long Form McGill Pain Questionnaire and the Short Form McGill Pain Questionnaire [16,17].

These diagnostic instruments determine with some accuracy the severity and nature of the pain experienced by patients and the level of the patient's ability to function. However, such instruments are time-consuming and reflect patients' subjective feelings.

Questionnaire-based diagnoses should thus be supplemented by the palpation method. Touch can indirectly give information about disturbances of the resting tissue tone and the severity of the pain. The palpation method, however, requires a good knowledge of the basics of anatomy, practical experience, and precise movements to guarantee repeatability [10,18]. Cooperation on the part of the patient-who should be able to differentiate between the feelings of touch, pressure, and pain induced by palpation-is also necessary. One useful characteristic of palpation assessment, and an advantage it possesses over other methods, is that it can be performed without any measuring devices, which is especially important when the appropriate clinical environment is not available or when the transport of equipment is impossible. Palpation assessment should not replace questionnaires that provide details of the qualitative and quantitative aspects of pain; it is a method performed to evaluate the patient's state before massage, and is often employed together with questionnaires and pain scales.

The palpation method is quick, easy, and always available, and so is often used in the work of massage therapists. Unfortunately, it is not objective [10,14,18].

The assessment of muscle sensitivity to pressure by means of an algometer is not only simple and convenient, but is also a reliable, noninvasive, and objective way to evaluate tissue status [5,19,20]. It enables patient diagnosis, limiting its subjectivity and doubts about the severity of the pain [5,11,13,14]. An algometer serves to measure the pain induced by mechanical factors of varying pressure applied to a strictly defined place on the bone attachments or the skeletal muscles [1,5]. Using an algometer, we can determine the minimum applied force that causes pain (the PPT). Algometry objectively shows the level of tissue sensitivity to pressure and the severity of pain; it is also very repeatable and produces reliable measurements [5].

As with palpation assessment, this method requires precise movements, a very good knowledge of soft-tissue anatomy, and experience in locating muscle attachments and the trigger points of muscles [4,9,11].

Algometers can be used both with healthy individuals and with those suffering from chronic pain [4,21,22]. They are used in cases of fibromyalgia, rheumatic diseases, and nonspecific spinal pain [3,23,24]. All these diseases involve abnormal tissue tone and increased sensitivity [3,23,24]. Algometers are also used in various types of soft tissue treatment (treatment of muscular trigger points, fascia mobilization, deep tissue massage, connective tissue massage) to determine and visualize changes in the pressure sensitivity of the structures following therapeutic interventions [21,22].

Aim of the study

The main purpose of this study was to evaluate the pressure sensitivity of selected muscles in the back part of the torso following classic massage of the back. The changes observed in the status of the male and female participants are additionally described.

Material and methods

Participants

The study group consisted of 60 subjects, 37 women and 23 men, aged 20–47 years (tab. 1). The participants were students at the Academy of Physical Education in Wrocław and the Complex of Secondary Schools in

Wrocław. The criteria for inclusion in the study were as follows: the participants were school or university students, entered the study voluntarily, and stated that they had good health and a lack of current pain symptoms (no diseases, new injuries, euphoria or strong negative emotions experienced recently (1–3 months), no rehabilitation or drugs taken recently), as well as a lack of contraindications against massage (for example, fever, skin breakdown, advanced pregnancy). The criteria for exclusion from the study were: not being a student, disease symptoms, new injuries, malaise on the given day, contraindications against classic massage. Age was not a criterion for inclusion in the study, as the university students were 20–25 years old, while students of the vocational college were adults aiming to improve their vocational qualifications. It should be emphasized that only one participant of the study was as old as 47 years old.

The project was presented to the students and pupils as a part of massage classes. Those who wished to take part filled in a form confirming that they were entering the study of their own free will and that they had received all necessary information about the procedures, the course, and the purpose of the trial. Patients could quit at any stage of the experiment. The study involved only volunteers. The respondents did not report any pain complaints and stated that, during the last three months, they had not used analgesic or sedative agents and had not undergone physiotherapy. They also stated that, prior to the study, they had not experienced any strong emotions (stress or anger due, for example, to exams, illness, accidents, or euphoria or happiness due to, for example, falling in love) as a result of a sudden event, which could have an indirect effect on the results of measurement. This study did not use scales or psychological questionnaires that might illustrate various states of the participants' nervous systems. We did not use any questionnaire to evaluate health status (such as presence or absence of symptoms in the back area). The only source of information about such symptoms was the participants' declaration of their good health, which was one of the criteria for inclusion in the study. What is more, every student undergoes compulsory periodic medical examination at the university or school, and so were all counted as healthy individuals. We are aware that a questionnaire would provide us with more details about the students' health status, and this information could contribute to the results. In our study, we focused on performing the massage properly and taking measurements using the algometer. It should be emphasized that the students demonstrated good skills in this field. The nonuse of a questionnaire is a limitation of our study (see the Limitations section).

The research documentation consisted of the patients' consent to participate in the study, a measurement card (recording the algometer measurements), and a personal questionnaire of the authors' own design that inquired about the participant's physical and mental states and any medications taken. The study was conducted from September 2014 to March 2015.

Table 1. Participants' sociodemographic data.

Study group (n = 60)		**Mean±SD (n = 60)**
Gender	female	37 (61.6%)
	male	23 (38.4%)
Age	female	28.49±9.12
	male	25.83±6.07
Height [ft]	female	5.41±1.27
	male	5.84±2.6
Weight [lbs]	female	128.9±18.7
	male	165.4±19.8

Experimental protocol

The experiment was performed by two vocational college students, with one making pressure sensitivity measurements and the other performing the massage. The aim of this procedure was to assess the contribution of massage to the normalization of resting muscle tone, and thus to a change in tissue pain sensitivity.

We chose classic massage of the back, as massage of this part of the body brings the greatest relaxation, eliminates fatigue, and facilitates rest and asleep [25,26].

It is safe, noninvasive, easy to perform, repeatable, and does not require specialist equipment [27,28]. It is the most popular type of massage in the world [29]. The massage methodology is simple, involving basic massage techniques performed in accordance with the layer principle, in the right direction, and with a definite number of repetitions. What is more, classic massage of various selected parts of the body, including the back, was this type of massage in which the students had the greatest practical experience.

Pressure sensitivity was measured on the latissimus dorsi and the trapezius muscles (descending and transverse parts). These muscles were chosen as they are large and superficial, and thus easily accessible. Additionally, we examined the spinal erector, a long muscle with a distinct final bone attachment, which facilitated measurement and reduced the probability of measurement errors. What is more, the trapezius muscle is very sensitive to stress: it reacts quickly to mental discomfort, which manifests as increased resting tone [30,31]. The measurement method used involved an algometer, which guaranteed objective results. The patients pushed one end of the device themselves when they felt the pain caused by the massage therapist pressing with the other end. The initial position for the massage was lying on the front of the body; the lack of visual and verbal contact prevented the massage therapist from influencing the patient's decisions. With the patient lying prone, the massage therapist has access to the back part of the trunk on both sides of the body, without needing to reposition the patient during the mas-

sage. The upper limbs were placed alongside the torso, and the lower limbs were slightly bent at the knee and ankle joints, with wedges placed under the ankle joints. The face was leaned against the frame.

The algometer used in our study was constructed at Wrocław Technical University specifically for this project, according to the specifications of personnel at the massage department of the Academy of Physical Education in Wrocław.

The research protocol involved completing the necessary documents (such as consent forms, the statements of the participants' emotional state, and tables with the results), giving instructions on the course of the procedure and on how to behave during the measurement, and performing trial measurements. Then the patient was correctly positioned for the massage, tissue sensitivity to pressure was measured prior to massage, classic massage was performed, and a repeat measurement was made of tissue sensitivity.

Prior to the study, the procedure was described to the participants; they were told how to behave during the measurements, and that they could withdraw from the study. At the beginning, a trial measurement was performed so that the patient could differentiate between the feeling of pressure and the feeling of pain and stop the algometer at the right moment. Next, a real measurement was performed on the bone attachments of certain back muscles.

Our study was based on PPT measurements made with an algometer before and immediately after classic massage. This device, along with the other methods, allowed us to evaluate the initial state, the changes that occur during a series of sessions, and the final effect of the therapy.

Methodology of massage

The methodology of classic massage involves correctly positioning the patient (to lie on the front of the body with wedges placed under the ankle joints, above the anterior superior iliac spines, and under the shoulder girdles) to ensure relaxation of the maximum number of muscles and the correct flow of venous blood and lymphatic fluid. The position was safe and comfortable for both the patient and the massage therapist (fig. 1), causing the joints to take up a middle position. Thus, the attachments of the majority of muscles that could influence the arrangement of the pelvis and the spine were close to each other, resulting in the relaxation of the maximum number of muscles. This gave the patient a feeling of whole-body relaxation. The patient was covered with a sheet for comfort, with only the part of the body being massaged remaining uncovered. The room was warm and silent. The massage therapist did not talk to the patient, and no sounds penetrated from the outside. If the wedges used in this type of massage are not available, rollers or rolled-up blankets may be employed; what is more important is the knowledge of how to place the wedges to ensure safety and comfort for the patient. The procedure can also be performed in other positions, such as lying on the side; this also requires wedges to be placed properly under the head and under the lower and upper limbs; the position of the patient must then be changed to the other side during the procedure in order to manipulate both sides of the body [18].

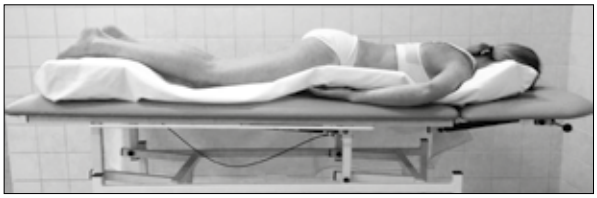

Figure 1. The prone lying position.

The methodology of classic back massage consists of three parts. The first part involves manipulating the skin and back fascia using appropriate techniques. In this part, we applied superficial stroking with and against the hair, as well as deep stroking. Next, we moved the skin within the range of its mobility, rolled the skin, and applied spiral friction. The first part lasted six minutes. In the second part, we manipulated muscles—first the superficial ones and then deeper muscles. In this part, we applied transverse kneading of the latissimus dorsi muscle, and then of the descending, transverse, and ascending parts of the trapezius muscle. We then manipulated the smaller and larger rhomboid muscles, the supraspinatus muscle, and the infraspinatus muscle using a spiral friction technique. We repeated the transversal kneading of the upper part of the latissimus dorsi muscle and the infraspinatus muscle, thus indirectly manipulating the teres minor and teres major muscles. The main part of the massage also included transversal kneading of the spinal erectors (to C6) on both sides of the spine. The final action in this stage was to rub the quadratus lumborum muscle (by stroking and friction performed together with the lateral part of the hand). We allowed ten minutes for the second part. During the third part of the massage—which was the shortest, lasting only three minutes—we applied deep stroking of the back and spiral friction to the supraspinous ligament. The whole session lasted 20 minutes [27,28].

Measures

Measurements of pressure sensitivity were performed on the latissimus dorsi, spinal erector, and trapezius muscles. The latissimus dorsi was assessed at the outer lip of the iliac crest (at its highest point), the spinal erectors were assessed at the posterior superior iliac spine, the descending part of the trapezius muscle was evaluated on the distal (shoulder) end of the clavicle, and the transverse part was assessed at the acromion process of the scapula [11]. Measurements were performed on the tendinous attachment of the muscle to the bone. The methodology was based on the research which demonstrated a positive correlation between measurements taken at the belly of the mus-

cle (the trigger point) and measurements at the bone attachment (the tendinous part), which indicated that measurements of tissue sensitivity to pressure in these two places are equally good and reliable [11]. Measurement at the bone is also easier to perform, because this place is easier to locate by palpation. The students had the theoretical knowledge and practical skills needed to find bone attachments of the muscles, which was why this measuring method was chosen. We could thus assess the state of the muscle based on the measurement at the bone attachment.

The next stage of the study involved classic massage of the back. Immediately after the procedure, the pressure sensitivity of the same muscle attachments was measured once again. Measurements were taken on the left and the right side of the body in the prone lying position. The results were recorded on a special card created specifically for this study.

Data analysis

Statistical analysis of the results was conducted using the statistical software R (version 3.1.3) running on OS X EI Capitan (version 10.11.5)

The pressure sensitivity results obtained for each measurement site were summed, and the population mean value of the pressure force was calculated for each muscle. The distribution of the measurement results [paired variables] in the study group diverged significantly from the normal distribution, which was verified by the Shapiro–Wilk test for $p = 0.05$. Hypotheses about the lack of differences were thus tested using the Wilcoxon signed rank test (in the paired two-sample case) and the nonparametric test for the paired variables. This test verified the null hypothesis that the x–y distribution (in the paired two-sample case) is symmetric about 0 and the one-sided alternative hypothesis that x is shifted to the right of y.

The study sample was relatively large (60 subjects). Since showing all the raw measurement results would require a 60-line table, for reasons of space—and since the distributions of the parameters examined here were close to the normal distribution—we present only the mean values and standard deviations (M±SD). The independent variables (age, weight, and height) had normal distribution, and so were characterized using means and standard deviations.

Results

All volunteers (60 subjects) who entered the research project met the inclusion criteria.

The measurements are presented in tab. 2, which shows the mean values of tissue sensitivity to pressure on the left and the right sides of the body, as well as a comparison of these values before and after massage.

The average PPT values on the bone attachments of all investigated muscles increased after massage. We observed that the massage had a statistically significant impact on the PPT values for all the studied muscles ($p < 0.05$) on both sides of the body. In the female

Table 2 . Comparison of mean values of PPT in the study group on the left and the right sides of the body, before and after massage.

	All groups (n = 60)	**mean**	**standard deviation**	**Q_1**	**median**	**Q_3**	**min**	**max**	**Shapiro–Wilk test p_1**	**Wilcoxon signed rank test p_2**
	Age	27.47	8.14	21.75	25.00	29.25	19.00	49.00	0	—
M1	Right latissimus dorsi before (y)	5.71	1.70	4.78	5.78	6.65	1.98	8.97	0.33858	0.00880
	Right latissimus dorsi after (x)	6.06	1.82	4.88	6.10	7.40	2.10	10.00	0.59157	
M2	Right erector spinal before	5.95	1.65	4.74	6.24	7.27	2.58	8.62	0.01800	0.00031
	Right erector spinal after	6.43	1.74	5.34	6.80	7.78	2.12	9.53	0.05430	
M3	Right trapezius muscle, transverse part before	4.06	1.14	3.19	4.02	4.69	1.61	8.01	0.08099	0.00003
	Right trapezius muscle, transverse part after	4.56	1.52	3.37	4.29	5.44	1.22	9.67	0.00281	
M4	Right trapezius muscle, descending part before	3.53	1.08	2.89	3.34	4.21	1.43	6.12	0.62130	0.00001
	Right trapezius muscle, descending part after	4.08	1.37	3.04	3.79	5.11	1.61	7.87	0.07338	
M5	Left latissimus dorsi before	5.64	1.77	4.38	5.64	6.72	1.99	10.00	0.84169	0.00417
	Left latissimus dorsi after	5.96	1.74	4.80	6.13	7.03	2.65	10.00	0.59184	
M6	Left erector spinla before	5.89	1.60	4.73	5.99	6.97	2.65	8.89	0.41700	0.00289
	Left erector spinal after	6.29	1.66	4.96	6.44	7.74	2.98	9.42	0.06249	
M7	Left trapezius muscle, transverse part before	4.09	1.31	3.22	3.90	4.70	1.58	8.65	0.00741	0.00046
	Left trapezius muscle, transverse part after	4.42	1.21	3.54	4.28	4.99	2.03	8.79	0.03298	
M8	Left trapezius muscle, descending part before	3.41	1.06	2.87	3.20	3.85	1.38	7.15	0.00863	0.00011
	Left trapezius muscle, descending part after	3.83	1.33	2.99	3.50	4.84	1.18	7.24	0.04528	

n: number of observations; Q_1: 25% quantile ; Q_3: 75% quantile; p_1: approximate p-value for Shapiro–Wilk test of normality; p_2: approximate p-value for Wilcoxon signed rank test of the null hypothesis that the distribution of x–y (in the paired two-sample case) is symmetric about 0, and the one-sided alternative hypothesis that x is shifted to the right of y

group, statistically significant changes were observed in all muscles on the right and left sides. In the male group, statistically significant changes were observed only in the transverse part on the right side (p = 0.001) in the descending part on the right side (p = 0.001), and on the left side (p < 0.001) of the trapezius muscle (tab. 3).

In the younger group (age ≤ 25 years), statistically significant changes were observed in all muscles, on the right and left sides. In the older group (age > 25 years), statistically significant changes were observed in all muscles, except on the right side (p = 0.092) of the latissimus dorsi and on the left side (p = 0.152) of the spinal erector (tab. 4).

Discussion

Massage and tissue sensitivity in healthy and dysfunctional individuals

The results of our study demonstrate changes in tissue sensitivity to pressure after massage. They reflect the contribution of classic massage to changes in the

Table 3. Characterization of changes in mean values of PPT on the left and the right sides of the body before and after massage, in the female and male groups.

Group			mean	standard deviation	Q_1	median	Q_3	min	max	Shapiro–Wilk test p_1	Wilcoxon signed rank test p_2
Female (n = 37)		Age	28.49	9.12	21.00	25.00	34.00	19.00	49.00	0.00016	—
	M1	Right latissimus dorsi before	5.20	1.57	4.50	5.42	6.12	1.98	8.48	0.47636	0.00727
		Right latissimus dorsi after	5.63	1.82	4.47	5.46	7.00	2.10	9.50	0.79566	
	M2	Right erector spine before	5.58	1.66	4.63	5.73	6.77	2.65	8.62	0.36120	0.00009
		Right erector spine after	6.24	1.71	4.97	6.11	7.57	2.12	9.53	0.26324	
	M3	Right trapezius muscle, transverse part before	3.78	1.07	2.91	3.76	4.63	1.61	6.50	0.37159	0.00295
		Right trapezius muscle, transverse part after	4.27	1.48	3.21	3.91	5.32	1.22	9.67	0.00399	
	M4	Right trapezius muscle, descending part before	3.37	1.09	2.67	3.14	4.09	1.43	5.77	0.67325	0.00001
		Right trapezius muscle, descending part after	3.91	1.39	3.02	3.66	4.73	1.61	7.75	0.10753	
	M5	Left latissimus dorsi before	5.25	1.65	3.66	5.54	6.20	1.99	8.54	0.36456	0.00085
		Left latissimus dorsi after	5.65	1.70	4.12	5.97	6.75	2.65	10.00	0.13133	
	M6	Left erector spine before	5.69	1.43	4.71	5.57	6.78	2.99	8.09	0.31690	0.00167
		Left erector spine after	6.18	1.71	4.94	6.54	7.49	2.98	9.42	0.12205	
	M7	Left trapezius muscle, transversal part before	3.89	1.24	3.22	3.63	4.29	1.58	8.65	0.00141	0.00167
		Left trapezius muscle, transversal part after	4.29	1.33	3.37	3.98	4.98	2.03	8.79	0.02560	
	M8	Left trapezius muscle, descending part before	3.29	0.93	2.96	3.22	3.53	1.38	5.55	0.02288	0.02010
		Left trapezius muscle, descending part after	3.57	1.27	2.97	3.44	3.89	1.18	7.24	0.08200	
Male (n = 23)		Age	25.83	6.07	22.50	25.00	27.00	19.00	48.00	0.00025	—
	M1	Right latissimus dorsi before	6.53	1.59	5.47	6.23	7.83	3.17	8.97	0.46330	0.21370
		Right latissimus dorsi after	6.75	1.63	5.93	7.13	7.58	3.09	10.00	0.23373	
	M2	Right erector spine before	6.55	1.48	5.93	7.09	7.52	2.58	8.62	0.01192	0.16470
		Right serector spine after	6.73	1.78	5.72	7.10	7.97	2.26	9.49	0.32054	
	M3	Right trapezius muscle, transversal part before	4.51	1.14	3.86	4.44	4.88	2.35	8.01	0.04054	0.00106
		Right trapezius muscle, transversal part after	5.01	1.50	4.17	5.01	5.71	2.46	9.35	0.32120	
	M4	Right trapezius muscle, descending part before	3.80	1.02	3.05	3.59	4.42	2.48	6.12	0.21510	0.00175
		Right trapezius muscle, descending part after	4.35	1.34	3.29	4.52	5.17	2.39	7.87	0.23583	
	M5	Left latissimus dorsi before	6.27	1.81	5.12	6.00	7.46	2.70	10.00	0.80859	0.20850
		Left latissimus dorsi after	6.46	1.72	4.97	6.29	7.71	3.35	10.00	0.49094	
	M6	Left erector spine before	6.19	1.84	4.89	6.24	7.66	2.65	8.89	0.50877	0.23170
		Left erector spine after	6.46	1.59	5.19	6.34	7.83	3.74	9.08	0.37127	
	M7	Left trapezius muscle, transverse part before	4.40	1.37	3.40	4.19	4.97	2.01	7.29	0.75120	0.05686
		Left trapezius muscle, transverse part after	4.65	0.95	3.84	4.71	5.00	3.23	6.54	0.32292	
	M8	Left trapezius muscle, descending part before	3.61	1.25	2.70	3.12	4.31	2.08	7.15	0.05635	0.00024
		Left trapezius muscle, descending part after	4.25	1.36	3.21	4.16	5.05	2.33	7.12	0.39971	

pressure sensitivity of the manipulated tissues—both those that are superficial and those located deep in the back. They show that massage reduces sensitivity to pain by normalizing the resting muscle tone.

This result is essential information both for healthy individuals who wish to maintain good health and for individuals who suffer from symptoms and dysfunctions within soft tissues. Healthy people should be aware that sedentary lifestyle, work, improper habitual posture, and stress can lead to changes in resting tone and sensitivity to manual stimulation of superficial and deep tissues, which may lead to pain symptoms over time [4]. It is important that healthy young people avoid pain in the soft tissues [26,29]. Our study involved healthy individuals and demonstrated a noteworthy influence of massage on PPT values. A statistically significant difference between the PPT value before and immediately after therapy was observed in all the investigated muscles. The results show that massage visibly reduces muscle tone, and thus sensi-

Table 4. Characterization of changes in mean values of PPT on the left and the right sides of the body before and after massage, in younger and older groups.

Group			mean	standard deviation	Q_1	median	Q_3	min	max	Shapiro–Wilk test p_1	Wilcoxon signed rank test p_2
Younger (age ≤ 25 years) (n = 32)		Age	22.03	2.16	20.00	22.00	24.00	19.00	25.00	0.00150	—
	M1	Right latissimus dorsi before	5.81	1.63	5.24	5.90	6.65	1.98	8.70	0.15892	0.01971
		Right latissimus dorsi after	6.26	1.88	5.05	6.68	7.40	2.10	10.00	0.62384	
	M2	Right erector spinal before	6.18	1.53	5.12	6.50	7.26	2.58	8.62	0.05360	0.02885
		Right erector spinal after	6.58	1.75	5.81	7.05	7.65	2.12	9.53	0.07852	
	M3	Right trepezius tranversal part before	4.02	0.99	3.19	4.09	4.67	1.61	5.79	0.50954	0.00557
		Right trapezius transversal part after	4.50	1.52	3.48	4.22	5.41	1.22	9.67	0.04244	
	M4	Right trapezius descending part before	3.43	1.03	2.86	3.31	4.09	1.44	5.54	0.90229	0.00041
		Right trapezius descending part after	3.98	1.26	3.06	3.75	5.11	1.81	6.28	0.17730	
	M5	Left latissimus dorsi before	5.86	1.57	5.01	5.97	6.76	2.45	10.00	0.89200	0.04692
		Left latissimus dorski after	6.23	1.76	5.01	6.43	7.16	2.78	10.00	0.61991	
	M6	Left erector spinal before	6.07	1.56	5.23	6.34	6.97	2.65	8.89	0.20612	0.00304
		Left erector spinal after	6.66	1.55	5.66	6.98	7.74	2.98	9.42	0.19615	
	M7	Left trepezius tranversal part before	4.18	1.42	3.34	3.98	4.92	1.58	8.65	0.10868	0.00419
		Left trepezius tranversal part after	4.60	1.34	3.76	4.50	5.49	2.03	8.79	0.17022	
	M8	Left trapezius descending part before	3.29	0.87	3.02	3.25	3.81	1.38	4.90	0.40528	0.01546
		Letf trapezius descending part after	3.66	1.41	2.77	3.45	4.20	1.18	7.24	0.01902	
Older (age > 25 years) (n = 28)		Age	33.68	8.01	27.00	31.00	40.50	26.00	49.00	0.00063	—
	M1	Right latissimus dorsi before	5.59	1.80	4.57	5.48	6.45	2.22	8.97	0.68464	0.09289
		Right latissimus dorski after	5.83	1.75	4.47	5.83	7.24	3.15	9.77	0.46535	
	M2	Right erector spinal before	5.69	1.78	4.25	5.64	7.28	2.65	8.59	0.18408	0.00059
		Right erector spinal after	6.25	1.74	4.44	6.34	7.79	3.16	9.07	0.07701	
	M3	Right trepezius tranversal part before	4.11	1.31	3.19	3.98	4.73	2.49	8.01	0.01914	0.00044
		Right trapezius transversal part after	4.61	1.54	3.19	4.66	5.44	2.67	9.35	0.01781	
	M4	Right trapezius descending part before	3.66	1.13	2.91	3.43	4.29	1.43	6.12	0.78040	<0.00001
		Right trapezius descending part after	4.19	1.52	3.04	4.07	5.02	1.61	7.87	0.16117	
	M5	Left latissimus dorsi before	5.38	1.98	3.66	5.53	6.68	1.99	9.53	0.46726	0.01089
		Left latissimus dorski after	5.66	1.69	4.06	5.81	7.01	2.65	8.48	0.33621	
	M6	Left erector spinal before	5.67	1.65	4.70	5.53	6.86	2.99	8.82	0.34322	0.15270
		Left erector spinal after	5.86	1.71	4.21	5.91	7.61	3.32	8.71	0.05303	
	M7	Left trepezius tranversal part before	3.98	1.18	3.22	3.69	4.57	2.33	7.29	0.02687	0.02387
		Left trepezius tranversal part after	4.23	1.02	3.43	4.11	4.86	2.42	6.36	0.50989	
	M8	Left trapezius descending part before	3.56	1.25	2.84	3.17	4.14	1.73	7.15	0.00811	0.00014
		Letf trapezius descending part after	4.02	1.24	3.18	3.55	5.15	1.41	6.11	0.05788	

n: number of observations; Q_1: 25% quantile; Q_3: 75% quantile; p_1: approximate p-value for Shapiro–Wilk test of normality; p_2: approximate p-value for Wilcoxon signed rank test of the null hypothesis that the distribution of x–y (in the paired two-sample case) is symmetric about 0 and the one-sided alternative hypothesis that x is shifted to the right of y.

tivity to pressure. Massage could be used as a prevention method to ensure regeneration and relaxation of the muscles.

The results obtained make us consider whether this method, used so successfully in healthy individuals, can also effectively reduce tissue tone and sensitivity in people suffering from soft tissue diseases (rheumatic diseases, fibromyalgia, myopathy), in elderly people, and in those with motor organ dysfunctions [3,23,24]. Such conditions often entail increased resting muscle tone and sensitivity to pain [3,23,24]. Massage could help alleviate pain, which is a dominant symptom of these conditions. Additionally, it could support the process of restoring muscle function by regulating and normalizing tissue tone and sensitivity, and prepare patients for rehabilitation.

Tissue sensitivity to pressure and muscle tone

Many authors have emphasized that abnormal tissue sensitivity to pressure is a manifestation of increased resting muscle tone, which accompanies nonspecific back pain and exertional muscle pain, and is also observed in rheumatic diseases, and fibromyalgia [3,23,24].

High sensitivity to pain in the deltoid muscle and the quadriceps muscle of the thigh has been observed in patients with diagnosed rheumatic disease [24]. Increased pressure sensitivity was also demonstrated in patients with chronic nonspecific spinal pain and in patient with lower back pain [3]. The studies mentioned above focused on changes in tissue sensitivity to pressure in people with pain complaints. All their authors unanimously agreed that there was a significant association between severity of pain and the PPT values. On the basis of his study, Somprasong observed that higher sensitivity of tissue to pressure was accompanied by more severe pain sensations [32]. Imamura observed a strong correlation between pain intensity and increased pressure sensitivity of the gluteus medius and iliopsoas muscles [3]. The studies confirm that one symptom entails the other. It is crucial that this relationship be taken into account. The reduction in tissue sensitivity to pressure, and thus to pain sensation, through the normalization of the resting tissue tone is the overriding goal of many therapeutic interventions [3,32]. This goal can be achieved by using massage as an effective, appropriate, and recommended method for dealing with muscle dysfunctions.

The literature repeatedly underlines the fact that, as an element of therapeutic intervention, massage has positive effects on the body, normalizes resting muscle tone, has an analgesic effect, reduces fatigue, stimulates the regeneration of tissues, improves blood supply to the manipulated structures, and affects mechanoreceptors and proprioreceptors [33–35]. However, these mechanisms have not yet been fully explored, understood, or accurately described. It is therefore important to present the effects of therapy using research and diagnostic instruments that provide objective information on the changes that occur in tissues following massage. Our trial is an example of using an algometer during massage to measure tissue sensitivity. The results obtained through massage and certain physical procedures in people with muscle pain are being increasingly often presented in the form of algometer measurements, as this is an objective method [36–38]. Together with palpation assessments, questionnaires, and surface electromyography, algometry gives a complete picture of the changes in tissues subsequent on the use of therapeutic methods [4,38].

Our study demonstrates that massage therapy, which essentially aims to normalize resting muscle tone, contributes to a decrease in tissue sensitivity to pressure. It is thus recommended to use massage for the relief of pain caused by abnormal resting muscle tone, and to check whether the desired effect, in the form of a higher PPT value, has been obtained. Numerous studies have presented the effects of various therapies, including types of massage, on PPT values [3–4,36,37]. One considered the effects of classic and connective tissue massage on the change in pain sensitivity in young women with a diagnosis of chronic neck pain. In that study, PPT was determined by means of an algometer and muscle activity was measured by surface electromyography. The evaluation was performed on the sternocleidomastoid muscles on both sides of the body. The first type of massage involved manipulation of the upper back and neck area using mainly classic (Swedish) massage techniques. The second type of massage—connective tissue massage—included manipulation of the lumbar region of the spine, then the scapula area, and then the neck and occiput areas. Each massage session lasted twenty minutes. After the classic massage session, the sensitivity to pressure of the tested tissues decreased, while the connective tissue massage resulted in reduced activity in the tested muscles. These effects confirmed previous reports on the contribution of classical massage to pain relief and, consequently, to an increase in the PPT value [36,37]. Reduction in tissue sensitivity, resting muscle tone, and pain is the desired therapeutic effect, but also provides vital diagnostic information during the rehabilitation process [36,37].

Effects of massage: sex and age

We also considered the effect of the massage by the sex and age of the participants, and found that these aspects contributed to the results of therapy. In female and younger participants (≤ 25 years of age), changes were observed in all the tested back muscles. In males, massage only decreased the sensitivity of the trapezius muscle, while in older participants (> 25 years of age), massage did not alter the PPT of two muscles on one side of the body. These results could be associated with the strength and time of the stimuli employed. One massage session could be an insufficient stimulus to trigger changes in the spinal erector, which is a

deep muscle and may need longer and stronger stimulation [13,14].

PPT values vary depending on the type of muscle and its location [39,40], so the muscles could react differently to a single massage session. What is more, the differences in initial PPT values between women and men (being higher in men) suggest a logical explanation for why the stimulation in men needs to be longer or repeated several times to achieve a decrease in these values.

The women had lower PPT values both before and after massage. This result corresponds with Fischer's theory that healthy men have a higher PPT and lower sensitivity to pressure and pain than women [5]. The results of our study were similar to those obtained by other authors, who found that PPT values in healthy subjects are usually characterized by differences between people of differing sex and age, that women have a lower PPT than men, and that tolerance to pain decreases with age [1,6,7,9].

What we want to emphasize, however, is that the main goal of our study was to demonstrate the positive effect of classic massage on the sensitivity to pressure of the manipulated tissues. Since the procedure decreased the pressure sensitivity of the manipulated structures in healthy individuals, it could also be applied on a wider scale—for example, in patients with chronic increased resting muscle tone and back pain syndrome, in whom the reduction of pain tissue sensitivity could be even more apparent and could have therapeutic effects. We suggest that massage be used as a form of manual therapy that normalizes resting muscle tone, and may thus reduce sensitivity tissues to touch, pressure, and pain.

Limitations

In our study, measurements were only taken at selected muscle attachments of particular muscles, without taking into account their trigger points.

The research would be worth conducting on a larger study sample, including comparison between healthy volunteers and patients with chronic diseases of the osteomuscular system.

In the study described here, each measurement was taken once immediately after the procedure—that is, 30 seconds after massage. In many reports, tissue sensitivity was measured 4 or 10 minutes after massage. In our study, the measurements were performed immediately after the end of the massage session, which was methodologically correct, but made it impossible to compare the results with those obtained by other authors (as we cannot compare measurements taken in different time intervals).

It is recommended that, in the future, the research methodology includes measurements taken at specific time intervals, and in particular, at longer time intervals after massage. This will provide a more detailed picture of changes in the pressure sensitivity of the manipulated tissues that occur after massage, and will show the permanence of the therapeutic effect. The above suggestions will be taken into consideration in our future work.

In our study, no questionnaires were used to assess the participants' mental status, and no valid questionnaires were employed to measure their pain or physical status, or to check whether they suffer from diseases. The methodology of future research on muscular and skeletal system problems should include such instruments.

The research was carried out on healthy people, which significantly limits the possibility of comparing the obtained results with the research of other authors. In the future, the research will be supplemented with a control group and a measurement after a certain time from the application of a massage (for example one month) to assess long-term effects.

Conclusions

This study reported that classic massage performed on healthy individuals raises their PPT values. The investigation provides the basis for further clinical studies on chronic lower back pain. The evaluation of changes in tissue sensitivity to pressure after massage should be made objective with the use of an algometer.

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Correspondence address:
Iwona Wilk PT, PhD
Physiotherapy Group,
University School of Physical Education in Wroclaw
Al. I. J. Paderewskiego 34 Str.
Wroclaw, Poland
Phone: (+48) 510 410 296
E-mail: iwona.wilk@awf.wroc.pl

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EFFECTS OF CAVITATION PEELING AND DIAMOND MICRODERMABRASION ON SELECTED SKIN PARAMETERS

Dorota Dybaś[B-F]
• ORCID: 0000-0001-7276-6767
Iwona Dzieńdziora[A]
• ORCID: 0000-0002-5800-7817

Faculty of Health Sciences, Opole Medical School, Poland

A – study design, **B** – data collection, **C** – statistical analysis, **D** – interpretation of data, **E** – manuscript preparation, **F** – literature review, **G** – sourcing of funding

ABSTRACT

Background: Peeling is a method of exfoliation. This type of treatment is carried out to completely or partially remove layers of the epidermis. With this treatment, it is possible to get rid of cosmetic defects or superficial lesions. The most common indications for performing peeling include, among others, the renewal of aging skin, the alleviation of pigmentary changes, and the leveling of acne scars.

Aim of the study: To evaluate the influence of cavitation peeling and diamond microdermabrasion on skin parameters such as skin structure, sebum level, dead skin level, size of sebaceous gland leaks, and degree of skin hydration.

Material and methods: A group of 10 women between the ages of 21 and 24 participated in this research. They underwent a treatment of cavitation peeling and diamond microdermabrasion. The skin analyzer, Beauty of Science's Nati Analizer, was used to evaluate particular skin parameters.

Results: The skin structure after both treatments is correct and the results have changed slightly. The skin of patients before the treatments was characterized by a tendency toward greasiness. After the treatments, the skin adopts the parameters of dry skin. In the case of hydration measurements for the T and U zones after the treatments, the values increase, but are still incorrect. After the cavitation peeling, the epidermis peels off in small amounts, whereas microdermabrasion provokes the skin to excessive exfoliation. The results obtained indicate that both treatments favorably reduce the width of the sebaceous glands.

Conclusions: Cavitation peeling and diamond microdermabrasion improve the functioning of oily and mixed skin. The results obtained indicate stimulation and provocation of the skin to an intensified level of reconstruction of the epidermis and dermis. Cavitation peeling adeptly cleanses the skin of its cover of older epidermis while microdermabrasion intensifies the skin regeneration processes.

KEYWORDS: cavitation peeling, diamond microdermabrasion, exfoliation

Background

Peeling is a method of exfoliation. The essence of the treatment is the complete or partial removal of layers of the epidermis in order to get rid of cosmetic defects or superficial lesions. Peels make the skin soft and its surface smooth, but consequently, it also becomes more sensitive to the effects of mechanical, thermal, and chemical factors [1]. Cavitation peeling and diamond microdermabrasion belong under the category of mechanical surface peelings; they are safe and they feature a low percentage of complications. This undoubtedly influences their high popularity, especially among customers of beauty salons. Exfoliation during this type of treatment involves only the epidermis, therefore the risk of scars is small. Undoubtedly, the great advantage of surface peels is that they do not cause the skin to change in ways which could serve to exclude the patient from everyday life. In the case of cavitation peeling and diamond microdermabrasion, the coloring of the skin or skin type (according to Fitzpatrick's classification) is also irrelevant [2]. The most common indications for peeling are the renewal of aging skin, the alleviation of pigmented lesions, the removal of the harmful effects of ultraviolet rays (UV), and the reduction of acne scars [1].

Cavitation peeling works superficially as it is a type of mechanical peeling. This method involves the use of ultrasounds to stimulate cavitation. During this treatment, the skin becomes temporarily reduced in pressure and gas bubbles form which, by breaking, release large

amounts of energy, thus detaching dead cells from the corneum layer [3]. Diamond microdermabrasion consists of mechanical exfoliation of the superficial layers of the epidermis using a head coated with diamond microcrystals. The epidermis is removed layer by layer until the desired level of exfoliation is obtained [4].

The study determined the effects of mechanical peels on selected skin parameters. Expected benefits include the exfoliation of cosmetic defects, the improvement of oily and combination skin function, the reduction of sebaceous secretion, lightening of any hyperpigmentation, smoothing of keratinized epidermis, stimulation and enhancement of epidermis and dermis reconstruction, and an overall improvement of skin structure.

Aim of the study

The objective is to evaluate the influence of cavitation peeling and diamond microdermabrasion on skin parameters such as skin structure, sebum level, dead skin level, the size of sebaceous gland leaks, and the degree of skin hydration.

Material and methods

The research was carried out after obtaining approval from the university's authorities and the bioethics commission. The treatments involved a group of 10 women between the ages of 21 and 24 (x = 22 years, SD +/- 1.05). Each client underwent a one-time treatment of cavitation peeling followed by diamond microdermabrasion. The interval between each treatment was 8 weeks. The patients were deemed to qualify for the procedure after a detailed interview, as well as an assessment of their current skin condition, and the elimination of any contraindications. The research group had oily or mixed skin, with phototype II and III (according to Fitzpatrick's classification).

The treatments were performed from December to February between the hours of 9.00 and 13.00, in order to keep the same measurement and evaluation time for each patient. The room temperature during the examination was stable in the 20–22°C range, while the relative humidity fell between 50–60%. The clients were informed in advance about the need for photoprotection after the end of the treatments and that on the day of the procedure, they were not to apply any facial cosmetics.

Cavitation peeling was carried out using the Biomak ultrasound device. Ultrasound waves with a vibration frequency of 25 kHz were used. Parameters such as a pulsing operation and galvanic current were turned off. The treatment time was 10 minutes.

A NOVA device was used to perform the diamond microdermabrasion. Pressure parameters during the procedure ranged from 20 cmHg (26 kPa) to 40 cmHg (53 kPa), depending on the area of the face being treated. A treatment head with D180 gradation was used. Each time, the treatment lasted 15 minutes.

Measurements of the selected skin parameters were taken before the procedure and an hour after its completion. For this purpose, the Beauty of Science Nati Analizer computer skin analyzer was used. The results of the measurements of all of the patients for each particular skin parameter were averaged before the cavitation peeling procedure so that the average of the all of the patients' results after the treatment could be calculated. The same was done in the case of diamond microdermabrasion, in which an average for each parameter was determined both before and after the procedure. Those values were compared to references prepared by Beauty of Science in order to determine the results.

The obtained values were also subjected to statistical analysis using a one-sided student's t-test of statistical significance for two dependent groups. The assumed level of significance is $p < 0.05$. The calculations were carried out using an MS Excel 2010 spreadsheet.

Results

Table 1. Results of skin structure measurement (average line smoothness defining the skin surface in the researched area).

Research group	Measurement of skin structure (own unit)			
	Cavitation peeling		Microdermabrasion	
	Before treatment	One hour after treatment	Before treatment	One hour after treatment
X	9.95	10.22	10.29	10.06
± SD	0.48	0.60	0.41	0.52
P	0.121		0.148	

Source: Researcher's compilation based on results.

Based on references provided by Beauty of Science, the structure of the skin, both before and after the cavitation peeling and microdermabrasion, is correct. The value of the measurement after cavitation peeling increased, while the value of the measurement after microdermabrasion decreased. No statistical significance was demonstrated for any treatments. Discrepancies in measurements in the field of the structure can potentially be attributed to an incorrect greasiness and hydration of the skin, after the carried out treatments.

Table 2. Results of measurement of oiling level.

Research group	Measurement of level of skin oiling (%)			
	Cavitation peeling		Microdermabrasion	
	Before treatment	One hour after treatment	Before treatment	One hour after treatment
X	22.66	5.30	24.86	6.74
± SD	9.31	3.77	17.12	3.01
P	0.0003		0.005	

Source: Researcher's compilation based on results.

Before each treatment, the reference tables show the skin of the patients as prone to oiling, while after the treatment of cavitation peeling and diamond microdermabrasion, the skin greasiness, in both cases, falls to the range of values corresponding with dry skin. Sta-

tistical analysis of these measurements showed that both results are statistically significant (for cavitation peeling p = 0.0003, for microdermabrasion p = 0.005).

Table 3. Results of measurement of hydration level in T zone.

Research group	Measurement of hydration in T zone (%)			
	Cavitation peeling		Microdermabrasion	
	Before treatment	One hour after treatment	Before treatment	One hour after treatment
X	24.90	28.80	23.40	27.40
± SD	7.09	11.24	9.03	6.54
P	0.226		0.019	

Source: Researcher's compilation based on results.

Before each treatment, the average measured hydration of the T zone is very low; in fact, it is at an alarming level. After the treatments of cavitation peeling and microdermabrasion, the values increase slightly, however, the results further demonstrate the level of skin hydration as being abnormal. Differences in average value indicate a lack of statistical significance for cavitation peeling. In the case of microdermabrasion, the result shows statistical significance (p = 0.019). Analysis of other data indicates an increase in the degree of hydration after the microdermabrasion.

Table 4. Results of measurement of hydration level in U zone.

Research group	Measurement of hydration in U zone (%)			
	Cavitation peeling		Microdermabrasion	
	Before treatment	One hour after treatment	Before treatment	One hour after treatment
X	24.90	28.80	23.40	27.40
± SD	7.09	11.24	9.03	6.54
P	0.226		0.019	

Source: Researcher's compilation based on results.

After each treatment, the level of hydration of the U zone was low, though the results still show an incorrect level. After the cavitation peeling and microdermabrasion treatments, the values increase slightly Nevertheless, they still fall under the definition of abnormal skin hydration. The differences in the average values of cavitation peeling and diamond microdermabrasion indicate a lack of statistical significance.

Table 5. Results of measurement of epidermis exfoliation.

Research group	Measurement of exfoliation (%)			
	Cavitation peeling		Microdermabrasion	
	Before treatment	One hour after treatment	Before treatment	One hour after treatment
X	16.05	14.03	15.67	16.63
± SD	3.13	2.98	1.71	3.33
P	0.029		0.227	

Source: Researcher's compilation based on results.

On the basis of data in the reference tables, the exfoliation of the epidermis before the performed treatments was determined to be abnormal. After the cavitation peeling treatment, the result assumes a value that is within the norm, meaning post-treatment, the epidermis peels off in small amounts. This indicates a good cleansing of dead cells from the skin. The result indicates a statistical significance at the level of 5% (p = 0.029). In the case of microdermabrasion, after the treatment, the results show that the epidermis begins to exfoliate excessively as a consequence of skin inflammation. Strengthening the process of exfoliation promotes the restoration of its structures. Statistical analysis of the obtained results for microdermabrasion did not show their statistical significance.

Table 6. Measurement results for the size of leaks of sebaceous glands.

Research group	The size of leaks of sebaceous glands (mm)			
	Cavitation peeling		Microdermabrasion	
	Before treatment	One hour after treatment	Before treatment	One hour after treatment
X	0.30	0.21	0.25	0.22
± SD	0.07	0.04	0.05	0.04
P	0.001		0.018	

Source: Researcher's compilation based on results.

All patients had very dilated sebaceous glands. The results show that both cavitation peeling and diamond microdermabrasion are beneficial to reduce pore width. The size of the gland leaks has decreased. However, to obtain a satisfactory result, it is advisable to undergo a series of treatments. The average results are statistically significant (for cavitation peeling p = 0.001, for microdermabrasion p = 0.018).

Discussion

The skin plays a very important function in our body, therefore it is worthwhile to maintain it in good condition. Treatments in the field of exfoliation of the epidermis effectively improve its functions. Among them, there may be especially efficacious forms of mechanical peeling such as cavitation peeling and diamond microdermabrasion. These treatments help to remove lesions or cosmetic defects found in the epidermis. The results obtained in this research show that both cavitation peeling and diamond microdermabrasion can have a beneficial effect on the functioning of oily and mixed skin. The positive effects of microdermabrasion in the reduction of sebum production are reported by Davari et al. [5]. However, the studies do not show any significant change in the level of hydration of the epidermis. The Kmieć and Broniarczyk-Dyła research shows a clear improvement in skin hydration. The study was performed in a series of 6 treatments, after the end of which, an increase in skin hydration was observed. The effects lasted up to two weeks [6]. It is becoming more and more common to see a combination of microdermabrasion and chemical peeling appearing in literature on the subject. The authors report better clinical effects and more effective penetration of active sub-

stances in the case of a combination of microdermabrasion, e.g., with glycol acid exfoliation [7,8]. There is no recent literature on this topic.

In the available literature, no papers were found that would indicate changes in functional parameters of the skin after applying cavitation peeling. The only information available about the use of this method for the care of acne skin is as a treatment to remove excess sebum, to cleanse the skin of dead skin cells, and to reduce the number of bacteria that cause acne [9].

Conclusions

Both methods of exfoliation influence the examined skin parameters. The values for the skin structure change during both treatments. However, none of them significantly affect the improvement of this parameter. The skin greasiness after both cavitation peeling and diamond microdermabrasion is very low, which allows the conclusion to be drawn that the use of the treatment series in both cases may contribute to the reduction of seborrhea and an improvement in the functioning of oily and mixed skin. The study showed that the cavitation peeling does not intensify the exfoliation processes, but rather cleanses the epidermis of the dead cells very well. The treatment supports corneal peeling and contributes to the unblocking of the skin pores. In the case of microdermabrasion, the exfoliation of the epidermis intensifies because the skin has developed inflammation and the regenerative processes are intensified. Disorders in the area of hydration, oiling, and exfoliation indicate the stimulation and provocation of the skin to the increased reconstruction of the epidermis and dermis. Due to the investigated methods of mechanical exfoliation, the sebaceous glands were unblocked and the pore diameter decreased.

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Correspondence address:
Dorota Dybaś
ul. Ligonia 46
47-325 Kamień Śląski
Phone: (+48) 888 105 522
E-mail: drt.gawlik@gmail.com

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PREGNANCY, CHILDBIRTH AND PUERPERIUM HEALTH PROBLEMS IN WOMEN AFTER 35 YEAR OF AGE: A SYSTEMATIC LITERATURE REVIEW

Iwona Kiersnowska[1 A,B,D–F]
• ORCID: 0000-0001-5615-367X

Barbara Baranowska[2 E,F]
• ORCID: 0000-0003-2723-9604

Grażyna Bączek[2,3 A,D–F]

Piotr Węgrzyn[1 A,D,E]

[1] Department of Obstetrics and Perinatology, Medical University of Warsaw, Poland

[2] Department of Obstetrics and Gynecology Didactics, Medical University of Warsaw, Poland

[3] St. Sophia Specialist Hospital in Warsaw, Poland

A – study design, **B** – data collection, **C** – statistical analysis, **D** – interpretation of data, **E** – manuscript preparation, **F** – literature review, **G** – sourcing of funding

ABSTRACT

Advancing medical knowledge, improving quality of life and increasing life expectancy have resulted in increased numbers of women deciding to deliver a child over 35 years of age. Infertility in delayed motherhood is associated not only with medical but also with psychological problems. The question of delayed motherhood concerns the whole world, and is of interest not only to obstetricians, but also economists and demographers.

The purpose of our study was to identify and review studies into the health problems of women over 35 years of age in pregnancy (Advanced Maternal Age), delivery and the puerperium.

Original papers investigating health problems in women over 35 years of age related to pregnancy, childbirth and the puerperium published between August 2017, and January 2018 were identified. Databases including PubMed, Scopus, ProQuest Central, and Elsevier Clinical Key Journals were utilised. After removing duplicates and those not meeting inclusion criteria, 15 studies were reviewed.

Findings are discussed according to three time periods; before pregnancy, during pregnancy, and during childbirth and the puerperium. AMA mothers, especially primiparous women, were more likely to suffer with underlying chronic diseases and were more likely to have been treated for infertility. Increased use ART (Assisted Reproduction Techniques) can explain an increased rate of multiple pregnancies and the resultant rise in both caesarean section deliveries and premature births. Study groups subclassified according to maternal age allowed outcomes which are progressive with age to be identified. All the studies we reviewed have reported similar health problems in women over 35 years of age.

The most common health problems in pregnancy, during childbirth and the puerperium in women over 35 years of age are diabetes mellitus type one and two, hypertension, preeclampsia, and cholestasis.

KEYWORDS: literature review, pregnancy, childbirth, puerperium, advanced maternal age

Background

Improving quality of life and increasing life expectancy, have increased the number of women who decide to deliver a child at an 'advanced maternal age' (AMA), that is, over 35 years old. Problems resulting from delayed motherhood can be seen the world over, and are of interest not only to obstetricians but also to economists and demographers [1,2].

Advancing medical knowledge allows women over 35 to maintain good health, especially those suffering from chronic diseases such as diabetes and hypertension. However, age naturally leads to decreased fertility, which may result in difficulties in achieving and retaining a healthy pregnancy. Pregnancy at AMA also carries a higher risk for the child, through an increased rate of birth defects and chromosomal abnormalities as well as multiple pregnancy, premature delivery and low birth weight. Infertility resulting from delayed motherhood is associated not only with medical but also with psychological problems. Reports from various countries

describe significantly increased health problems during pregnancy, delivery and the puerperium among AMA mothers when compared to younger mothers [3,4].

The progress of modern medicine, including the development of ART (Assisted Reproduction Techniques) methods, has extended the limit of fertility beyond the menopausal age. Advanced ART techniques such as oocyte donation and micromanipulation can allow older women to deliver a healthy child [3,4].

Advanced maternal age presents a challenge not only for optimising pregnancy and neonatal outcomes, but also suggests an important role for doctors, nurses and midwifes, in the education of young women to reduce delayed motherhood.

Aim of the study

The purpose of our study was to undertake a systematic review of the literature to identify health problems encountered by AMA women during pregnancy, delivery and the puerperium.

Material and methods

A systematic review of the literature was conducted from August 2017, through to December 2017. We performed the review using the following databases: PubMed, Scopus, ProQuest Central, and Elsevier Clinical Key Journals. Search terms included the key words „advanced maternal age", „after 35 years of age" „pregnancy", „childbirth", „postpartum" combined with: new-born, fertility, infertility, ART, prenatal diagnosis, delayed maternity, high risk factors.

Results were limited to quantitative studies on the health problems of women over 35 years of age in pregnancy, delivery and the puerperium published during last 10 years in a peer-reviewed journal in the Polish or English language. Articles where there were no data from pregnancy, delivery or the puerperium, or did not include a distinct group of mothers over 35 years of age, were excluded. The search process is presented in fig. 1.

Results

The table below shows the specific characteristics of the country, study dates and the main topics of the papers included in our review.

Health problems identified in research studies are discussed in terms of their timing: before pregnancy, during pregnancy, or during childbirth and the puerperium.

Before pregnancy

AMA mothers, especially primiparous women are more likely to be suffering from chronic diseases such as hypertension or diabetes mellitus type 2 [5,6]. A significant increase in the incidence of maternal hypertension was seen with age greater than 45 years [7]. The studies identified a higher prevalence of a history

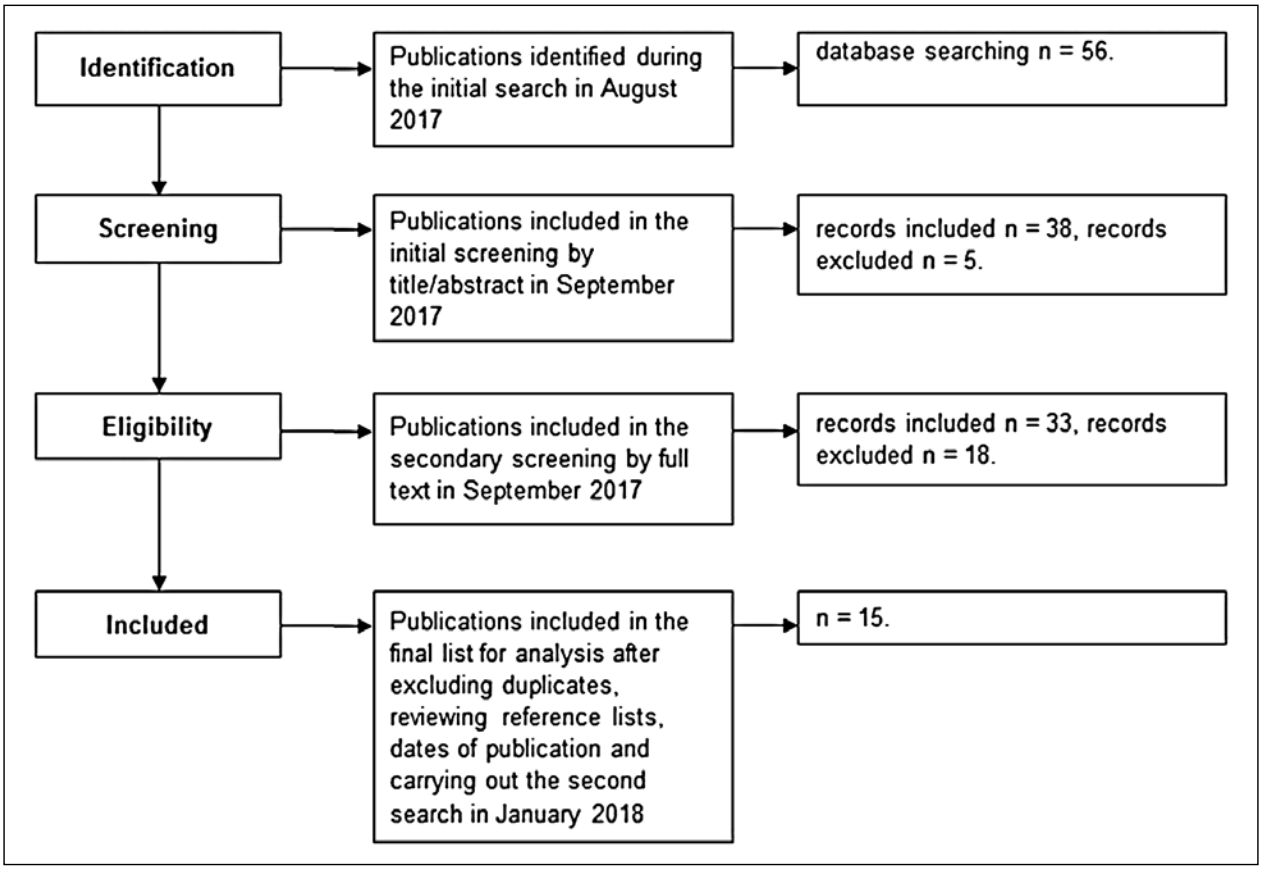

Figure 1. Flow chart of the systematic literature search.

Table 1. Characteristics of included studies.

Study (reference)	Country/ Year of publication	Data collection period	Participants	Groups	Subject
Pregnancy outcome in primiparae of advanced maternal age. [5]	Belgium, 2007	01.2002–12.2003	Primiparous with singleton pregnancies, n = 26 891.	25–29 years n = 23 921, ≥35 years n = 2970.	Investigation of the impact of maternal age on singleton pregnancy outcome, taking into account intermediate and confounding factors.
A significant linear association exists between advanced maternal age and adverse perinatal outcome. [6]	Israel, 2011	1995 - 2005	Nulliparous with singleton gestations, n = 45 033.	≤35 years n = 43 809, 35–40 years n = 1,036, >40 years n = 188.	Characterization of elderly gravidas, and assessment of age as a risk factor for perinatal, and maternal morbidity and mortality.
Pregnancy after 35 years of age. [7]	Poland, Katowice, 2012	Not available	Primiparous and multiparous, n = 280.	20-30 years (control group) n = 150, ≥35 years n = 130.	Assessment of the influence of age >35 years on the course of pregnancy, delivery and puerperium.
Pregnancy after 35 years of age – obstetric results based on our own material of the Collegium Medicum Obstetrics Clinic in Bydgoszcz.[8]	Poland, Bydgoszcz, 2012	01.01.–31.12.2010	Primiparous and multiparous, n = 134.	35-39 years n = 103, ≥40 years n = 31.	Analysis of the course of pregnancy and delivery, and the health status of the newborn in women over 35 years of age.
Advanced Maternal Age and Adverse Pregnancy Outcome: Evidence from a Large Contemporary Cohort. [9]	UK, Manchester, 2013	01.01.2004–31.12.2008	Primiparous and multiparous, singleton pregnancies n = 215 344.	20–29 years n = 122 307, 30–34 years n = 62 371, 35–39 years n = 33 966, ≥40 years n = 7 066.	1) To investigate the crude and adjusted associations between advanced maternal age (35 years and older) and adverse pregnancy outcomes. 2) To investigate whether any observed associations can be attributed to the confounding effect of known modifiable risk factors (BMI) or un-modifiable risk factors (ethnic origin). 3) To investigate the association between maternal age and pregnancy outcome in the most and least socially deprived women and in primiparous and multiparous women (subgroup analysis).
Maternal age and adverse pregnancy outcome: a cohort study.[10]	UK, London, Kent, 2013	Not available	Primiparous and multiparous, singleton pregnancies, no aneuploidies n = 76 158.	35 years n = 55 772, 35–39 years n = 16 325, ≥ 40 years n = 4 061.	The association between maternal age and adverse pregnancy outcome including preeclampsia, gestational hypertension, gestational diabetes mellitus, preterm delivery, small-for-gestational age neonate, large-for-gestational age neonate, miscarriage, stillbirth and elective and emergency, caesarean section.
Very advanced maternal age and morbidity in Victoria, Australia: a population based study. [11]	Australia, 2013	2005-2006	Primiparous and multiparous, n = 49 026.	30–34 years - control group n = 48 909, ≥ 45 years n = 217.	Determine the maternal and perinatal outcomes of pregnancies in women aged 45 years or older compared to women aged 30–34 years.

Study (reference)	Country/ Year of publication	Data collection period	Participants	Groups	Subject
Advanced maternal age and pregnancy outcomes: a multicountry assessment.[12]	29 countries in Africa, Asia, Latin America, and the Middle East. (developing countries and Japan), 2014	05.2010 - 12.2011	Singleton pregnancies, n = 308 149.	20–34 years n = 238 504, 35–39 years n = 29 245, 40–44 years n = 7 015, ≥45 years n = 1 527.	The association between advanced maternal age and adverse pregnancy outcomes.
The effects of maternal age and parity on maternal and neonatal outcome. [13]	Israel, 2014	06.2005–10.2011	Singleton, spontaneously-conceived pregnancies, n = 24 579	24–27 years (control group) n = 13 336, ≥ 35 years n = 11 243.	The impact of advanced maternal age and parity on maternal and perinatal outcomes.
Advanced Maternal Age and Risks for Adverse Pregnancy Outcomes: A Population-Based Study in Oman. [14]	Oman, 2015	2000	Married, primiparous and multiparous women n = 1 345	20–34 years (reference group) n = 1030, ≥ 35 years n = 315.	Investigate if advanced maternal age of 35 years or more is a risk factor for adverse outcomes in pregnancy after controlling for the effects of potential confounding factors.
Obstetric and perinatal outcomes in women ≥40 years of age: Associations with fetal growth disorders. [15]	Spain, Barcelona, 2016	06.2009–06. 2012	Singleton pregnancies, n = 11 328.	<35 years n = 7893, 35–39 years n = 2781, ≥ 40 years n = 654.	Evidence indicates that advanced maternal age is associated with adverse obstetric and perinatal outcomes.
At what age does the risk for adverse maternal and infant outcomes increase? Nationwide register-based study on first births in Finland in 2005–2014. [16]	Finland, 2016	2005–2014	Primiparous, singleton pregnancies, n = 228 348.	20–24 years (reference group) n = 56 282 25-29 years n = 86 540, 30-34 years n = 60 716, 35–39 years n = 20 501, 40–44 years n = 4113, ≥ 45 years n = 196.	Examine at which maternal age the use of maternity care and the risks for adverse maternal and infant outcomes increase.
Twin pregnancies after assisted reproductive technologies: the role of maternal age on pregnancy outcome. [17]	Italy, 2016	01.2010 - 11.2014	Nulliparous, dichorionic diamniotic twin pregnancies conceived with ART, n = 430.	<40 years n = 265, ≥ 40 years n = 165.	Investigation of whether advanced maternal age (40 years) still impairs the outcome of twin pregnancies after assisted reproductive techniques.
Maternal and neonatal outcomes in advanced maternal age: a retrospective cohort study. [18]	Turcja, 2017	01.2008-08. 2010	Singleton pregnancies, n = 254.	≥40 years n = 127, 21–35 years (control group) n = 127.	To describe the effect of extremely advanced maternal age on maternal/neonatal outcomes.
Is primiparity a risk factor for advanced maternal age pregnancies? [19]	Turcja, 2017	03.2008–02.2015	Primiparous and multiparous, singleton pregnancies, n = 1680.	primiparous ≥35 years, n = 472, multiparous ≥35 years n = 1208.	Comparison of maternal characteristics, pregnancy and, fetal outcomes between assisted and non-assisted reproductive techniques in multiparous and primiparous women.

of miscarriages [6,7] and stillbirth [9,10]. In addition, this group of women were more likely to have planned the pregnancy [11], have been treated for infertility, undergone gynaecological surgical interventions in the past [8] or used ART [6,11,12,13].

During pregnancy:

Amongst AMA women the most frequent health problems in pregnancy were: gestational diabetes mellitus type 1 and 2 [5,8,10–12,14–17], hypertension [10,11,17], preeclampsia [7,10,15] and cholestasis [8,11]. The incidence of respiratory infections, urine infections and anaemia was also higher [8]. With advancing age the risk of placenta praevia increases [7,8,17]. Rising numbers of miscarriages [15] and antepartum haemorrhage [7] are also seen. In AMA primiparous women preeclampsia [13] and IUGR [8,13] occur more often, while in multiparous women preeclampsia, placenta previa, hydramnion and oligohydramnion are more likely [12].

During delivery:

Among women giving birth after the age of 35, the percentage of preterm births [8,10,18] especially those due to multiple pregnancy [6,7] and other delivery complications [10] increases. Emergency [5,15,16] and elective [8,9,11,15] caesarean section are more common than natural delivery [8,7,10,12,14,17]. The main indications for assisted delivery are advanced maternal age and previous surgical interventions, such as myomectomy [8]. In the primiparous group delivery induction and epidural anaesthesia occurred more often [14], while amongst the multiparous group malpresentation, cephalopelvic disproportion, non-progressive first stage of labour and, fetal distress in the second stage of labour, were reported [12]. In these publications there were no statistical differences in birthweight or Apgar score [8,11,16]. However, it was shown that ART pregnancies in women over 40 years of age are at a higher risk of obstetric and neonatal complications than pregnancies after natural conception in women in the same age group [6].

During the puerperium:

Only two publications mention complications in the time after childbirth. These papers report an increased risk of maternal death [11] and prolonged postpartum hospital stay≥ 7 days [17] in AMA mothers.

Discussion

This is the first literature review of health problems in women over 35 years of age occurring in pregnancy, delivery and the puerperium. Studies included in our review were performed in developed [6–9,11,14–17] and in developing countries [5,10,12,13,18,19]. In only one study there were data from more than one country (Africa, Asia, Latin America, and the Middle East) [18]. All studies reported similar findings.

We identified only one study which compared the outcomes of ART and non-ART AMA mothers. This study reported a higher initial BMI and a lower incidence of smoking in non-ART mothers [13].

Study groups defined according to maternal age allowed the examination of outcomes which are progressive with age [7,12,15]. For maternal risk factors, threshold-ages of 25 years for diabetes, 33 years for hypertension, 38 for preeclampsia, 27 for placenta praevia and 36 for perinatal mortality were defined [17].

The studies are not without discrepancies, for example some studies indicate no significant variation between the first and second stages of labour among AMA women [8] while others found differences [12]. Such discrepancies may perhaps be explained by the lower number of participants in some studies.

There was also variation among the investigated variables between papers. Earlier studies concentrated more on sociodemographic details (including level of education, smoking, use of alcohol, BMI) [5,7–9,11,12,14,15,18] while more recent papers focus on factors such as comparing ART use between primiparous and multiparous women [13]. The use of ART causes a twelve times increased frequency of multiple pregnancy, with a resultant rise in, caesarean section and premature birth [7].

Limitations of the studies include missing data in big, cohort or population--based studies [9,12–14,19] whereas in single–centre studies the authors noticed that although the results varied somewhat with the referral level of the hospital [5,8,11,15,16], trends were similar. Only a few studies comment on health problems in the early postpartum period, and all focus on the period of hospitalization. We did not identify any publications investigating the late puerperal period, particularly in the area of postnatal depression or other late complications of the puerperium.

Conclusion

The most common health problems during pregnancy and delivery in women over 35 years of age are diabetes mellitus type 1 and 2, hypertension, preeclampsia and cholestasis. There is a significant increase in preterm birth and caesarean section in this group. Owing to widespread use of ART, there is an increased risk of multiple pregnancy. Increased risk of maternal death and prolonged hospital stay ≥ 7 days are the most frequently reported problems in the puerperium.

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Correspondence address:
Iwona Kiersnowska
Klinika Położnictwa i Perinatologii
Warszawski Uniwersytet Medyczny
ul. Żwirki i Wigury 63a, 02-091 Warszawa
Phone: (+48) 501 203 128
E-mail: ikiersnowska@wum.edu.pl

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THE PATHOPHYSIOLOGY OF VASOVAGAL SYNCOPE

Ewelina Barbara Kolarczyk[1 A,B,D–F]
• ORCID: 0000-0002-8837-4087
Ewa Nowakowska[2 B,D,F]

[1] State University of Applied Sciences in Racibórz, Poland
[2] PROELMED (Private Limited Company) Children Primary Health Care Services, Łaziska Górne, Poland

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ABSTRACT

Vasovagal syncope, known also as neurogenic or neurocardiogenic syncope, accounts for about 30–40% of syncopes of unclear origin and is the most common type of syncope among children and adolescents. Vasovagal syncope is defined as a state of temporary loss of consciousness with reduction of muscle tone followed by sudden, rapid and total return of consciousness. Vasovagal syncope is caused by a drop in blood pressure and/or reflex bradycardia which occurs as a result of emotional or orthostatic stress. Consequently, in understanding the mechanism of neurogenic syncope, most attention is paid to the dysregulation of sympathetic-parasympathetic autonomic nervous system.

The main objective of this study was to systematically review the pathomechanisms triggering a vasovagal reaction. The analysis is based on a review of the literature on this topic. Material was obtained using the library system ALEPH. The literature was obtained from databases such as PubMed, Medline and GBL. This study focused on the role of tilt testing in the diagnosis of vasovagal syncope as well as other tests used to assess the functioning of the autonomous control of the cardiovascular system in syncope.

KEYWORDS: vasovagal syncope, neurogenic syncope, tilt test

Background

Sudden loss of consciousness is a common problem among children and adolescents and, in approximately 30% of patients, the cause cannot be determined. It belongs to the group of reflex syncopes, described as vasovagal, neurogenic or neurocardiogenic syncope. Episodes of vasovagal syncope consist of short-term and transient loss of consciousness that is accompanied by a decrease in postural muscle tone, followed by independent recovery of consciousness [1]. It is caused by a decrease in the blood supply to the central nervous system as a result of a reflex drop in blood pressure and/or pulse rate. Vasovagal syncope constitutes approximately 30% of all syncopes and is one of the most common reasons for loss of consciousness in children and adolescents. It is estimated that approximately 20–50% of healthy adolescents have experienced at least one episode of syncope. A characteristic feature of vasovagal syncope is the appearance of prodromal symptoms preceding the syncope such as nausea, anxiety, excessive sweating, pallor of the skin, changes in vision and hearing, and dizziness [2]. These clinical symptoms are typically associated with time spent in stuffy, hot, crowded areas, standing up or in a situation of emotional stress (e.g. the collection of blood) [3,4]. Pharmacotherapy is relatively ineffective in the treatment of vasovagal syncope and prevention and education to prevent syncope play an important role in its management. An important consequence of syncope is trauma resulting from collapsing, as well as fear and uncertainty which reduces patients' quality of life. Despite numerous trials to elucidate the pathophysiology of vasovagal syncope, its main cause has yet to be clearly determined. The main objective of this study was to characterize the reflex regulatory mechanisms of the autonomic nervous system which play an important role in neurocardiogenic syncope.

Autonomic nervous system in the patho-etiology of neurocardiogenic syncope

It is believed that a key role in the pathogenesis of vasovagal syncope is played by the autonomic nervous system (ANS), which is responsible for controlling the functioning of the cardiovascular system. Correct functioning of the cardiovascular system is essential in the

maintenance of homeostasis of the organism as a whole. The ANS has the primary role in the regulation of cardiovascular homeostasis. The autonomic system affects the reflex regulation and function of internal organs and is responsible for the adaptability of the body in variable conditions [5]. Its function is also to protect the body by inducing a defensive reaction of a fight and escape type, i.e. stimulation of the sympathetic nervous system in connection with the somatic system and an aversion response, i.e. activation of the parasympathetic nervous system with a simultaneous somatic inhibition. Neurocardiogenic syncope is triggered as a result of an interaction between sympathetic and parasympathetic nervous systems in the form of stimulating or inhibiting those systems. In reflex syncope, the reflexes are those of the autonomic nervous system, consisting of afferent and efferent nerve fibers, and the neural path (or reflex arc) that controls the reflex. The afferent pathway in neurocardiogenic syncope is composed of cranial nerves – vagus and glossopharyngeal nerves (impulses from mechanoreceptors of the cardiovascular system, gastrointestinal tract, urinary system and baroreceptors of the carotid sinus), trigeminal nerve, facial nerve and vestibulocochlear conduct (impulses from mechanoreceptors of the respiratory system), and nerves conducting impulses from chemoreceptors of the circulatory system (parasympathetic cardiac branches of the vagus nerve and sympathetic cardiac, cervical and thoracic nerves). Afferent impulses, carried by the vagus nerve from the circulatory system, are accumulated in the solitary nucleus in the medulla oblongata, which constitutes the center of the reflex arc of a neurogenic syncope. Impulses from the solitary nucleus are passed on, by means of an ascending path, to superior units, i.e. the diencephalon and cerebrum. Those nerve impulses then run via a descending path down from the centers of the superior units to centers of inferior ones, i.e. sympathetic and parasympathetic preganglionic neurons in the medulla oblongata [6]. This is where fluctuations in stimulation and inhibition of the sympathetic or parasympathetic system take place. Neurocardiogenic syncope is a physiological defensive reaction of the circulatory system, protecting it against excessive adrenergic stimulation, triggered by hypovolemia. Subsequently, syncope is a side reaction that is aimed at deflecting actions of the autonomic nervous system leading to an increase in catecholamines and excessive heart stimulation [1].

Taking pathogenesis into consideration, vasovagal syncope can be divided into syncope of a peripheral and central types. In the peripheral type, as well as in the central type, the afferent fiber of a vasovagal reaction is the same. The difference, however, is located in the efferent pathways of the autonomic nervous system .The peripheral theory by Oberg and Thoren recognizes that syncope is a consequence of a long-lasting motionless vertical position of the body. In an adult, within 10 seconds being in an upright position, about 500–1000ml of blood moves into the venous system located below the diaphragm. Over the next 10 minutes, 700 ml of fluid is filtrated into the extravascular space, resulting in a significant decrease in blood pressure and filling of the heart cavities as well as drop in ejection volume [7,8]. Changes in hemodynamic conditions stimulate mechanoreceptors (in the left ventricle and auricles, in the aortic arch) and peripheral chemoreceptors of blood vessels [6]. A decrease in stroke volume and a reduction in venous return to the heart leads to the activation of the sympathetic system, which increases vasoconstriction of the vessels and the contractility of ventricles resulting in insufficient filling. As a result of ensuing tachycardia, activation of the parasympathetic system follows and mechanoreceptors in the left ventricle are triggered. They, in turn, activate the vagus nerve in the medulla oblongata via the afferent pathway. Consequent to this activation of the parasympathetic system, blood vessels dilate and the heartbeat slows. This causes a decrease of the brain's perfusion and syncope [3]. This type of syncope presents itself mainly in situations where a person remains motionless (e.g. in a church, at the bus stop, at the school assembly) in a sultry, warm room for a long time. The loss of consciousness is preceded by vegetative, heralding symptoms, like dizziness, impaired vision, excessive perspiration, pale skin and nausea [2].

Similarly, prodromal symptoms are present in vasovagal syncope of the central type. According to James-Lange's behavioral theory, somatic and behavioral changes and vasovagal reactions appear as a result of factors like pain, fear or emotions (Fig.1). The physiological background of vasovagal syncope of the central type is the occurrence of a reflex due to the stimulation

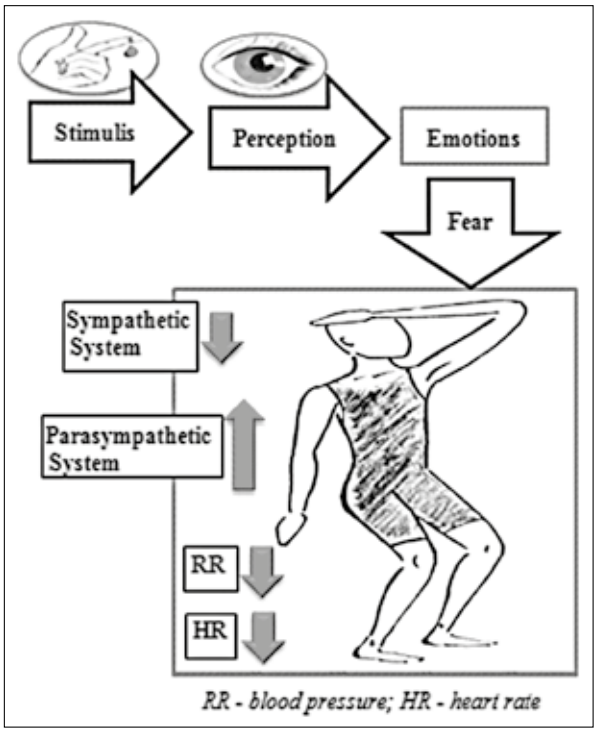

Fig. 1. Pathomechanism of vasovagal reaction according behavioral theory

of sensory fibers (e.g. during blood collection) and the resulting activation of cortical and subcortical centers by neurohormones (endorphins) and neurotransmitters, which lead to a vasovagal reaction [1,6,9].

Methods of evaluating the etiology of syncope

Table tilt test is one of the most commonly used clinical tests to evaluate the function of the autonomic system in children diagnosed with vasovagal syncope. The table tilt test, as a diagnostic tool of vasovagal syncope, was introduced in 1986 by Kenny et al. [10]. The tilt test is useful in the evaluation of the influence of the autonomic system on the occurrence of a vasovagal reaction because it enables the pathological vasovagal reaction to be recreated in controlled conditions [11,12]. Children and adolescents suspected of vasovagal syncope, after excluding other mental, cardiological and neurological causes (for example demonstrative syncope, heart defects, epilepsy and long QT syndrome) are suitable for the tilt test examination. The head-up tilt test is carried out in the morning hours in a warm, quiet room. There are numerous methods of executing the tilt test, which vary in the time taken for the examination, angle of the table and types of pharmacological provocation. Head-up tilt test can be passive or active. The former is most commonly performed according to the Westminster protocol, during which a patient is tilted to a 60° angle for a period of 45 minutes, and the later uses pharmacological provocation. Hemodynamic changes, which result from dominating influences of the sympathetic and parasympathetic systems, are documented during the course of the test, when blood pressure (most often using the method of *beat to beat*), and pulse are checked and ECG recorded [4,10–13].

The objective of the tilt test is to document hemodynamic changes preceding reflex syncope. During the tilt test, continuous and sequential changes in the autonomic system occur. These changes are correlated with the intensity of a stimulus, which, in this case, is the angle of tilting of the patient. It has been demonstrated that the heart rate drops at a rate which depends on the angle at which the table is tilted. Changes in heart rhythm during the head-up tilt are often used to evaluate the activity of subdivisions of the autonomic system [8]. At the time of the of tilt testing procedure, orthostatic stress occurs, where, owing to gravity, blood flows from venous bed below the diaphragm with a simultaneous decrease of venous return to the right ventricle. Initially, the sympathetic system is activated resulting in ventricles, which are insufficiently filled, increasing in contractility [3]. The result of stimulating the sympathetic system during the head-up tilt test is moderate tachycardia [8]. Paradoxically, mechanoreceptors in the left ventricle become stimulated and send an impulse to the vagus nerve in the medulla oblongata via type "C" afferent fibers. As a result of the misinterpreted blood pressure increase in the left ventricle, the parasympathetic system becomes activated. The consequence of this situation is hypotonia caused by blood vessel dilatation (vasodilatation) and reduced heart rate (bradycardia). Consequently, this results in cerebral hypoperfusion and the loss of consciousness [3,14].

In the course of the head-up tilt test, different mechanisms of neurocardiogenic responses are observed. According to VASIS classification (*Vasovagal Syncope International Study*) the following types of syncope can be distinguished:

1. Type 1- mixed – consists of lowering of the heart rate that does not reach the level of 40 bpm or reaches it for a period less than 10 seconds. If asystole occurs, it does not last more than 3 seconds. In the mixed type, the decrease in heart rate is preceded by a decrease in blood pressure.
2. Type 2- cardioinhibitory – in which 2 subtypes can be differentiated: II A (without asystole) when the heart rate drops below 40 bpm for a period of not longer than 10 seconds, but without the occurrence of asystole longer than 3 seconds. Although the blood pressure may increase, it consequently decreases before the drop in the heart rate. Subtype II B – (with asystole) when asystole occurs for more than 3 seconds with a decrease in blood pressure.
3. Type 3- vasodepressive – when syncope occurs as a result of lowering of the blood pressure and the reduction of the heart rate does not exceed 10% of the maximum value recorded throughout the test [13].

In patients with a positive outcome of the head-up tilt test, loss of consciousness usually takes place between the 10th and 30th minute of the test. Limited available diagnostic methods create difficulty in determining the influence of the autonomic system on the pathomechanism of syncope. Other methods used to assess the autonomic system, which at the same time record hemodynamic changes, are the head-up tilt table test, Valsalva maneuver, deep breath test and the carotid sinus pressure test [4,12,13].

The Valsalva maneuver is performed by moderately forceful attempted exhalation against a closed glottis. It is a non-invasive method of autonomic modulation of the cardiovascular system used to assess the integrity of baroreceptor reflexes of cardio-pulmonary and arterial systems, mainly to assess baroreceptor sensitivity. However, in addition to reflexes of the arterial baroreflex, reflexes such as low-pressure cardio-pulmonary baroreceptors reflexes, reflexes of chemoreceptors, Bainbridge reflex and central motor command are also triggered with conscious contraction of striated muscles. In order to obtain reliable results of the responsivity of baroreceptors, the Valsalva test needs to be performed repeatedly. Therefore, this test is not very useful in the evaluation of the sensitivity of baroreceptors [15].

The deep breath test involves deep breathing at a rate of 6 breaths / min controlled by a metronome for 3 min. This test mainly causes changes in the parasympathetic component of the autonomic nervous system in the form of its deceleration and activation. During the test, systolic blood pressure in the chest increases with a simultaneous adjustment in the length of the R-R interval. The test result is calculated using the I-E indicator which is the average difference of maximum and minimum heart rate during each 6 breaths per minute [16].

Another simple, non-invasive procedure is the Schellong test, performed at the patient's bedside. It involves tilting the patient after 10–15 minutes of resting to an upright position, followed by the measurement of blood pressure at 1 and 3 minutes after the tilting, with the last measurement performed 10 minutes after tilting. When a drop in systolic blood pressure is at least 20 mmHg or the diastolic blood pressure is at least 10 mmHg during the first 3 minutes of the test, orthostatic hypotension is diagnosed. Whereas, if within the five minutes into the test, there is an increase in heart rate of more than 30 beats / min. or a heart rate of more than 120 beats / min., postural orthostatic tachycardia syndrome is diagnosed [17].

A less popular method used in the study of dysautonomia is the carotid sinus pressure test. Applying carotid sinus pressure for about 20–30 seconds causes the heart rate and blood pressure to naturally drop. Changes such as asystole lasting over 3 seconds or significant bradycardia triggered by the pressure are classified as pathological [18].

In children, the percentage of positive results of the passive tilt test is notably low and varies from 8% to 65%. However, after pharmacological provocation, the number of positive results increases from 57% to 80% [6]. Medicines used during the test are nitroglycerine, isoprenaline, edrophonium, adenosine and esmolol [12].

During the tilt test, the level of catecholamines increases. The main function of catecholamines in the human body is the stimulation of the mechanoreceptors of the heart, which increases its contractility and, as a result of a reflex reaction, hypotension and bradycardia occur. Research carried out by Kozlowski et al. on the use of esmolol in the tilt test showed the utility of this medicine in diagnosing syncope, especially in patients with permanent sinus tachycardia. Esmolol was demonstrated to have an unblocking influence on beta-adrenergic receptors, which are susceptible to endogenic levels of catecholamines such as epinephrine and norepinephrine. The resulting amplified body stress supports a positive test result [19]. Steward et al. reported that 75% of patients with vasovagal syncope had reduced systemic vascular resistance, of whom 23% had significantly reduced cardiac output. The authors used a Finometer to measure the cardiac output and systemic vascular resistance in the supine position and with the table inclined to an angle of 70°. According to the authors, young patients with vasovagal syncope experience both reduced cardiac output and reduced vascular parenchyma, resulting in splanchnic vasoconstriction [20]. However, in Verheyden's studies in patients with vasovagal syncope, during the tilt test both with and without the addition of nitroglycerine, and a significant decrease in blood pressure, a 50% decrease in cardiac output was recorded, but systemic vascular resistance remained unchanged [21].

Wei-Ting Lai and et. al. investigated the use of head-up tilt table testing in the management of neurocardiogenic syncope (NCS) in 79 children with a mean age of 12.4 years. The study showed neurocardiogenic syncope occurred in 65 patients and non-NCS in 14 patients. Isoproterenol infusion significantly increased the sensitivity of the test from 28% to 45% and was associated with a slight decrease in specificity from 93% to 86%. The authors concluded that the tilt test can be safely performed with a high specificity in children, with the sensitivity of tilt test improved by isoproterenol [22].

Other research into the pathomechanism of vasovagal syncope combines the tilt test with the monitoring changes in the brain (EEG, monitoring the flow in cerebral arteries using transcranial Doppler ultrasonography, measurement of oxygenation of the brain using near infrared spectroscopy -NIRS) and changes in peripheral hemodynamic parameters [22,23]. Studies conducted by Bosak et. al. analyzed changes in the interictal electro-encephalographic recording of 41 patients aged 29.8 years, with vasovagal syncope diagnosed on the results of passive tilt testing, where 40% of patients had generalized or focal slow activity (theta and delta). Results indicated the presence of changes in the interictal electroencephalographic recording, especially during hyperventilation. Patients with neurogenic syncope may be more sensitive to changes in Pco2 and PO2 induced by hyperventilation resulting in hyperventilation-induced changes in the EEG [24]. EEG, conducted during the tilt test, can be used to diagnose psychogenic or possibly epileptic causes of syncope. In a report by Kucinska and Werner, the tilt test made it possible to establish the correct cause of syncope in a 17-year-old patient during an alleged fainting episode when there were no changes in electrocardiogram, heart rate and blood pressure [25]. Psychogenic syncope, with a very similar clinical picture to neurocardiogenic syncope, is a child's attempt to draw attention to psychological problems. The disturbed mental state may activate the nervous system resulting in vegetative symptoms and somatic diseases. Accurso et. al. have shown that loss of consciousness among people who experience syncope caused by anxiety during blood collection is due to the dysregulation of the autonomic nervous system. In assessing the etiology of syncope, the authors used a tilt test, during which the parameters of the heart rate and blood pressure were monitored for 15-minutes in a horizontal position and for 45 minutes in a vertical position, at a table tilt up to 70°. In addition, one person from the control group

experienced syncope, which may indicate provocation of sympathetic-parasympathetic dysregulation following verticalization during the tilt test [26]. According to Fucá et. al., in patients with vasovagal syncope and a positive tilt test result, 3 minutes before fainting, an increase in the heart rate was observed (which may indicate sympathetic activation), followed by a sudden decrease in HR during fainting. The authors showed that cardiac output during the tilt test decreased significantly which can be a significant marker for early detection of bradycardia in the majority of patients with vasovagal syncope [27].

Among the diagnostic tests for syncope, the most commonly used is the table tilt test. There are, however, some restrictions which can contribute to a false positive test result. Apart from pharmacological interventions, the angle the tilt table influences the accuracy of the tilt testing procedure. It is believed that angles above 60° increase the number of false positive results and that the reduction of the angle of tilting below this value negatively affects its accuracy [28]. Another factor that determines the sensitivity of the tilt test is the time of the passive phase, with a longer passive phase, increasing diagnostic accuracy. In examinations of children, using this procedure, passive orthostatic stimulation is preferred, without pharmacological intervention. Moreover, there is no clear guidance in regard to the time of the test in order to maximize its accuracy. However, even though there is no uniformly accepted methodology for conducting head-up tilt testing, in the absence of alternative diagnostic tests for vasovagal syncope, it is extremely useful clinically in the assessment of neurocardiogenic syncope. Using another diagnostic device such as a Finometer during a tilt test is a non-invasive way of more fully characterizing arterial circulation, pressure variability, heart rate, cardiac output and systemic peripheral resistance [4,29,30].

Conclusion

Vasovagal syncope is caused by reflex dysfunction of the autonomic nervous system. The head-up tilt test is a valuable diagnostic tool in the diagnosis of neurocardiogenic syncope. With this procedure, the reflex interaction of the autonomic can be documented in controlled laboratory conditions. Despite head-up tilt test and other methods of assessing autonomic disorders, the mechanism of vasovagal syncope has yet to be fully explained.

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Correspondence address:
Ewelina Barbara Kolarczyk
Państwowa Wyższa Szkoła Zawodowa w Raciborzu
ul. Słowackiego 55
47-400 Racibórz
Phone: (+48) 32 415 50 20 ext. 176
E-mail: ewelina.kolarczyk@pwsz.raciborz.edu.pl

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MANAGEMENT OF THE HEALTHCARE SYSTEM IN GERMANY AND FRANCE

Piotr Rajfur[1 B,E,F]
• ORCID: 0000-0003-4988-4559
Katarzyna Hys[2 E,F]
• ORCID: 0000-0003-0800-2804

[1] WSB University, Dąbrowa Górnicza, Poland
[2] Faculty of Production Engineering and Logistics, Opole University of Technology, Poland

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ABSTRACT

Reflections on the issue of human life, its quality and duration, have contributed to health being increasingly considered a common good – a public good. Changes in perspectives relating to human life and health led to protection of life being recognized as the highest good and the greatest gift offered to a man. Society entrusted this task to a public authority. The public authority, recognizing that protection of the health of the citizens is one of its most important tasks, initiates and creates a system where the tasks related to health protection are implemented in an efficient and organized manner.

The basic criterion for a patient's selection of a medical facility is quality and effectiveness of provided services, assuming their availability. The adopted procedures for managing and financing the health system in a given country significantly influence the quality and effectiveness of provided medical services.

This article will present the functional principles of healthcare systems in Germany and in France, the organization of these systems and their main elements and interrelationships.

The aim of the article is to compare the management and financing systems for healthcare in both countries. The healthcare systems in both Germany and France are derived from the insurance model. However, these two countries have different approaches to management and financing, and accordingly, they understand the role and the responsibility of the state in this process differently. In order to achieve the article's goal, documents including the leading positions in Polish and foreign literature relating to the merits of the issues, together with the available literature published by institutions, have been examined and reviewed.

KEYWORDS: system, health protection, management, financing, France, Germany

Background

When comparing the German and the French healthcare systems, it is impossible not to recall the historical circumstances that helped in shaping them. Considering historical premises, four classic models of health protection can be distinguished: an insurance model (German, Bismarck), a supply model (British, Beveridge), a socialist model (Soviet, Siemaszki) and a multi-market model (residual, American) [1].

The distinguishing features of healthcare models belonging to the classic classifications, is the role that the state and the public authority play in the creation and functioning of each model in a given country. The system for financing healthcare (collection of funds and the manner of their distribution) and availability of medical services for the community are other parameters that characterize each of the models. In their studies, the classic models of healthcare were introduced by, among others, Leowski [2], Lewandowski [1] and Przybyłka [3].

In the light of the topic under consideration, it is useful to present the main assumptions of the insurance model.

The insurance model, often referred to as the "Bismarck model", owes its name to the creator – Otto von Bismarck, then the Chancellor of Germany, who introduced the system of financing healthcare through obligatory and general health insurance contributions. As a result of the introduction of general insurance, state organizations were formed which society could easily identify with, and they comprised one of the elements of the concept of the national German state – a concept promoted by the Chancellor [4].

In the described insurance model, the decision-making process is decentralized. The role of the state is to create the basis and legal framework for the function-

ing of the system, while management is performed by financial institutions that function independently of the public authorities. The main assumption of this model, with regard to the creation and operation of such institutions, is the collection and accumulation of insurance premiums, which are used to finance healthcare.

Furthermore, access to medical services is provided to every insured person who pays premiums (it is a condition for granting the benefits), and the scope of such benefits are specified in an insurance contract.

Management of the healthcare system in Germany

In 1883, Germany implemented compulsory health insurance which became the precursor to the introduction of a socially legislated health insurance system. The fundamental principles underlying the introduced changes were the separation of health insurance premiums from state revenues obtained via taxes and obligatory participation in the scheme (the employer and the employee are legally obliged to pay the insurance premiums). These two principles have remained essentially unchanged to this day [4].

At the national (central) level the House of Parliament (Bundestag) is the main legislative body and the Federal Council of Germany (Bundesrat) performs legislative functions and establishes the law, whereas the responsibility of the Federal Ministry of Health (Bundesministerium für Gesundheit) is legislative initiative. The scheme of German healthcare system management is shown in fig. 1.

The Federal Ministry of Health prepares drafts of laws, develops regulations and provisions related to the functioning of the healthcare system and submits them to the Parliament and the Federal Council of Germany.

Statutory health and social insurance are a primary concern of Federal Ministry of Health activities, as well as matters related to protection of health and life. The Federal Ministry of Health establishes the requirements and formal procedures for clinical trials and also controls and monitors medication and pharmaceutical distribution. The scope of the Ministry's competencies also includes creating provisions for medical profession admission criteria and establishing regulations for professional trainings. The Federal Ministry of Health, which is supported by the Robert Koch Institute (Robert Koch-Institut), the Paul Ehrlich Institute (Paul-Ehrlich-Institut), the Federal Centre for Health Education (Bundeszentrale für gesundheitliche Aufklärung), the Federal Institute of Medicines and Medical Equipment (Bundesinstitut für Arzneimittel und Medizinprodukte) and the German Institute for Documentation and Medical Information (Deutsches Institut für Medizinische Dokumentation und Information) manages the German healthcare system and authorities of the 16 federal states – Länder [5,6].

The functioning of healthcare system, at the level of the Länder, rests with the state government, whose separate thematic departments manage various aspects of citizen life. The governments of the federal states do not have legislative powers related to healthcare. Länder authorities exercise a direct supervision over professional physician associations, health insurance funds and oversee their respective hospital policy (planning the development of a network of state and private hospitals in their area, bearing costs related to hospital investments, e.g. buildings, medical devices, etc.). It is also the responsibility of a Länder to determine the number of locations able to participate in medical studies and to define standards and benchmarks related to the implementation of medical practices and specializations [6].

The Central Decision Committee in the German healthcare system is the Joint Federal Committee (Gemeinsamer Bundesausschuss), which issues directives for many aspects of healthcare examination and treatment and supervises implementation of each aspect, e.g. regulation of medicinal products, introduction of new treatment methods, etc. The Federal Committee consists of representatives from self-governing professional associations of physicians and hospitals, health insurance companies, the German Federation Hospital (Deutsche Gesellschaft Krankenhaus) and patients' associations.

Medical and hospital associations, private and state-owned as well as patients' associations, also play a significant role in the German healthcare system.

Medical services are provided by physicians affiliated with regional and federal associations of physicians and dentists, who perform individual or, less frequently, team-based medical practice and hospitals affiliated with hospital associations at the federal and Länder level.

Physicians are affiliated with regional associations of physicians, providing services that are covered by health insurance (Kassenärztliche Vereinigungen). Membership in the professional self-government is obligatory. An affiliated doctor receives payments for completed medical services directly from their professional self-government. A self-government of doctors, on behalf of their members, conclude contracts with health insurance companies, which are obliged to enter into contracts with all eligible persons.

The basic source of financing for healthcare is the statutory health insurance. There are also voluntary private insurance funds. The private medical services market is a complement to the functioning healthcare system in Germany, under which more affluent people have the opportunity to purchase services through a direct payment [5].

Statutory health insurance funds are collected centrally in the Health Fund and transferred to health insurance companies. Health insurance companies (Landesverbände der Krankenkassen) at the Länder level are associated with the federations of insurance

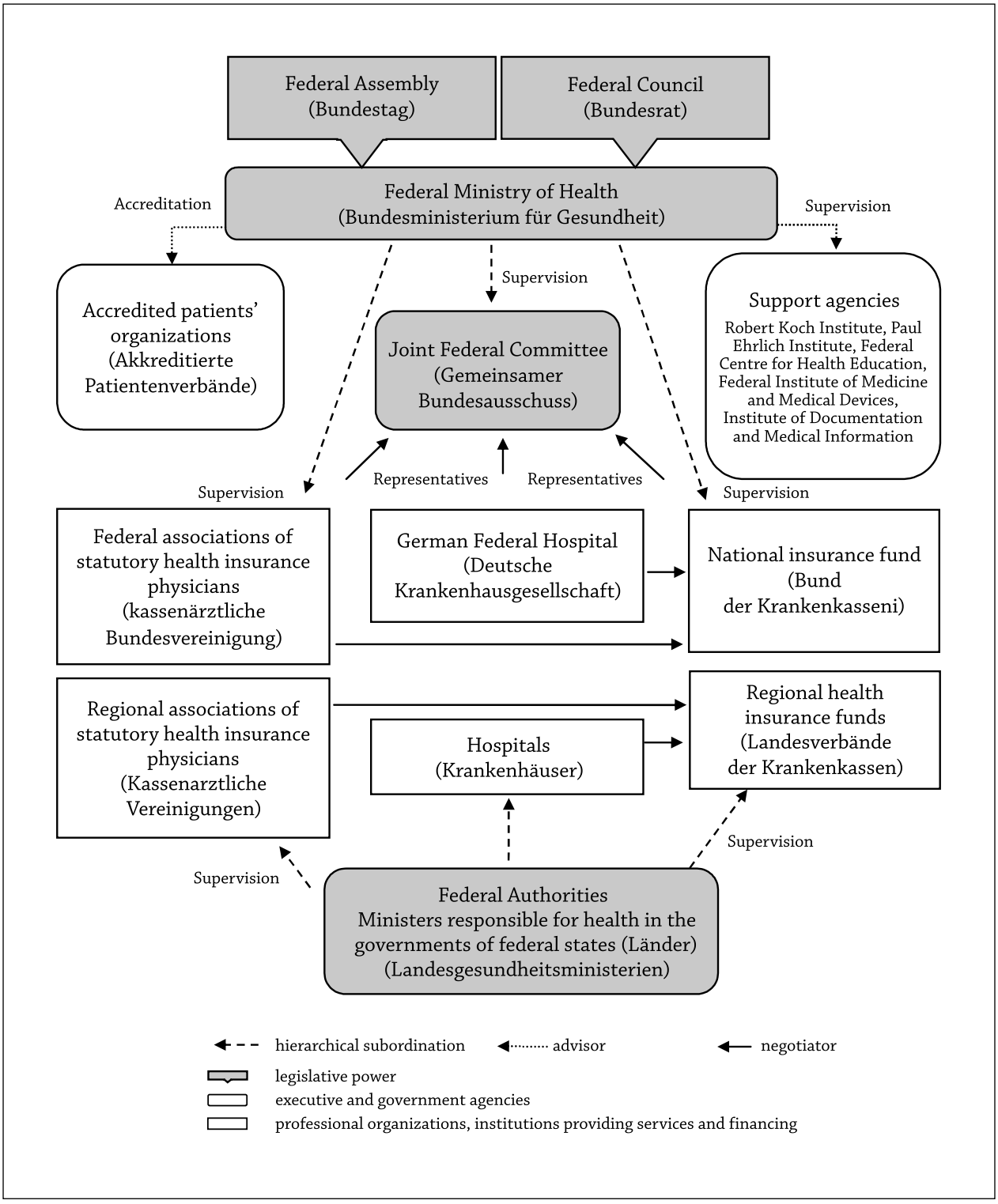

Figure 1. Scheme of Germany healthcare system management.

Source: authors' findings based on: Busse R, Blümel M [5].

companies (Bund der Krankenkassen) at the central level. These insurance companies are a direct payer of medical services provided to the eligible persons – the insured.

Patients in Germany generally have the freedom to select their physicians (from those physicians who have signed contracts with health insurance companies). Persons covered by statutory health insurance can freely choose from ambulatory care physicians who have been accredited by the health insurance funds. Patients can also freely choose from hospitals with whom the health insurance funds have signed contracts. The freedom of choice also applies to health insurance funds. In the case of uninsured people (mainly long-term unemployed, disabled, addicted, homeless), payment is covered by social assistance.

Management of the healthcare system in France

The French healthcare system was introduced in 1930 along with the Social Security Act. For the first time, a mandatory healthcare system was implemented that was paid for by the employers. An employer was obliged by law to pay insurance premiums for the employees earning the least.

The French healthcare system historically derives from the insurance model and is organizationally based on the Bismarck approach. The public authority is the main element of the healthcare system and it manages all of its activities and processes. In France, the state intervenes directly in the financing and organization of health services. The scheme of the French healthcare system is shown in fig. 2

The French Parliament has a legislative and control role in health policy and regulations related to the healthcare system, and it controls the realization of the primary health policy objectives and healthcare resources. Every year, the Parliament adopts the Act on Financing Social Security, in which, among other provisions, it sets expenses for the next year related to health insurance and defines the national targets for health insurance expenditure. The author of the Act is the government supported by the Auditors of the Court of Auditors (Cours des comptes), the High

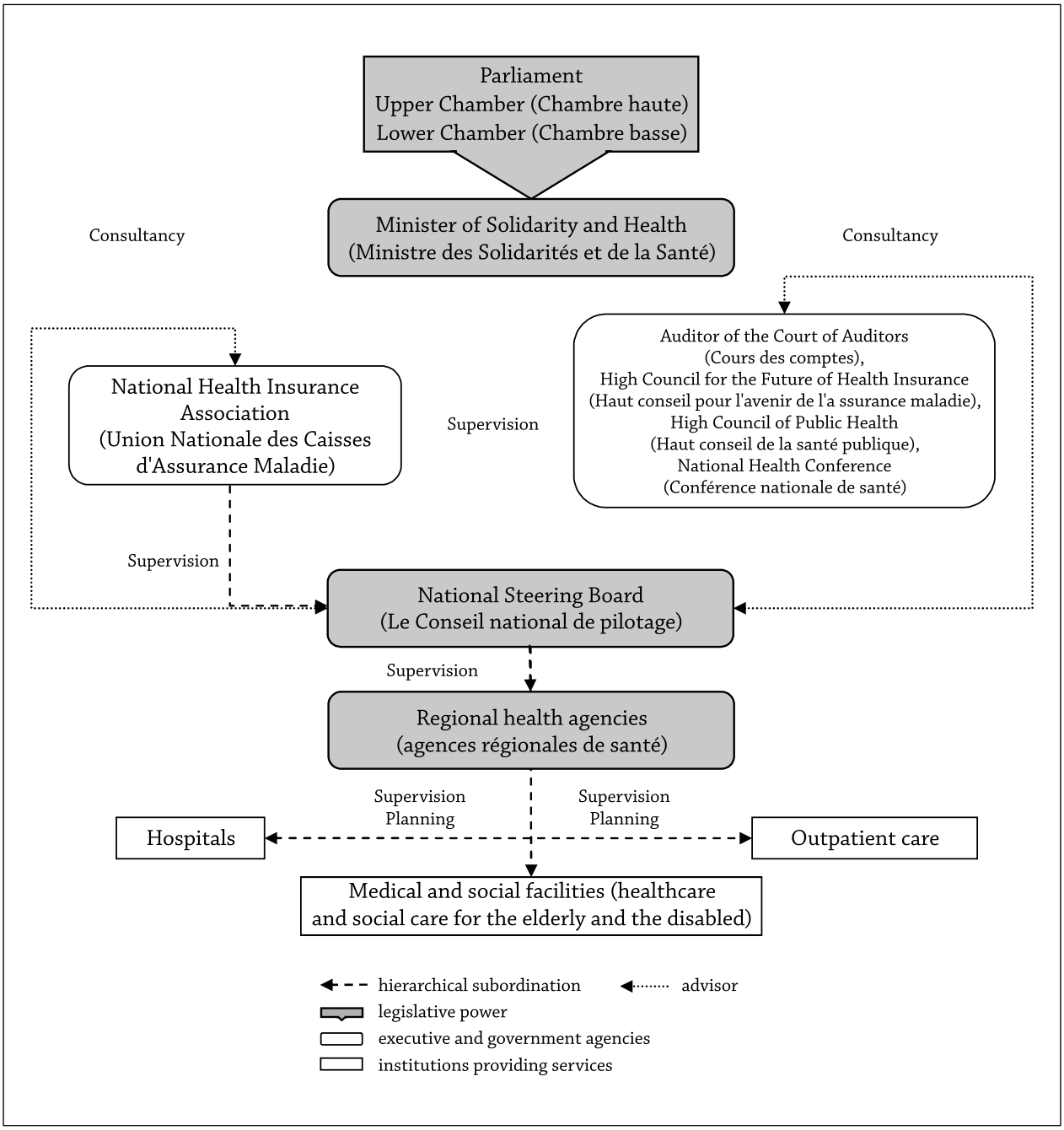

Figure 2. The scheme of French healthcare system management.

Source: authors' findings based on: Chevreul K, Brigham KB, Durand-Zaleski I [7].

Council for the Future of Health Insurance (Haut conseil pour l'avenir de l'assurance maladie), the High Council of Public Health (Haut conseil de la santé publique) and the National Health Conference (Conférence nationale de santé) [7].

The government's role is to initiate legislation and develop and present legal regulations to the Parliament. The government is accountable to the Parliament for the implementation of health policy and operation of the healthcare system. The Ministry of Solidarity and Health (Ministre des Solidarités et de la Santé) acts on behalf of the government. Its duty is also to prepare and implement government policy regarding families, the elderly and drug users/addicts. In this aspect, it prepares and implements provisions regarding the management of social insurance organizations and pension, sickness and maternity insurance, as well as family benefits. The Ministry is responsible for the functioning of public hospitals, supervision of all healthcare institutions and provision of healthcare, medical and social care as well as outpatient facilities. The scope of activities and responsibilities of the Ministry also includes supervision of the training of healthcare workers [8].

At the regional level, the state is responsible for the organization and management of the healthcare system. For this purpose, the Regional Health Agencies (Agences Régionales de Santé) have been established. Since 2016, there have been 17 regional health agencies (13 in the metropolises of France and 4 foreign) established in accordance with the territorial organization of France.

The governing body of the Regional Health Agencies is the National Steering Board (Le Conseil national de pilotage), which ensures the coherence of public health policy. The National Steering Board determines the strategic directions of national activities that contribute to improving the quality of care provided in the region.

The Regional Health Agencies define the coherent management of healthcare resources in order to ensure equal and undisturbed public access to the appropriate level of healthcare. The main tasks of the Regional Health Agencies are supervision of public health policy and management of regional healthcare, as well as monitoring the regional health status of the population and assessment of the education of health workers .

The Regional Health Agencies are public institutions, autonomous both functionally and financially. At the regional level, they are the primary managing authority for all of the health-related entities operating within a given region. Regional Health Agency activities are implemented through the regional health programmes created out of, among others, preventive plans and care organization plans (in patients' homes, outpatient clinics and hospitals), as well as regional program for the organization of medical care for the elderly, the dependent and the disabled [9].

The healthcare system in France is financed by general health premiums, paid through statutory health insurance which essentially the entire society contributes to (99% of the country's population). General statutory health insurance consists of several programs. The main programs include [7]:

- a general statutory health insurance program (*Caisse nationale d'assurance maladie des travailleurs salariés*), which includes employees working in trade, industry and services including their families,
- an agricultural statutory health insurance program (*Mutualité Sociale Agricole*), which includes farmers and agricultural workers including their families,
- a statutory health insurance programme for the self-employed (*Régime social des independents*), it includes the self-employed, e.g. lawyers.

The statutory health insurance programs belong to the National Union for Health Insurance (*Union Nationale des Caisses d'Assurance Maladie*) and are represented by the union, among others, in negotiations with entities providing medical services [10].

Employees and their families are associated with an insurance program based on their employment status and remain in it until their retirement. Working people have no choice in program to which they are registered, and they cannot opt out of insurance except for some cases (e.g. emigrants and employees of multinational corporations). Non-working people are automatically assigned and registered in the general system.

Conclusions

In Germany, the healthcare system is decentralized. Competencies are shared between the federal government, the federal states – Länder and the corporate level – the associations and chambers of medical professions, as well as organizations associated with medical entities and public and private insurance companies. All these institutions participate in the management of the healthcare system and are jointly and severally responsible for its functioning. In Germany, the state organizes the healthcare system, while the operational management of the healthcare system and its financial management is assigned to institutions, which are independent of public authorities.

In France, the state is responsible for operational and financial management of the healthcare system. The public authority takes full responsibility for the management of the healthcare system, its organization and the creation of its structures, as well as the establishment of subordinate and dependent institutions. The state ensures the coherence of public healthcare and is responsible for the quality, availability and efficiency of the entire system. The French healthcare system is mixed and combines features of the insured model with features of the supply model, as reflected in a single public payer and strong state intervention.

Although the level of healthcare in both countries is considered to be one of the best in Europe, the German and French healthcare systems present different con-

cepts of societal responsibility for citizens' healthcare [11]. This assertion is based on, among other things, the assessment of the quality of medical services provided, access to medical care, including specialists, which translates into the life expectancy of citizens of these countries. The systems of both Germany and France are characterized by some of the highest average life expectancies of citizens worldwide. In France, life expectancy is 79.3 years of age for men and 85.5 years of age for women. In Germany, it is 78.3 years old for men and 83.2 years old for women. The average is 77.9 years of age for men and 83.1 years of age for women (to compare, the life expectancy value for Polish citizens is 73.5 years of age for men and 81.6 years of age for women) [12–13].

The extent to which the healthcare system is financed combined with high life expectancies, among other things, affects the perception of healthcare system functioning in both Germany and in France. In Germany, 11.3% of GDP is devoted to healthcare and 11.5% of GDP in France (compared to 6.7% of GDP in Poland) [3,13] which, considered in the international arena, puts these two countries at the forefront in respect to financing.

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Correspondence address:
Piotr Rajfur
Państwowa Medyczna Wyższa Szkoła Zawodowa w Opolu
ul. Katowicka 68, 45-060 Opole
E-mail: rajfurp@wsm.opole.pl

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PYODERMA GANGRENOSUM – AN INTERDISCIPLINARY APPROACH TO THE DISEASE

Aleksandra Kapuśniak[A–F]

Aleksandra Czachor[C–F]

Grażyna Wąsik[C–F]

Provincial Hospital in Opole,
Department of General and Oncological Dermatology
with Daily Sub-Division, Opole, Poland

A – study design, **B** – data collection, **C** – statistical analysis, **D** – interpretation of data, **E** – manuscript preparation, **F** – literature review, **G** – sourcing of funding

ABSTRACT

Pyoderma gangrenosum is a rare dermatosis of unknown etiology. It is classified as being a neutrophilic dermatosis, in which there is inflammatory infiltration consisting primarily of mature polynuclear leukocytes. Its pathogenesis is multifactorial and is thought to involve neutrophilic dysfunction, inflammatory mediators in combination with a genetic predisposition for the disease. Neutrophilic infiltration is observed in new lesions, while necrosis associated with fibrosis and granulomas are seen in chronic lesions, however these findings are not pathognomonic. Pyoderma gangrenosum can occur at any age. However, it most commonly develops in young and middle-aged adults predominantly women between the second and fifth decades of life. Grossly, pyoderma gangrenosum is characterized by skin lesions in the form of rapidly spreading ulcers, with cylindrical edges and necrotic bottoms. These ulcers are painful and crusted but have undermined borders. Pyoderma gangrenosum commonly presents with the rapid development of one or more purulent ulcers with undermined borders on sites of normal or traumatized skin. Pyoderma gangrenosum is often associated with other systemic diseases such as ulcerative colitis, Crohn's disease, monoclonal gammopathies, IgG or IgA myelomas and tumors of internal organs and hematopoietic system diseases, which supports the immunological mechanisms involved in the pathogenesis of the disease. Of note, neutrophilic infiltration associated with other extracutaneous manifestations and different systemic disorders can co-exist with pyoderma gangrenosum. Despite the recent development of immune modulating drugs in the treatment of skin conditions, steroid therapy still plays a pivotal role. For patients with mild pyoderma gangrenosum, the local application of topical corticosteroids or calcineurin inhibitors can be sufficient. Systemic therapy is necessary in patients with more extensive disease. The role of surgery is controversial, as it is associated with the induction of pathergy. The clinical, histopathologic and laboratory findings in pyoderma gangrenosum are non-specific, and a diagnosis can only be made once other diagnoses have been excluded.

KEYWORDS: pyoderma gangrenosum, ulcers, neutrophilic dermatosis

Background

Pyoderma gangrenosum is a rare disease with an incidence of 1/100,000 per year in Western European countries [1]. The disease is observed in all age groups with a peak incidence between the ages of 40 and 60, with a slight female predominance [2,3]. It is rarely found in children and infants (about 4%), in which symptoms more frequently affect the scalp and anogenital region [4,5]. The exact etiology of pyoderma gangrenosum is unknown, but it is thought to be due to immune system dysfunction. Pyoderma gangrenosum is classified as a neutrophilic dermatosis due to the presence of extensive neutrophilic infiltrations within the skin, which subsequently leads to secondary vascular injury. Although neutrophilic infiltrations are found in the tissues affected by pyoderma gangrenosum, bacterial infection does not play a direct role in pathogenesis. Bacterial cultures from the skin lesions and blood are always negative and antibiotic therapy does not affect the course of the disease [6].

The aim of our article is to illustrate the ambiguous clinical picture and diagnostic difficulties associated

with the disease, and the multidisciplinary approach required to treat patients with pyoderma gangrenosum.

Co-existing diseases

Pyoderma gangrenosum occurs spontaneously, either as the idiopathic or primary form or as secondary to another systemic disease. In cases where pyoderma gangrenosum occurs with another disease, it may precede, parallel or follow the disease. Patients with pyoderma gangrenosum often attend multidisciplinary clinics. As pyoderma gangrenosum is a diagnosis of exclusion, before a diagnosis is made patients often have been treated with the suspicion of another disease process. Pyoderma gangrenosum often accompanies:

- Inflammatory bowel diseases such as Crohn's disease, ulcerative colitis, diverticulosis, solid tumors of the large intestine, carcinomas and peptic ulcer disease (14–30%).
- Hematological disorders such as IgA Gammopathy, Multiple myeloma, myeloid leukemia, real dysentery, malignant granuloma and lymphomas (15–28%).
- Rheumatic diseases such as rheumatoid arthritis and ankylosing spondylitis (10–20%).
- Other systemic diseases such as diabetes, hepatitis, cirrhosis, Takayasu's disease, Wegener's granulomatosis, systemic lupus erythematosus, autoimmune thyroid disease, Sweet's syndrome and Sarcoidosis [1–3,7,8].

Pyoderma gangrenosum also occurs more frequently in immunocompromised patients. With the more frequent use of immunosuppressive drugs, as well as the increase in the incidence of HIV, the incidence of pyoderma gangrenosum has also increased [7].

Pyoderma gangrenosum may occur as one of the manifestations of monogenic autoinflammatory syndromes such as: PAPA (purulent arthritis, pyoderma gangrenosum and acne syndrome), SAPHO (synovitis, acne, pustulosis, hyperostosis and osteoarthritis) or PASH (pyoderma gangrenosum, acne, acne inverted acne) [9].

Clinical picture

Pyoderma gangrenosum initially takes the form of a small lesion imitating a boil, pimple or blister, but can rapidly develop into a larger area of ulceration associated with necrosis. The lesion spreads rapidly peripherally, thus producing a large but relatively superficial area of ulceration with a swollen necrotic bottom and elevated dark red edges. These edges are usually submerged, blue or violet in color, irregular, or can be elevated in cases where fistulas are present. The bottom of the ulceration is filled with hemorrhagic secretion, partially covered by necrotic scabs, with or without granulation. Pimples are present both in the active edge and at the bottom of the ulceration [1,2]. The ulcers are sometimes preceded by inflammatory infiltration or a blistering reaction [3]. Skin lesions disappear leaving scars, these scars which result from the healing of lesions are referred to as 'sieve-like' scars as they are associated with numerous small recesses and holes [1,2]. Skin lesions are painful, often appearing on the lower limbs, mainly on the anterior surface of the lower thighs. However, they may occur on any part of the skin or mucous membranes [4]. Patients with facial lesions can often visit beauty parlors prior to seeking medical attention, therefore it is important that cosmetologists are aware of this condition and the phenomenon of pathergy. Mesotherapy and cosmetic procedures aimed at treating the skin are contraindicated, as they may intensify the disease process. According to reports, pyoderma gangrenosum can also affect organs outside of the skin and mucous membranes, and there can be associated neutrophilic infiltration of the bone, lungs, liver, pancreas, spleen, kidneys and central nervous system [10].

The course of the disease may be rapid and in untreated cases may lead to the involvement of deeper tissues, such as the muscles, vessels, nerves, fascia and bones.

The main symptom of pyoderma gangrenosum is pathergy. This altered skin reaction involves the appearance of skin lesions at the sites of minor injury. Pathergy occurs in 25% of patients with pyoderma gangrenosum. It is one of the criteria used for the diagnosis of the disease [1,2,9]. If the disease is not properly diagnosed and incorrectly treated by surgical debridement, it can lead to further peripheral disease progression [11]. Therefore, where pyoderma gangrenosum is suspected, any procedures are contraindicated, as they may adversely affect the course of the disease.

Diagnostic criteria

Larger:

- Rapidly growing, painful ulceration with features of necrosis with an irregular, violet-colored and submerged edge.
- Exclusion of other potential diagnoses.

Smaller:

- History suggesting pathergy or the presence of reticular scars.
- The presence of a disease associated with pyoderma gangrenosum.
- A rapid response to conventional treatments such as systemic steroid therapy.
- Typical histopathological picture such as neutrophilic infiltration and perivascular lymphocytic infiltration

Recognition

2 larger criteria and 2 smaller criteria

Clinical forms

- Blistering dysentery,
- Malignant pyoderma,
- Pyostomatitis vegetans,
- Periapical pyoderma gangrenosum,
- Postoperative skin gangrenosum,
- Genital pyoderma,
- Superficial granulomatous pyoderma,
- Pyoderma vegetans,
- Pustular pyoderma [1–3,7,8].

In pyoderma gangrenosum, patients may also report general symptoms such as; fever, malaise and joint pain. Of note, the ulcers are invariably painful [1].

Diagnostic tests

There is no clear diagnostic test to confirm a diagnosis of pyoderma gangrenosum. Neither histopathological examination nor specific laboratory tests can confirm a diagnosis, it is primarily diagnosed clinically [1]. However, the majority of authors recommend the collection of a skin segment for histopathological examination to exclude other causes of ulcers. For histopathological examination, it is recommended to take a cuticle from the edge and bottom of the ulceration [9]. In some cases, neutrophil and fiber deposits are found in superficial vessels in biopsy from the edge of the lesion. Neutrophilic inflammation with abscess formation and necrosis is often present [2]. There are no serological or hematological markers for this disease [7]. Laboratory tests performed in patients diagnosed pyoderma gangrenosum are important only in the search for possible coexisting systemic diseases.

Pyoderma gangrenosum is a chronic disease. In the idiopathic form, the course of the disease is chronic, with periods of exacerbation and remission. In the case of pyoderma gangrenosum coexisting with other diseases, its course depends on the prognosis of the underlying illness. If the underlying disease is curable, the prognosis is good, if not, the curability of the disease is much less likely.

Differential diagnostics

Differential diagnoses include; bacterial infection, gangrenous atypical mycosis, systemic mycoses, arthritic conditions, subcutaneous tissue inflammation, pemphigus erythematosus, self-inflicted injuries, Sweet's syndrome, Behcet's disease, Churg-Strauss syndrome, inverted acne, leukoclastic vasculitis, Wegener's syndrome, insect bites, leishmaniasis, amoebiasis and cancer [12].

Patient with pyoderma gangrenosum should be adequately cared for and the examinations necessary for differential diagnostics should be performed. The diagnosis of pyoderma gangrenosum often requires dermatologist expertise, however, doctors of various specialties are often involved in the search for possible coexisting diseases.

Treatment of pyoderma gangrenosum

Treatment of skin lesions may be topical or systemic, depending on the severity of pyoderma gangrenosum that is the extent and depth of skin lesions, the rate of appearance of new lesions and the general condition of the patient [4]. It is often necessary to use both forms of treatment simultaneously. Corticosteroids or cyclosporine are used as first choice drugs in systemic treatment. If steroids and cyclosporine are ineffective, biological drugs are used such as; infliximab, adalimumab, etanercept, alefacept and ustekinumab. Additional drugs that may be used include; sulfones, sulfasalazine, antibiotics, mycophenolate mofetil, azathioprine, methotrexate, cyclophosphamide, chlorambucil, thalidomide, intravenous immunoglobulins, as well as NSAIDs and opioids for pain [1,2,13–15]. In terms of local treatment, patients require careful wound management and dressing by specialist nurses. Surgical interventions should be discontinued, as both the surgical treatment of wounds and the location of skin grafts may result in failure or even deterioration due to the process of pathergy [1]. According to some authors, pyoderma gangrenosum patients who take immunosuppressive medications should not develop pathergy during surgical wound cleaning [16]. Topical treatments include; corticosteroids, calcineurine derivatives, hydrogel dressings, antiseptics and hyperbaric oxygen therapy [1–3,13,15,17–19].

Conclusions

Pyoderma gangrenosum remains a challenge for modern medicine due to its poorly understood etiology and pathogenesis, its variable clinical picture and a lack of useful diagnostic tests. A strong understanding of this condition, an awareness of the phenomenon of pathergy and a knowledge of potential treatment modalities is key to optimizing care in patients with pyoderma gangrenosum. An interdisciplinary approach will result in the avoidance of errors, appropriate wound management and better outcomes for patients with the disease.

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Correspondence address:
Aleksandra Kapuśniak, MD
Provincial Hospital in Opole,
Department of General and Oncological
Dermatology with Daily Sub-Division
E-mail: kapusniaka@poczta.fm

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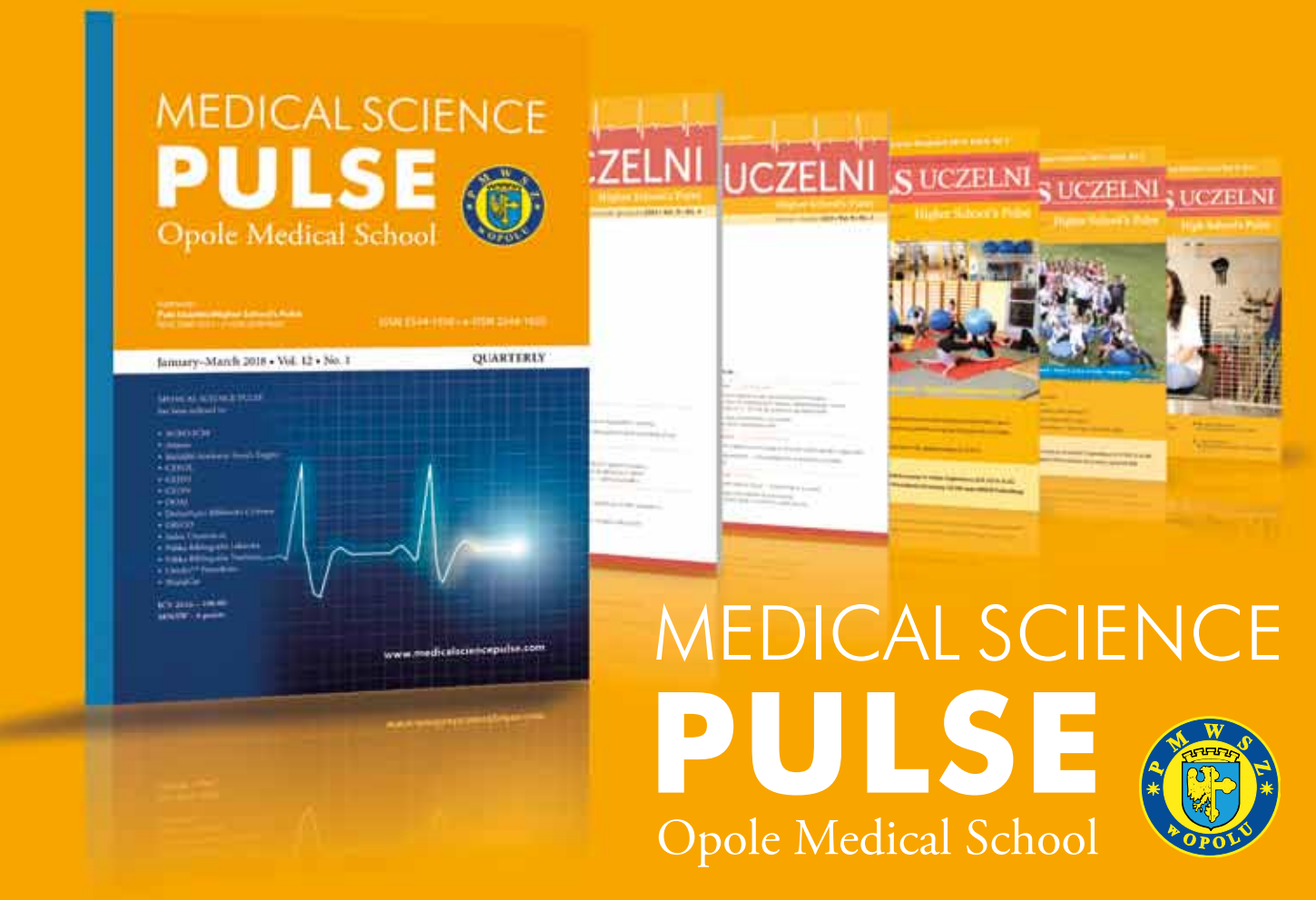

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