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INTRAOPERATIVE HYPOTENSION DURING GENERAL ANESTHESIA AFTER METAMIZOLE ADMINISTRATION: A CASE REPORT AND LITERATURE REVIEW

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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: Multiple factors often cause hypotension in patients undergoing operations. The simultaneous presence of several detrimental factors tends to lower arterial pressure.

Aim of the study: To investigate the specificity of intraoperative hypotension during general anesthesia after metamizole administration and describe this phenomenon based on a literature review.

Case report: This report describes a patient who experienced a sudden drop in blood pressure after receiving metamizole, an agent commonly used for intraoperative pain management during general anesthesia. However, the drop in blood pressure was not accompanied by other symptoms, indicating that it was unlikely caused by additional factors. The patient was treated with a sympathomimetic agent.

Conclusions: Metamizole is a relatively safe drug commonly used for optimal pain control in anesthesia practice. The occurrence of hypotension after its administration is an infrequent phenomenon, but proper monitoring and observation of patients' vital signs during infusions of this drug are essential.

KEYWORDS: blood pressure, ephedrine, isolated hypotension, dipyrone

Background

Despite substantial advances in medicine, intraoperative hypotension remains one of the most common side effects in patients undergoing anesthesia for surgery [1]. Indeed, a multicenter observational study with a sample of over 22,000 people showed that there was at least one episode of hypotension, defined as mean arterial pressure (MAP) <65 mm Hg lasting for 1 minute, in 88% of cases [2].

The pathophysiological basis of hypotension is not simple [3]. A 2009 study, described as groundbreaking, found that the occurrence of intraoperative hypotension was not related to annual mortality [4]. Thirteen years later, reports on the phenomenon have not brought us closer to an international consensus on the exact definition of intraoperative hypotension [3]. Wesselink et al. investigated which MAP values and their duration are associated with the risk of complications such as death, myocardial infarction, and acute kidney damage. Their analysis showed a slight increase in the risk of complications with MAP <80 mm Hg for ≥10 minutes or ≤70 mm Hg for <10 minutes. Furthermore, an elevated risk of complications was observed when MAP was <65 mm Hg for ≥20 min, <50 mm Hg for ≥5 min, or <40 mm Hg for any length of time. The analysis also revealed that the MAP thresholds associated with the risk of adverse events vary depending on the organ system [5]. In addition to defining the level of blood pressure that can be considered hypotension, it is necessary to account for the many possible causes of the phenom-

enon during surgery and introduce effective treatment after identifying the cause.

Based on the following case report, the authors attempted to address the differential diagnosis and proper management of intraoperative hypotension.

Aim of the study

This case study aimed to present a clinical case of a patient experiencing intraoperative hypotension during general anesthesia after metamizole administration and to describe this phenomenon based on a literature review.

Material and methods

Study design and setting

A case study was conducted in March 2022 at the Klinika-Hospital Zum Heiligen Geist in Fritzlar. Data was obtained by analyzing medical documentation and an anesthetic monitoring chart. The patient was informed of the study's intention and provided informed consent.

Participant

A 75-year-old male was admitted to the Department of Orthopedics for a planned endoprosthetic procedure on the right hip joint. The patient was being treated for left ventricular heart failure, hypertension, and type II diabetes. In addition, he had second-degree obesity (38.31 kg/m2) and an implanted pacemaker. Medications for his co-morbidities included a fixed combination of angiotensin-converting enzyme inhibitors (ramipril), statins (atorvastatin), and acetylsalicylic acid. Before the procedure, he had taken all medications except ramipril and did not report any drug allergies.

Data sources/measurements

After bringing the patient to the operating room, perioperative monitoring began, which included electrocardiography, non-invasive blood pressure monitoring, determination of functional oxygen saturation, and body temperature measurement. The patient was then oxygenated passively for three minutes with 100% oxygen through a face mask. Induction of anesthesia used sufentanil (10 μg), propofol (200 mg), atracurium (20 mg), and dexamethasone (4 mg). The patient was intubated with an 8.5 mm tube, and its correct location was confirmed by auscultation and capnometry.

Anesthesia was maintained by sevoflurane (minimum alveolar concentration of 0.9-1.0) in air, with a fraction of inspired oxygen of 0.5 and a fresh gas flow rate of 1 L/min. Ventilation was conducted in volumetric mode with a positive end-expiratory pressure of 5 cm H_2O. A drip infusion of 500 ml of multielectrolyte fluid was administered, and the patient was connected to a time of flight (TOF) neuromuscular blockade monitoring device, which indicated 0% after induction. A solution of 1.5 g of cefuroxime was used for prophylactic antibiotic therapy. After 20 minutes of intubation, a bolus of sufentanil (10 μg) was administered intravenously to optimize analgesia. A downward trend in the patients' pressure measurements was noticed approximately 25 minutes after intubation, so a 9 mg bolus of ephedrine was administered and had the expected adrenergic effect.

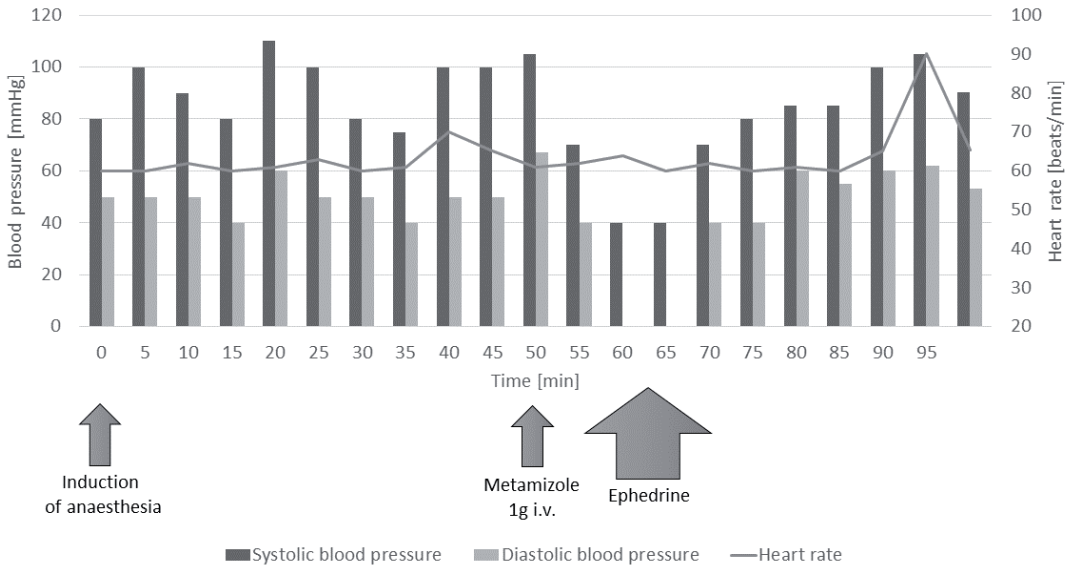

Figure 1. Monitoring of hemodynamic parameters. Abbreviations: i.v. – intravenous

Results

Fifty minutes after intubation, 1 g of metamizole in a 0.9% sodium chloride (NaCl) solution and a 5 μg bolus of sufentanil were administered intravenously. Approximately five minutes after the patient's last supply of drugs, there was a drastic drop in blood pressure to unquantifiable values, and he developed tachypnea (27 breaths/minute) (Figure 1).

A total of 54 mg of ephedrine was administered (four 9 mg boluses and one of 18 mg), with short intervals of a few minutes between doses, which allowed the blood pressure to return to a value observed before the episode of hypotension. The non-standard (for Polish conditions) dosage of ephedrine is due to the fact that it is available in 30 mg/ml ampoules in hospitals in Germany, where this event occurred. General endotracheal anesthesia lasted for 95 minutes, and the extubation and awakening of the patient went without further complications. No unexpected blood loss was recorded, and the patient scored 10 points on the Aldrete scale after waking up. The postoperative course was without complications.

Discussion

Key results

The issue of intraoperative hypotension is complex, and there is no single correct definition of this clinical condition. Furthermore, low blood pressure during anesthesia can have various causes. Therefore, the patient's clinical profile, medical procedures, and drug side effects should be considered during treatment management. However, it should also be noted that removing the direct cause of hypotension may not always be the best solution.

Interpretation

Intraoperative hypotension always requires an immediate response from the anesthesia team because prolonged episodes of low blood pressure or very low MAP values, regardless of duration, are associated with a higher risk of complications such as death, myocardial injury, myocardial infarction, cardiogenic shock, acute renal failure, hallucinations, and stroke [6].

The absolute values defining hypotension are generally considered as MAP <60 mm Hg and/or systolic arterial pressure (SAP) <90 mm Hg. However, these values are used as cut-off points in clinical trials but are not included in official guidelines. The literature describes hypotension as any reduction in blood pressure requiring a therapeutic intervention that increases the volume of the vascular bed or employs vasoconstrictors. On the other hand, other researchers consider hypotension to be a decrease in blood pressure values by 10-60% compared to baseline [6].

The causes of intraoperative hypotension are preoperative, intraoperative, and postoperative. For a better illustration, they are detailed in Table 1.

Table 1. Causes of perioperative hypotension [2, 6-8]

Causes of perioperative hypotension			
Preoperative	**Intraoperative**		**Postoperative**
Patient-related	**Anesthesia-related**	**Operation-related**	**Complications-related**
• Advanced age • Low blood pressure before anesthesia • Hypovolemia • High ASA score • Long-term hypotensive treatment • Diabetes mellitus • Hypothyroidism • Alcohol abuse • Low BMI	• Too-deep anesthesia • Too high a dose of painkillers • Anaphylactoid response • Sympathetic blockade (if indicated – consider paravertebral blockade) • Measurement error • Adverse drug reactions and/or interactions • Other drugs – nitroprusside, nitroglycerine, histamine-releasing agents	• High-risk operations • Long-term surgery • Intraoperative bleeding	• Myocardial ischemia • Hypovolemia • Dysrhythmia • Dynamic left ventricular outflow tract (LVOT) stenosis • Pneumothorax • Cardiac tamponade • Embolism • Sepsis • Hemorrhage

Abbreviations: ASA – American Association of Anesthesiologists; BMI – body mass index.

Recently, several interesting studies have emerged assessing artificial intelligence (specifically a machine learning model) for estimating the risk of perioperative hypotension in real time [9-11]. However, despite promising results, some researchers recommend caution and a more pragmatic approach to this new technology [12].

The intervention procedure used during intraoperative hypotension consists of increasing vascular bed filling using fluids or blood preparations and plac-

ing the patient in the Trendelenburg position. However, these are very general recommendations, and the primary aim is to conduct a quick and accurate differential diagnosis to determine the most probable cause of the hypotension. Some causes, such as sepsis, pulmonary embolism, and arrhythmias, necessitate using appropriate protocols or guidelines. Meanwhile, other situations require the supply of fluids and drugs such as ephedrine, norepinephrine, adrenaline, and phenylephrine.

An undoubtedly vital issue to consider in intraoperative hypotension is the supply of anesthetic drugs. Indeed, anesthesia being too deep is one of the primary causes of intraoperative hypotension. However, the Position of the Consultation Council of the Polish Society of Anesthesiology and Intensive Therapy is that interventions for hemodynamic instability should initially aim to optimize the circulatory system, if possible, and shallow anesthesia combined with the parallel administration of amnestics (benzodiazepines) and analgesics (opioids) should be a last resort. Their position is justifiable given that intraoperative hypotension is a significant risk factor for unintentional intraoperative return of consciousness [6, 13].

The authors of the international consensus of the Perioperative Quality Initiative do not explicitly state which therapy is most suitable for use in intraoperative hypotension. As such, the choice of therapeutic interventions is the subject of ongoing debate, and it remains unclear which treatment strategies significantly affect outcomes [13]. However, Meng et al. proposed a scheme for the differential diagnosis and treatment of perioperative hypotension, as shown in Figure 2 [14].

Prevention of undesirable drops in blood pressure is most difficult when the occurrence of factors related to the patient prevails. In the case of hypotension prevention and stabilization of the circulatory system, volume loss should be replaced with fluids while avoiding harmful leakages [6, 15], with a maximum volume of shunted fluids of less than 2 ml/kg/h [15]. In addition, if the patient is taking ACE-I/ARBs (angiotensin-converting enzyme inhibitors/angiotensin II receptor blockers), they should be suspended during the perioperative period (minimum ten hours of withdrawal), as their use is associated with prolonged and refractory hypotension [16]. Also, episodes of hypotension caused by excessive medication doses can be prevented by monitoring the depth of anesthesia using indicators such as the Bispectral Index (BIS). The literature also emphasizes the role of intraoperative transoesophageal echocardiography in detecting changes in myocardial contractility, which indicates that ischemia may result from a decrease in blood pressure [6].

In the current case, the patient had several preoperative, non-modifiable risk factors for hypotension, including old age, hypertension, left ventricular heart failure, and an American Association of Anesthesiologists (ASA) classification of III. Nonetheless, attention should be paid to any dangerous episode of low blood pressure immediately after administering metamizole and sufentanil. However, the authors rule out the possibility of the opioid provoking such a severe event because a small dose was adminis-

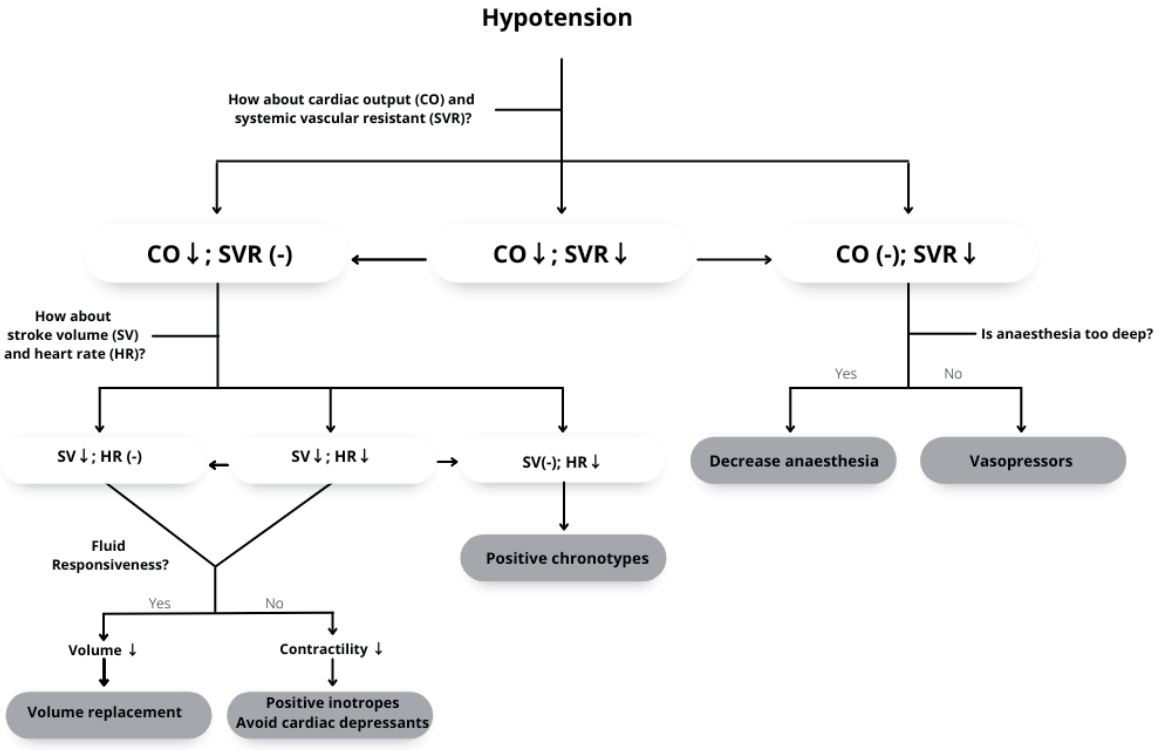

Figure 2. Differential diagnosis and treatment of hypotension in perioperative care [14]

tered, and previous boluses did not cause significant fluctuations in blood pressure.

In this case, the principal cause of intraoperative hypotension was metamizole, which can cause isolated hypotension of unknown prevalence after intravenous administration, according to the Summary of Product Characteristics [17]. In addition, retrospective studies from the 1990s demonstrated that severe hypotension occurred at a frequency of 1:300 after parenteral administration of the drug [18, 19]. Also, pharmacological factors indicate that metamizole was responsible for the episode of hypotension, as the drug relaxes smooth muscle cells. Moreover, metamizole obtained a value of 3 on the Naranjo scale, indicating that an adverse reaction is possible when the drug is used [20, 21].

Metamizole intake significantly affects the expression and function of certain drug-metabolizing enzymes belonging to the cytochrome P450 (CYP) family, with studies showing that metamizole can induce human CYP2B6 and CYP3A4 [22]. Furthermore, metamizole increases the risk of severe hypothermia when used in combination with neuroleptic and phenothiazine derivatives. Additionally, metamizole can increase the serum concentration of methotrexate, which exacerbates its toxicity [23]. However, it is highly unlikely that the hypotonia resulted from an interaction between metamizole and any drugs we administered or that the patient had taken before the procedure [24].

Therapeutic intervention in the current case may be debatable. According to the Product Characteristics, ephedrine should only be administered to a maximum dose of 30 mg. If this does not produce the expected effect, another drug should be considered (a continuous infusion of norepinephrine would be most appropriate in this situation). Indeed, continued use of ephedrine without adequate breaks leads to tachyphylaxis, with the loss response caused by decreased sensitivity to the agent [17, 25].

A review of the literature using PubMed/Medline and Google Scholar did not provide definitive answers on the characteristics of the metamizole-induced intraoperative hypotension phenomenon. Using anesthetics in older patients increases the risk of hypotension and cardiovascular collapse. However, an initial dose of up to 10 mg of metamizole per kg of body weight is recommended for all patient groups before commencing continuous drug infusion [16, 26]. As such, attention should be paid to anaphylactic reactions, and blood pressure should be monitored regularly [26]. Before the end of the procedure, metamizole should be administered as a fifteen-minute infusion of 1.0 g/100 ml of 0.9% NaCl solution, although the maximum daily dose suggested by the manufacturer is 5 g intravenous [17, 26]. Nonetheless, it should be noted that the therapeutic index of metamizole is very high [27].

Generalizability

An appropriate response by doctors to patient complaints allows for quick diagnosis, identification of underlying causes, and implementation of optimal treatment and care procedures.

Study limitations

The study was limited to only one patient, which should be expanded to include additional subjects in the future. Furthermore, subsequent research should focus on the frequency of intraoperative hypotension during general anesthesia after metamizole administration.

Recommendations

It is important to be aware of all causes of perioperative hypotension and the protocols or guidelines for managing such cases to improve the level of care provided. Additionally, it is crucial to consider that each patient requires an individualized approach.

Conclusions

There is no officially accepted definition of intraoperative hypotension. However, any lowering of blood pressure values of concern to a physician should be carefully analyzed regardless of which of the available values we accept as valid. Such scrutiny is warranted given the range of causes of hypotension and the many direct consequences of this phenomenon. Metamizole is a safe drug commonly used for optimal pain control in anesthesiology practice, and hypotension does not appear to be a frequent phenomenon after its administration. However, proper monitoring and meticulous observation of patients' vital signs during infusions of this drug is mandatory. Indeed, even drugs that are commonly used, and are considered safe, have side effects.

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EVALUATION OF THE STATE OF KNOWLEDGE OF POLISH STUDENTS ON THE TOPIC OF CANNABINOIDS: CROSS-SECTIONAL LOCAL STUDY

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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: Cannabis is a plant that possesses psychoactive properties and contains approximately 500 active substances, including more than 100 cannabinoids. THC (Tetrahydrocannabinol) and CBD (Cannabidiol) are the best known. Cannabinoids are used to treat a number of disorders.

Aim of the study: Learn about medical students' knowledge of medicinal cannabinoids.

Material and methods: A total of 240 medical students from the University of Technology and Humanities in Radom were surveyed. In this study, the method of diagnostic interviewing used was auditory interviewing. The author's questionnaire was used as the research tool. IBM SPSS Statistics package version 26 performed statistical analysis of key descriptive statistics. Student's t-test, Kolmogorov-Smirnov test, Spearman's rho test, ANOVA, and post hoc Tukey test were applied.

Results: The average level of knowledge about the application of medicinal cannabinoids was 44.24, deviating by +/– 4.40. The students of medical programs have a knowledge significantly larger than physical therapy students, whereas nursing students are not different in this respect from either medicine or physical therapy students.

Conclusions: Medical students do not have sufficient knowledge about the application of medicinal cannabinoids. The introduction of this subject matter to undergraduate programs seems reasonable.

KEYWORDS: knowledge, cannabinoids, students, medical faculties

Background

Cannabis is becoming increasingly popular among the public. This growing popularity is driven by improved access to cannabis, frequent debates about its legalization, and reports on the effectiveness of cannabinoids in treating or alleviating the symptoms of many diverse disorders [1].

Many states have decided to legalize and regulate the sales of marijuana. In line with the Polish Act Amending the Counteracting of Drug Addiction Act and the Refunding of Medication, Special Nutrition Foods, and Medical Products Act of July 7, 2017, prescription drugs can be made containing more than 0.2% of Tetrahydrocannabinol (THC) and THC-A on the dried basis. Growing cannabis is prohibited in Poland, and obtaining marketing authorization is complicated. Prescriptions for medical marijuana have an availability class meaning it contains narcotic or psychotropic substances defined in separate regulations [2,3].

According to the recommendation of the President of the AOTMiT No. 80/2019 of November 7,

2019, the indications for treatment with medical marijuana are disorders including spasticity with pain (multiple sclerosis, spinal cord injuries), nausea and vomiting (in the course of chemotherapy, radiotherapy, combination therapy of HIV and hepatitis C), chronic pain (especially neurogenic pain), palliative treatment of cancer and AIDS (stimulating appetite, reducing pain, preventing weight loss and nausea), and refractory glaucoma [4]. The pharmacological potential of cannabinoids can also be used in: anorexia, inflammatory diseases, degenerative diseases of the central nervous system (Parkinson's, Huntington's, Tourette's, and Alzheimer's disease), epilepsy, glaucoma, schizophrenia, certain cardiovascular and metabolic diseases, cancer, and obesity [5,6].

In connection with the spreading popularity of cannabinoids and divergent information about their actual effects, healthcare professionals, as a source of information for patients, should have the necessary knowledge on the topic at hand.

Aim of the study

Learn about medical students' knowledge of medicinal cannabinoids.

Material and methods

Participants, study design, and organization

A total of 240 medical students (medicine, nursing, physical therapy) from the University of Technology and Humanities in Radom were surveyed from September to December 2021. The questionnaires were anonymous and completed independently. Everyone was informed about the purpose of the survey and assured of their anonymity in advance of the survey.

Research method

The methods of a diagnostic survey and the technique of an auditory survey were employed. The original survey questionnaire consists of 31 closed-ended questions divided into socio-demographic particulars and some questions verifying a respondent's knowledge of medicinal cannabinoids. Students were asked to assess their level of knowledge about the effects of cannabis on the human body and to cite the source of this knowledge. The survey included questions on knowledge of cannabinoid-containing medicines, indications for the use of medical cannabis, side effects, and legal regulations in Poland. Specific questions concerning the effects of the substance in specific disease entities (Alzheimer's, Tourette's syndrome, amyotrophic lateral sclerosis, asthma, glaucoma, autoimmune, gastrointestinal, and cardiovascular diseases). In two questions, students were asked for their opinions on the legalization of cannabis for recreational purposes and the relevance of introducing this topic into the didactic classes of medical faculties.

Statistical methods

IBM SPSS Statistics package version 26 was used for statistical analysis of the fundamental descriptive statistics. Student's t-test, Kolmogorov-Smirnov test, Spearman's rho test, ANOVA, and post hoc Tukey test were applied. An $\alpha = 0.05$ is assumed to be the level of statistical significance.

Ethical considerations

The draft study has been approved by the Bioethical Commission with the University of Technology and Humanities in Radom in its resolution No. KB/2/2021.

Results

Socio-demographic characteristics of the respondents

The students of the medical program (70), nursing (100), and physical therapy (70) were surveyed. Most were aged 21. There were more females (78.3%) than males (21.7%) among the respondents. Nearly half (45.9%) stated they live in the country and the others in towns and cities of various sizes.

Use of cannabis by respondents

Most students (68.8%) declared they have never used marijuana/hashish recreationally, while the rest (31.2%) answered in the affirmative (21.0% choose the answer "1–2 times a year", 7.2% "several times a year", 1.3% "every month", and only 1.7% "every week").

Declared level of knowledge of medicinal cannabinoids

Only 35.4% of those surveyed believe their knowledge of medicinal marijuana was moderate, including

50.0% of nursing students, 31.4% of physiotherapy students, and 40.0% of medical students. The same share (35.4%) described their knowledge as minimal or non-existent. Merely 29.2% estimated their knowledge as good or very good. As many as 81.7% of the respondents are of the opinion that their knowledge of medicinal cannabinoids should become a fixture in medical programs.

Sources of respondents' knowledge of medicinal cannabinoids

They point to books (nursing – 94.0%, medicine – 97.14%), social portals (Facebook, Instagram, etc.), and YouTube (physical therapy: 87.1% and 85.7%, respectively) as their main sources of knowledge about medicinal marijuana. Their courses are indicated by 91.4% of medical students, 88.7% of nursing students, and 60% of physical therapy students.

Assessment of knowledge on the use of medicinal cannabinoids in the opinion of respondents

Although the students claim that medicinal marijuana has no applications, the distribution of their responses suggests they do have knowledge of its therapeutic applications (Table 1).

Table 1. The distribution of responses concerning indications for the application of medicinal marijuana (a number of responses)

What, to your knowledge, are the indications for the application of medicinal marijuana?	Nursing			Physiotherapy			Medicine		
	n	%	% respondents	n	%	% respondents	n	%	% respondents
Treatment of refractory epilepsy	39	2.7	39	10	1.2	14.3	28	2.8	40.0
Pain associated with multiple sclerosis	43	3.0	43	21	2.5	30.0	36	3.5	51.4
Minimizing neoplastic pain	32	2.2	32	20	2.4	28.6	33	3.2	47.1
Reduction of migraine fits	66	4.6	66	32	3.8	45.7	43	4.2	61.4
Alleviation of Parkinson's symptoms	62	4.3	62	27	3.2	38.6	42	4.1	60.0
Treatment of nausea and vomiting	88	6.1	88	45	5.4	64.3	62	6.1	88.6
Treatment of MND	75	5.2	75	36	4.3	51.4	48	4.7	68.6
Treatment of Huntington's disease	79	5.5	79	51	6.1	72.9	63	6.2	90.0
Treatment of anorexia	85	5.9	85	41	4.9	58.6	65	6.4	92.9
Treatment of Alzheimer's disease	70	4.9	70	39	4.7	55.7	53	5.2	75.7
Alleviation of enteropathic inflammatory disease symptoms	89	6.2	89	56	6.7	80.0	61	6.0	87.1
Treatment of Tourette's syndrome	77	5.3	77	48	5.7	68.6	48	4.7	68.6
Treatment of glaucoma	88	6.1	88	46	5.5	65.7	57	5.6	81.4
Treatment of schizophrenia	89	6.2	89	44	5.3	62.9	55	5.4	78.6
Treatment of dizziness	90	6,2	90	58	6,9	82,9	60	5,9	85.7
Treatment of hepatitis	96	6.7	96	67	8	95.7	68	6.7	97.1
Treatment of HIV /AIDS	90	6.2	90	65	7.8	92.9	66	6.5	94.3
Treatment of cystic fibrosis	89	6.2	89	61	7.3	87.1	63	6.2	90.0
No applications	95	6.6	95	69	8.3	98.6	66	6.5	94.3

n – number, % – percentage distribution.

When asked about the availability of medicinal products containing herbal cannabis in Poland (prescription drugs containing narcotic or psychotropic substances), 17.1% (7.9% of physical therapy, 5.4% of nursing, and 3.7% of medicine students) have some knowledge about it. As many as 82.9% gave incorrect answers.

A majority of the respondents (74.6%) provided the correct answer about the method of administering cannabis and its products (77.0% of nursing, 82.8% of physical therapy, and 68.8% of medical students). Those surveyed said the preparations can be administered through the skin, mucosa, by smoking, inhaling with vaporizers, and as part of food products. Merely 30.8% of those queried (nursing 27.0%, physical therapy 38.6%, medicine 28.6%) were correct in describing the analgesic effectiveness of cannabinoids as comparable to that of mild opioids.

As far as the effect of marijuana on the digestive system is concerned, nearly half the students (42.5%) did not know the correct answer. Only 34.2% selected the right choice, including 52.8% from the

physical therapy, 34.2% from the medical, and 21.0% from the nursing program. When asked how cannabinoids work in the treatment of glaucoma, 47.5% of respondents select the correct answer (they reduce intraocular pressure), including 21.25% of physical therapy students, 14.6% of nursing students, and 11.7% of medical students.

The answers to the questions about the medicinal effects of marijuana on asthma are distributed as follows: it lowers the quantity of mucus (78.3%), it is antiphlogistic (77.9%), and it increases patency of the airways (74.2%). The answer 'it loosens the bronchia" had the fewest selections of all (46.3%). The students were asked to select the auto-immunological disorders in which they believe cannabinoids to have beneficial therapeutic impacts. The correct answers included: Graves's disease (96.3%), celiac syndrome (95.0%), ulcerative colitis (88.75%), Hashimoto's thyroiditis (89.6%), rheumatoid arthritis (75.0%), and multiple sclerosis (60.4%).

The action of THC and its analogs in the treatment of Alzheimer's was correctly identified by 15.0% of those asked: 'it raises the acetylcholine level, preventing the neurotransmitter degradation and reducing β-amyloid deposits'. This response was chosen by 27.1% of physical therapy, 15.7% of medicine, and 6.0% of nursing students.

Of all respondents, 45.0% answered correctly that marijuana reduces the number and intensity of ticks characteristic of Tourette's syndrome (42.0% of nursing, 48.6% of medicine, and 45.7% of physical therapy students). As far as the effect of cannabinoids on the MND is concerned, only 25.4% of those queried believe they enhance the survival of nerve cells, 62.9% point to the analgesic function, 57.5% state they increase appetite, and 45.4% selected the myorelaxant function.

Students' level of knowledge on the use of medicinal cannabinoids

The average standard of knowledge about the applications of medicinal cannabinoids was 44.24, with a SD of +/–4.40. The median for this variable was 44.00. The minimum score was 32 and the maximum was 56. The results of the Kolmogorov-Smirnov test were statistically significant (Table 2).

Table 2. Key descriptive statistics and the result of the Kolmogorov-Smirnov test

Knowledge about the applications of medicinal cannabinoids	M	Me	SD	Sk.	Kurt	Min.	Maks	D	p
	44.24	44.00	4.40	–0.05	–0.48	32.00	56.00	0.09	<0.001

M – mean, Me – median, SD – standard deviation, Sk – skewness, Kurt. – kurtosis, Min. – minimum value of the set, Maks. – maximum value of the set, D – results of distribution normalcy (Kolmogorov-Smirnov) test, p – statistical significance.

Relationship between the field of study and level of knowledge of medicinal cannabinoids

The one-way analysis ANOVA shows the program of studies differentiates the level of knowledge about the applications of medicinal cannabinoids. This is a statistically significant effect of moderate strength (Table 3).

To determine exact differences, the post hoc Tukey test was applied. Paired comparisons demonstrated the students in the medical program exhibited a markedly greater knowledge about the applications of medicinal cannabinoids than the physical therapy students (p = 0.002). The nursing students' knowledge, on the other hand, was no different from that of the medical students (p = 0.242) or the physical therapy students (p = 0.095).

Table 3. The differences in the extent of knowledge about the applications of medicinal cannabinoids depending on the program of study

Knowledge about the applications of medicinal cannabinoids	Nursing (n=100)		Physical therapy (n=70)		Medicine (n=70)		*F*	*p*	η^2
	M	SD	M	SD	M	SD			
	44.33_{ab}	4.33	42.93_{a}	**4.05**	45.41_{b}	4.53	5.85	0.003	0.05

The various letters suggest statistically significant differences of $p < 0.05$; M – mean, SD – standard deviation, n – number, *F* – ANOVA test, *p* – statistical significance, η^2 – eta squared.

Relationship between cannabis use and level of knowledge of medicinal cannabinoids

The analysis continues to verify whether personal experience with marijuana differentiates knowledge about the applications of cannabinoids. To this end, a Student's t-test for independent samples, its non-parametric equivalent, and Spearman's *rho* correlation analysis were undertaken.

Given the numerical divergences of the groups, the results are verified with a non-parametric test.

Table 4. The differences in the extent of knowledge about the applications of medicinal cannabinoids depending on the use of marijuana

Knowledge about the applications of medicinal cannabinoids	Experience with marijuana (n=75)		No experience with marijuana (n=165)		*t*	*p*	95% CI		Cohen's *d*
	M	SD	M	SD			LL	UL	
	44.17	4.72	44.27	4.26	–0.15	0.879	–1.30	1.12	0.02

M – mean, SD – standard deviation, n – number, *t* – Student's t-test statistics, *p* – statistical significance, CI – 95% confidence interval, LL – the lower limit of the confidence interval, UL – the upper limit of the confidence interval, Cohen's – scale of the effect.

The results of both tests were statistically insignificant (Table 4).

Spearman's *rho* correlation between the frequency of marijuana use and knowledge about the applications of medicinal cannabinoids was then analyzed. The analysis results were statistically insignificant. The frequency of marijuana use does not differentiate the level of knowledge (Table 5).

Table 5. Correlations between the frequency of marijuana use and knowledge about the applications of medicinal cannabinoids

Knowledge about the applications of medicinal cannabinoids		
Frequency of marijuana use	Spearman's *rho*	0.01
	Significance	0.879

Discussion

The issue of legalization and the use of cannabis is controversial in Poland. What is certain is that cannabinoids show therapeutic potential in many diseases. Although drugs from this group are not recommended as first-line therapy, current recommendations allow for consideration of their use in the treatment of neuropathic pain, some symptoms of multiple sclerosis, and seizures associated with Lennox-Gastaut and Dravet syndromes [7,8,9].

The issues of legalizing marijuana and its use are controversial in Poland. It's certain cannabinoids have therapeutic potential in a number of disorders. The research in this area is scarce in Poland, this is a recent and developing subject matter with huge research potential. Reliable and credit-worthy data should undoubtedly be part of the curriculum for medical students. Current students and soon-to-be healthcare professionals should have some knowledge about the applications of cannabinoids in the treatment of certain diseases. Information about the possible health effects of abuse or problematic use should not be forgotten in the process.

This study implies 81.7% of those surveyed believe the subject of medicinal marijuana should be a fixed part of teaching. Similar findings (86%) were reported by Wolan, Dziadosz, and Jacek, who performed a study with medical students as well [10]. This is also corroborated by a 2020 survey of nursing students in Spain. As many as 87.6% of the respondents see the need for expanding their knowledge of medicinal marijuana as part of their academic program [11]. A 2018 US study of pharmacy students showed 84% are of the opinion the subject of medicinal marijuana should be touched upon in optional courses [12].

The author's research implies 57.1% of medical students do not know what type of prescription to issue for medicinal marijuana. Merely 12.9% selected the right answer. In a 2020 study by Bielski, Hus, Sadowska, and Kosson, 26.9% of medical students were aware an Rpw prescription needs to be issued. The students in the same survey declared they do not have sufficient knowledge to provide reliable information to patients that could take advantage of the potential of medicinal marijuana [13]. Another study in Poland found it necessary for education on both the legal and medical aspects of marijuana treatment [10]. Gazdowicz, Susłowska, Piątkowska, and Zimmermann concluded that students' knowledge is scarce and more education is required [14], which is upheld by the author. This study consists of 21 closed-ended questions, including more than 50% responses to 18 and more than 70% with more than 70% incorrect responses. These figures are deeply worrying. The question is, do those surveyed have sufficient knowledge, and are they prepared to inform their patients about the therapeutic possibilities of cannabinoids?

Limitations

Limitations associated with our study relate to the lack of inclusion of all years of the faculties included in the analysis (in the case of the medical faculty, this was due to the absence of the last two years of students - the fifth and sixth years). The results do not show the knowledge of students by year of study. The data would indicate whether the length of education influences a higher level of knowledge within a given subject. For this reason, this article can be seen as a pilot study. To improve the quality of this study and to draw broader conclusions, it would be necessary to carry out a study with a breakdown by faculty and year of student.

Conclusion

Medical students do not have sufficient knowledge about the application of medicinal cannabinoids. The introduction of this subject matter to undergraduate programs seems reasonable.

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EXAMINATION OF THE SCALP AND HAIR AND EVALUATION OF HOME CARE IN CASES OF TRICHOLOGICAL PROBLEMS

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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: Diseases of the scalp and hair adversely affect the quality of life of those affected. Proper diagnosis and therapy require a holistic assessment and the cooperation of several specialists.

Aim of the study: The purpose of this study was to evaluate the effectiveness of home scalp care treatments to determine the prevalent diseases among subjects, and to find out the opinions of the study participants on the diagnostic methods mentioned.

Material and methods: The survey consisted of four stages. In Stage I, a diagnostic survey was conducted, and respondents were asked to complete a proprietary questionnaire. In Stage II, a routine diagnostic exam nation was performed using the Courage+Khazaka MPA® device. Stage III included an examination with a trichologist using a HD Connected ® Micro Camera. Stage IV included a routine mycological examination of the scalp. After 14 weeks of using the recommended care, the examination was performed again using the Courage+Khazaka MPA® camera.

Results: Respondents participating in Phase I of this study, for the most part, have never used a trichologist, most often washed their scalp and hair daily or every other day, and mostly did not use scrubs. The problems indicated by respondents were hair loss and greasy hair. Test results using the Courage+Khazaka® device indicated deviations in skin moisture, seborrhea, redness, and pH. Mycological diagnosis of scrapings confirmed the presence of fungal cells in two cases. Among the subjects, one case of telogen effluvium was found.

Conclusions: Most of those surveyed have never been to a trichologist and have no knowledge of how to properly care for the scalp or what care to use. Home care has little effect on the condition of the scalp. The micro camera examination and the results of the scrapings indicate the presence of telogen effluvium, fungal scalp inflammation, and scalp seborrhea among the respondents.

KEYWORDS: trichology, scalp care, mycology

Background

Trichology is a rapidly developing field that deals with the diagnosis and/or treatment of diseases of the scalp and hair. An important stage of care is the proper diagnosis, which in a trichology office is an interdisciplinary process. Diagnosis should include a subject examination, physical examination, and

trichoscopy or other imaging study of the scalp condition. A holistic assessment of the condition of the scalp and hair allows cosmetology and trichology specialists to select appropriate home care, as well as select appropriate skin care and treatment procedures [1]. The condition of the hair is affected by many factors, both endogenous and exogenous. Today, an important factor affecting the condition of the scalp and hair appears to be the COVID-19 pandemic. In addition to fever, dry cough, and chronic fatigue, an increasingly common symptom is excessive hair loss of a telogenic nature [2]. Telogenic effluvium involves the premature arrival of the involution period of the hair follicle, and, thus, its accelerated transition to the resting phase. The hair falls out after a latent period - usually 2–4 months after the exposure to the cause [3]. A diagnostic test often used in dermatology and trichology is the mycological examination of scrapings of the skin and its appendages. Mycology is the branch of microbiology that deals with the study of fungi that are pathogenic to humans [4]. In the case of fungal infections, patients present with nonspecific signs and symptoms. Therefore, an effective diagnosis is made possible by laboratory diagnosis of the fungal infection [5]. The scalp is colonized under physiological conditions by a variety of microorganisms, including *Malassezia spp.,* which can cause hair infections in moist and oily areas [6]. The material collected from a patient undergoes an initial microscopic evaluation and is transferred to fungal culture media. In a further step, the identification of the cultured microorganisms is made based on their morphological and biochemical characteristics [4].

Aim of the study

The purpose of this study was to evaluate the effectiveness of home scalp care treatments selected based on trichological and mycological examination, to determine the prevalent diseases among the subjects using diagnostic methods, and to find out the opinions of the study participants regarding the mentioned diagnostic methods and the daily care preparations they use.

Material and methods

Study design and setting

The study was conducted between January 2022 and May 2022. Diagnosis of the scalp, using the Courage + Khazaka MPA ® apparatus, was carried out at the Cosmetology Laboratory at the Podhale State University of Applied Sciences in New Market. The trichological diagnosis was performed at the American Dreams Health & Beauty trichology office. A routine mycological examination of the scalp was performed at the Microbiology Laboratory of the Laboratory Diagnostics Department of the L. Rydygier Specialized Hospital in Krakow.

Participants

The first stage of the study involved 111 people - 95 women (85.6%) and 16 men (14.4%), aged 15 to 54. Seven people qualified for the second stage of the study - they were all women between the ages of 21 and 25.

Ethical approval and consent to participate in the study

The seven people that qualified for the 2nd stage of the study were volunteers - women aged 21 to 25. Five of the subjects were cosmetology students and two students were from the architecture department of Podhale State Vocational University in New Targ. The subjects, prior to participation, were informed about the study procedures and provided written informed consent to participate in the study.

Organization and course of the study

In the first stage of the study, a questionnaire was conducted. It asked whether the person had used the help of a trichologist, as well as the frequency of washing and using scrubs. The survey was also used to determine the scalp and hair problems experienced. The questionnaire included questions about products used for care and styling and the features of the cosmetic that are paid attention to during purchase. Out of the respondents, 7 people were selected to participate in the second stage of the study. These individuals declared various types of scalp disorders. The second stage of the study involved skin evaluation using the Courage + Khazaka MPA ® instrument [7]. In the third stage, the same subjects were consulted by a trichologist and underwent a routine trichological diagnosis using a micro camera. Patients signed a consent form prior to visiting the trichologist to use the results of this study for publication. The examinations were performed free of charge by a trichology specialist, courtesy of American Dreams health & beauty. In the fourth stage of the study, a routine mycological diagnostic was performed to test for the presence of microorganisms - the fungi *Malassezia furfur* and the human nematode *Demodex folliculorum*. For this purpose, scalp scrapings were

taken. The collected material was subjected to microscopic evaluation in a direct lightened preparation (DMSO/KOH) and transferred to a suitable culture medium for microbial growth. The examination was carried out by a laboratory diagnostician, in a laboratory performing routine microbiological diagnostics. Based on the results of these tests, a customized scalp and hair care product was applied to each person. This included: washing with a shampoo adapted to skin type, use of a scrub - once a week (fine or enzymatic), conditioner or mask applied below the level of the ear adapted to the degree of porosity of the hair, application of a poultice adapted to the type of scalp, and oiling of the scalp and hair - in the present study cold-pressed black cumin oil was used. Thymoquinone is a component of nigella oil, which has antimicrobial properties, including antibacterial and antiviral properties. In addition, preparations based on black cumin show anti-inflammatory effects [8]. After 14 weeks of home care, the study was conducted again using Courage + Khazaka MPA ®, and the results were compiled, and conclusions were drawn.

Tools used in the study

Evaluation of the scalp was carried out using the Courage+Khazaka® instrument [7]. This device contains different types of probes to measure skin properties, such as: hydration level (using a probe called a Corneometer), skin pH (Skin-pH-Meter probe), redness level (Mexameter probe), and the amount of transepidermal water loss (Tewameter probe).

The trichological examination was performed using the HD Connected® MicroCamera [9], which contains different types of lenses that allow for viewing the scalp at high magnification and diagnosing conditions. The lenses that were used in the study were: Macro, with Wood's light, fluorescent light, and a 400x magnification.

Results

Phase 1

Most of the respondents did not use a trichologist. Respondents mostly washed their scalps and hair daily or every 2 days, and most of them did not use scalp scrubs. The most common problems were hair loss and hair that gets greasy quickly. Respondents also marked dry and brittle hair. Of those surveyed, 31.5% reported having fine and thin hair. The most common products used for hair care were shampoo and leave-in conditioner. Most people did not use hairstyling products, and if they decided to, they most often reached for hairspray or mousse. When buying cosmetics, respondents most often paid attention to effectiveness and price.

Table 1. Results of the survey

Variable	Answers
Using the help of a trichologist	Yes: 89.2% No: 10.8%
Frequency of washing	Once every 2 days: 43.2% Every day: 37.8% 2–3 times a week: 20.7% Once a week: 4.5%
Use of scrubs	No use of scalp peeling: 61.3% Once a week: 19.8% Once every 2 weeks: 17.1%
Occurring scalp and hair problems	Hair loss: 46.8% Oily hair: 45.9% Brittle hair with a tendency to split ends: 33.3% Fine, thin hair: 31.5% Damaged, dry hair: 22.5% Dandruff: 20.7% Itching of the scalp: 16.2% Dryness of the scalp: 12.6% Scalp is hypersensitive: 12.6% Thinning hair: 9.9% None of the above: 12.6%
Products used for care	Shampoo: 100% Rinse-off conditioner: 58.6% Hair mask: 40.5% Oils: 36.9% Rubs: 32.4% Peeling: 29.7% Leave-in conditioner: 28.8% Serum: 16.2%
Products used for styling	Hairspray: 35.1% Hair Foam: 15.3% Hair gel: 9% Hair gum: 8.1% Hair powder: 6.3% Hair wax: 1.8% None of the above: 49.5%
Features of the cosmetic you pay attention to when shopping	Price: 49.5% Brand: 26.1% Effectiveness: 55.9% Safety: 17.1% Purpose: 36.9% Packaging: 9.9% Fragrance: 30.6% Composition: 41.4% Consistency: 5.4% Reviews: 45.9% Popularity: 15.3%

Phase 2

After a period of 14 weeks, the study was repeated using the Courage Khazaka apparatus.

Table 2 shows the results of this study. Analysis of the results showed that in some subjects, the parameters improved or were unchanged. In contrast, individual parameters worsened despite the introduction of care, which may indicate that extrinsic or intrinsic factors may have a more important influence than proper home care. The table shows detailed measure-

ment results. The scalp was divided into four parts and labeled as follows: UL – upper left scalp, UR – upper right scalp, LL – left lower scalp, and RL – right lower scalp.

Table 2. Examination of the scalp with the Courage+Khazaka apparatus

Number of the person tested	Corneometer	pH-meter	Mexameter	Tewameter
1	Before: UL: 4.93 UR: 4.18 LL: 4.58 RL: 4.35 After: UL: 4.63 UR: 4.13 LL: 4.4 RL:4.73	Before: UL: 12.68 UR: 8.43 LL: 4.59 RL: 11.42 After: UL: 6.4 UR: 4.45 LL: 4.63 RL: 4.03	Before: UL: 194.5 UR: 246.25 LL: 263.5 RL: 282.0 After: UL: 190.0 UR: 202.33 LL: 188.33 RL: 277.33	Before: UL: 12.0 UR: 13.8 LL: 7.2 RL: 10.8 After: UL: 10.7 UR: 8.5 LL: 7.0 RL: 13.1
2	Before: UL: 2.97 UR: 3.2 LL: 3.73 RL: 6.13 After: UL: 3.7 UR: 4.87 LL:2.36 RL: 5.53	Before: UL: 4.62 UR: 4.57 LL: 4.7 RL: 4.59 After: UL: 4.57 UR: 4.68 LL: 4.8 RL: 4.5	Before: UL: 176.5 UR: 216.0 LL:254.25 RL: 274.5 After: UL: 176.5 UR: 216.0 LL: 254.25 RL: 274.5	Before: UL: 10.7 UR: 10.9 LL: 11.3 RL: 9.6 After: UL: 16.0 UR: 16.1 LL: 12.9 RL: 13.0
3	Before: UL: 4.35 UR: 4.2 LL: 6.03 RL: 6.95 After: UL: 3.43 UR: 5.8 LL: 4.8 RL: 4.8	Before: UL: 4.52 UR: 4.81 LL: 4.68 RL: 4.4 After: UL: 7.94 UR: 6.58 LL: 4.52 RL: 4.05	Before: UL: 211.0 UR: 185.0 LL: 201.75 RL: 220 After: UL: 200.0 UR: 207.67 LL: 208.67 RL: 246.0	Before: UL: 18.0 UR: 6.9 LL: 16.4 RL: 6.1 After: UL: 7.8 UR: 8.7 LL: 6.9 RL: 7.2
4	Before: UL: 3.7 UR: 3.4 LL: 6.0 RL: 4.95 After: UL: 3.2 UR: 4.63 LL: 7.0 RL: 3.63	Before: UL: 4.84 UR: 4.77 LL: 4.71 RL: 4.78 After: UL: 3.95 UR: 3.56 LL: 4.31 RL: 4.44	Before: UL: 243.0 UR: 259.25 LL: 335.7 RL: 299.5 After: UL: 247.33 UR: 228.33 LL: 277.33 RL: 307.67	Before: UL: 16.9 UR: 5.7 LL: 8.7 RL: 11.4 After: UL: 12.5 UR: 7.7 LL: 11.5 RL: 9.9
5	Before: UL: 5.6 UR: 6.95 LL: 10.85 RL: 5.13 After: UL: 5.23 UR: 4.83 LL: 5.37 RL: 10.07	Before: UL: 4.48 UR: 6.95 LL: 4.61 RL: 4.54 After: UL: 4.76 UR: 4.52 LL: 4.69 RL: 4.73	Before: UL: 166.25 UR: 177.25 LL: 276.0 RL: 219.5 After: UL: 177.67 UR: 199.67 LL: 194.0 RL: 224.0	Before: UL: 23.1 UR: 17.6 LL: 7.9 RL: 12.0 After: UL: 14.1 UR: 13.2 LL: 11.8 RL: 13.0
6	Before: UL: 3.38 UR: 5.08 LL: 3.9 RL: 3.58 After: UL: 3.87 UR: 5.0 LL: 4.8 RL: 6.37	Before: UL: 4.09 UR: 5.05 LL: 4.57 RL: 4.04 After: UL: 5.86 UR: 5.46 LL: 4.36 RL: 3.73	Before: UL: 173.75 UR: 133.75 LL: 200.5 RL: 200.5 After: UL: 156.0 UR: 202.0 LL: 210.33 RL: 190.33	Before: UL: 16.5 UR: 15.8 LL: 14.09 RL: 12.4 After: UL: 9.6 UR: 9.7 LL: 13.9 RL: 16.7

Table 2 contd.

Number of the person tested	Corneometer	pH-meter	Mexameter	Tewameter
7	Before: UL: 3.1 UR: 3.78 LL: 6.23 RL: 7.43 After: UL: 3.03 UR: 4.87 LL: 7.93 RL: 6.63	Before: UL: 4.87 UR: 4.85 LL: 4.96 RL: 4.67 After: UL: 3.85 UR: 3.93 LL: 4.1 RL: 3.75	Before: UL: 178.0 UR: 246.0 LL: 253.0 RL: 286.0 After: UL: 258.67 UR: 259.67 LL: 278.67 RL: 315.33	Before: UL: 11.1 UR: 14.0 LL: 11.4 RL: 18.6 After: UL: 13.6 UR: 18.5 LL: 37.8 RL: 25.9

Phase 3

Table 3 shows the results of tests conducted on three people. In one person, inflammation of the scalp was observed, which indicated a fungal background. The subject was ordered to undergo a mycological examination. The second person was diagnosed with telogen effluvium and hair loss secondary to thyroid dysfunction. The specialist indicated the possible causes of this and recommended further treatment, and referred them to a specialist. The third person examined was found to have plugged sebaceous gland outlets. The specialist recommended cleansing the skin with salicylic acid in a trichology office.

Table 3. HD micro camera results

Case	Results
1 (Figures 1 and 2)	Inflammation of the scalp was observed in a woman aged 23 (Figure 1). This raised suspicion for a fungal substrate. A mycological examination was performed, confirming the presence of Malassezia furfur. Its abundant growth is shown in Figure 2. The subject was ordered to see a dermatologist and work with a trichologist. The specialist also noted the condition of her facial skin and stressed that it was worth consulting a cosmetologist. The treatment of this respondent required a holistic approach and the cooperation of several specialists.
2 (Figures 3 and 4)	During the study, telogen effluvium was found in a woman aged 22 (Figure 3) and so-called "thyroid hair" (Figure 4). The specialist indicates that the cause of the scalp condition and hair may be hormonal disorders, as well as a history of Covid-19. In this case, too, a medical visit to an endocrinologist was ordered, tests were ordered by the doctor, and cooperation with a trichologist was suggested. The trichologist suggested combination therapies to stimulate hair growth, which allows for a faster improvement in the condition of the scalp and hair.
3 (Figures 5 and 6)	This woman, aged 24, showed numerous plugged sebaceous gland outlets and sebum accumulation around the hair follicles (Figure 5). The specialist assessed that the skin required cleansing, for example, with salicylic acid (the skin after applying the cleansing lotion can be seen in Figure 6). The respondent was instructed to work with a trichologist.

Figure 1. Inflammation of the scalp – Wood's light lens, 20x image magnification

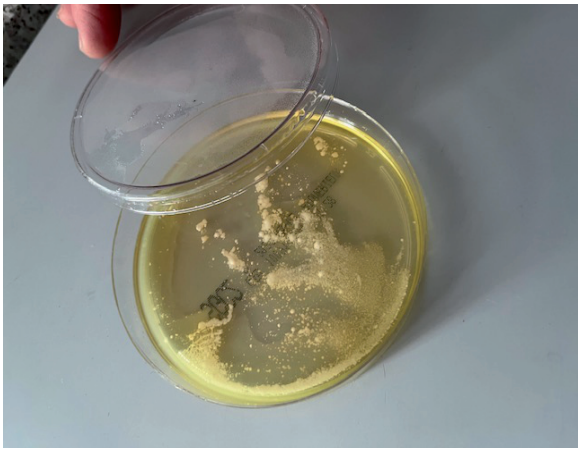

Figure 2. Abundant growth of *Malassezia furfur* on culture medium

Figure 3. Telogen effluvium - Lens. MACRO OT-4000. Panoramic image

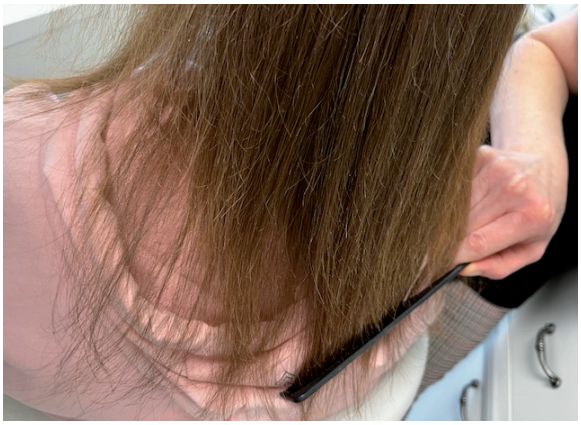

Figure 4. Thyroid hair

Figure 5. Plugged outlets of sebaceous glands - lens with fluorescent light

Figure 6. View of the scalp after using the cleansing lotion

Phase 4

Due to the suspected fungal etiology of the skin inflammation found using the micro camera, a mycological examination was performed for the presence of fungal cells and the human nematode *Demodex folliculorum*.

Table 4. Mycological results

Number of the person tested	Direct preparation lightened (DMSO/KOH)		Breeding *Malassezia furfur*
	Fungal cells	*Demodex folliculorum*	
1	positive	negative	abundant growth
2	positive	negative	growth weak
3	negative	negative	lack of growth
4	negative	negative	lack of growth
5	negative	negative	lack of growth
6	negative	negative	lack of growth
7	negative	negative	lack of growth

In the first case, a positive result was obtained in culture, confirming the intense growth of *Malassezia furfur* fungi. The microorganism was also confirmed in the second case, but the number of colonies cultured indicates that their presence was due to their presence in the natural microbiota of the skin, where there are a large number of sebaceous glands. None of the subjects tested were found to have human nematodes.

Discussion

Hair is one of the few physical features that we can change and manipulate under the influence of culture and fashion [10]. Diseases of the scalp and hair have adverse effects on the quality of life of those affected. Diagnosis of diseases in this area is difficult and requires a holistic approach to the patient to achieve a proper diagnosis [11]. To aid in the diagnosis, there has been a rapid development in examination techniques, which include trichoscopy [12]. First, however, it is important to conduct a physical examination

of the scalp to determine if there is a visible reduction in the amount of hair and any redness or flaking of the skin, which can indicate various diseases [13]. A mycological examination also plays an important role in making the diagnosis. The causes of hair weakness and loss are often complex. Contemporary cases of excessive hair loss and telogen effluvium are observed as a result of a history of SARS-CoV-2 virus infection [2, 14]. Complications after COVID-19 can affect a variety of tissues, and some of them are dermatological problems associated with excessive hair loss. Telogen effluvium is characterized by diffuse hair loss after a triggering event, which can be acute febrile conditions, physiological stress, or medication-related [15]. According to studies, up to 80% of patients have symptoms lasting 4 to 12 weeks or longer after COVID-19 infection [16]. The early onset of telogenic effluvium after COVID-19 can be observed within 2 months of an infection, which may be related to the direct effect of high levels of pro-inflammatory cytokines on hair follicle cells. In addition, pro-inflammatory conditions induced by COVID-19 can cause the formation of microclots in hair follicles, leading to a blockage of their blood supply [17]. In addition, factors that intensify the tendency to telogen hair loss are the use of pharmacotherapy, the presence of hypothyroidism or hyperthyroidism, micronutrient and macronutrient deficiencies, nutrient deficiencies, as well as the physiological state caused by a history of severe disease (including liver and kidney failure, systemic lupus erythematosus, syphilis, and cancer) [14]. Another scalp condition can be seborrheic dermatitis. It is a very common chronic and recurrent inflammatory scalp disorder in which yeast from the genus *Malassezia* is considered the central predisposing factor. However, studies hypothesize that high *Malassezia* counts alone are insufficient to cause the condition, and it is important to investigate other factors present - including genetic predisposition, host interactions with sebaceous gland activity, and nutrition [18]. This study was conducted to evaluate the effectiveness of home scalp care treatments, selected based on trichological and mycological examination, in a group of selected people indicating the presence of various ailments, as well as to find out the opinions of the study participants regarding the diagnostic methods and the skin and hair care preparations used. Respondents participating in the first stage of the study, for the most part, had never used a trichologist, which proves that this field, although known to many, is not yet popular enough for widespread use. Home care consisted of frequent washing of the scalp and hair and the use of conditioners. The problems indicated by the respondents included hair loss and greasy hair. The results of the examinations of the selected group with the Courage Khazaka device indicated slight deviations in skin moisture, seborrhea, redness, and pH, while a mycological diagnosis of scrapings confirmed the presence of fungal cells in 2 cases, including one of the subjects the fungi could have directly affected the inflammation confirmed by the trichological examination with a micro camera. Among the subjects, 1 case of telogen effluvium was found, which, as confirmed by the history, may have been associated with endocrine disorders and a history of SARS-Cov-2 infection. Complex causes require appropriate redirection of the patient to physicians in endocrinology and dermatology. Analysis of the effectiveness of recommended hair and scalp care showed that there is no clearly defined relationship between the condition of the skin and the skin care treatments used. In some of the subjects, the parameters measured by the Courage + Khazaka MPA ® apparatus either improved or were unchanged. In contrast, despite the introduction of care, individual parameters worsened, which may indicate that extrinsic or intrinsic factors may have a more important influence than proper home care. Exogenous factors include physical and chemical damage. Examples include the use of perms, the wearing of unvented headgear, and treatments that use high temperatures [19]. Oxidative stress can be a factor that also affects the condition of the scalp, weakening the hair follicles and causing hair loss. Oxidative stress occurs when there are too many reactive oxygen compounds (ROS) in the body. ROS are formed in the body as a result of external factors such as ultraviolet and ionizing radiation, chemotherapy, smoking, and drinking alcohol [20]. On the other hand, endogenous factors affecting the condition of the scalp include disturbed sebaceous glands, resulting from improper functioning of the nervous system and hormones [19], genetic conditions, lifestyle, and diet. Proper diagnosis and therapy require a holistic assessment and the cooperation of several specialists. Educating people about the impact of lifestyle on skin and hair condition is also important.

Limitations of study

The results obtained in this study need to be confirmed on a larger group of subjects and a control group with a variety of scalp and hair problems. A small number of people were included in this study due to the reluctance of the participants during the period and the limitations of the COVID-19 pandemic.

Conclusions

According to the survey, the majority of respondents have never been to a trichologist and do not know how to properly care for the scalp and what

care to use. Home care has an insignificant impact on conditions of the scalp. The important influences include past chemical treatments, oxidative stress, disorders of various natures, nutritional deficiencies, and past illnesses. The role of trichology is to perform specialized treatments to support the condition and treatment of the skin and hair, as well as provide diagnostics in this area. There are disease entities and symptoms among subjects that require a holistic approach and treatment by specialists, therefore, all subjects were advised to go to appropriate specialists and receive further treatment.

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Candida parapsilosis PERITONITIS IN A PATIENT ON AUTOMATED PERITONEAL DIALYSIS TREATMENT: A CASE REPORT

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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: Fungal peritonitis is a rare complication of peritoneal dialysis treatment. Risk factors for fungal peritonitis include advanced age, diabetes, immunosuppressive treatment, and long-term antibiotic therapy. The occurrence of this complication requires resolute management, including the following: discontinuation of peritoneal dialysis, removal of the peritoneal catheter, initiation of hemodialysis, and antifungal treatment.

Aim of the study: To describe a rare case of *Candida parapsilosis* peritonitis and to assess the problem of fungal peritonitis in our peritoneal dialysis center.

Case report: *Candida parapsilosis* peritonitis was reported in a 66-year-old male on automated peritoneal dialysis. The diagnostics approach, clinical course, management, and epidemiology of fungal peritonitis in our center are presented.

Conclusions: *Candida parapsilosis* and other non-*albicans Candida* peritonitis in peritoneal dialysis patients seem to be an emerging clinical problem.

KEYWORDS: chronic kidney disease, peritoneal dialysis, fungal peritonitis, *Candida parapsilosis*

Background

Peritonitis is the most common infectious complication of peritoneal dialysis (PD) treatment. It is most often caused by Gram-positive bacteria; in approximately 40–75% of cases, these infections are caused by skin bacteria of the species *Staphylococcus epidermidis*. Peritonitis caused by Gram-negative flora or cases of iatrogenic (chemical) peritonitis associated with the use of icodextrin occur much less frequently. Appropriate patient selection for PD treatment, correct patient training processes, mod-

ern connection systems in patients on automated peritoneal dialysis (APD), or the use of incremental PD reduce the incidence of this complication. It is currently estimated that the incidence of peritonitis is approximately one case per 24 patient-months of treatment. Fungal peritonitis is a relatively rare complication of PD treatment. According to the International Society of Peritoneal Dialysis (ISPD), it occurs in approximately 2% of patients. This complication is associated with high mortality rates, from 50 to 91% of cases, according to studies, so it requires decisive management. *Candida albicans* is a common cause of fungal peritonitis. Currently, the share of infections caused by non-*albicans Candida* species is increasing, including *Candida glabrata*, *Candida krusei*, *Candida tropicalis*, and *Candida parapsilosis*. We present a case of a patient with fungal peritonitis caused by a relatively rarely identified pathogen — *Candida parapsilosis* [1,2,3].

Aim of the study

The aim of this study was to analyze a rare case of fungal peritonitis in a PD patient. We focused on clinical presentation, diagnostics, and treatment procedures.

Material and methods

Study design and setting

A case study was conducted in May 2022 during a patient's hospitalization in the Department of Nephrology, Hypertension, and Internal Medicine of University Hospital No. 1 in Bydgoszcz, Poland. All data were obtained by analyzing medical documentation, interviews, physical examinations, and observations of the patient during his stay at the hospital. The patient was informed of the intention of the study and agreed to participate.

Participant

A 66-year-old Caucasian male with stage 5 chronic kidney disease (CKD) of a solitary right kidney (had undergone left nephrectomy because of kidney cirrhosis in 1995) who was on APD using a Fresenius system since October 2017 was admitted to the hospital because of severe diffuse abdominal pain and cloudy dialysate. These symptoms appeared three days before admission. He denied nausea, vomiting, diarrhea, and fever. His medical history included long-standing hypertension, general atherosclerosis, coronary artery disease, myocardial infarction, hyperlipidemia, aneurysm of the thoracoabdominal aorta, branched stent-graft implantation of the thoracoabdominal aorta (2016), benign prostatic hyperplasia, renal anemia, chronic kidney disease, and mineral bone disorder (CKD-MBD). His medications included bisoprolol 5 mg daily, amlodipine 5 mg daily, calcium carbonate 3×1.0 g per day, atorvastatinum 20 mg daily, acetylsalicylic acid 75 mg daily, and folic acid 5 mg daily. He was undergoing home nocturnal automated dialysis (NPD) with 12.0 liters of 1.5% dextrose (Fresenius system). His residual diuresis was approximately 1.0 liters. The dialysis time was 10 hours. Conventional PD was performed each night.

During the past three months, he was hospitalized in our department twice because of relapsing peritonitis caused by *Enterobacter cloacae*. During the second episode of peritonitis, we decided to remove the peritoneal catheter and switch him to temporary hemodialysis. After full recovery, we decided to insert a PD catheter and restart PD treatment. Five weeks after restarting PD, he was admitted again, and fungal peritonitis was diagnosed.

Data sources/measurements

The vital signs on admission were as follows: temperature: 36.6°C, blood pressure: 128/65 mmHg, heart rate: 78 beats per minute, and respiratory rate: 18 breaths per minute. There were no pathological murmurs over the heart or any pathological sounds upon pulmonary examination. His abdomen was tender to palpation in all quadrants, but no rigidity was present. There were no peritoneal signs. Bowel sounds were present. The exit site of the peritoneal catheter was without any pathological discharge. There was no peripheral edema.

An abdominal X-ray showed no signs of ileus or gastrointestinal tract perforation. A chest X-ray revealed an enlarged left ventricle without any evidence of pulmonary congestion. An abdominal ultrasound examination showed a solitary right kidney with a cyst in the upper pole (diameter of 2 cm), but there were no signs of urinary retention in this kidney. The bladder was empty. The peritoneal catheter was on the right site. No fluid was detected in the peritoneal cavity. Ultrasound examination of the PD catheter showed no signs of tunnel abscess or external cuff inflammation. The laboratory tests performed upon hospital admission are presented in Table 1.

Urinalysis showed traces of protein but no blood, bacteria, or leukocytes. An analysis of peritoneal fluid revealed a dialysate leukocyte count of 15,082 cells/μl, with a neutrophil percentage of 82%. A sample of dialysate was taken for microbiological culture.

Table 1. Laboratory tests upon hospital admission

Variable	Results	Reference range
WBC	10.96	4.23–9.07 [×10³/µl]
RBC	3.88	4.63–6.08 [×10⁶/µl]
HGB	11.2	13.7–17.5 [g/dl]
HCT	34.5	40.1–51.0 [%]
MCV	88.9	79.0–92.2 [fl]
MCH	28.9	25.7–32.3 [pg]
MCHC	32.5	32.3–36.5 [g/dl]
PLT	146	132–370 [×10³/µl]
Serum amylase	48	30–118 [U/l]
Total bilirubin	0.32	0.2–1.1 [mg/dl]
AST	22	5–40 [U/l]
ALT	8	5–40 [U/l]
C-reactive protein	78.05	<5.00 [mg/l]
PCT	0.47	0.05–0.1 [ng/ml]
Creatinine	5.55	0.60–1.10 [mg/dl]
eGFR (CKD-EPI equation)	9.83	>60.00 [ml/min]
BUN	64	20.0–40.0 [mg/dl]
Sodium	135.6	135.0–145.0 [mmol/l]
Potassium	4.6	3.5–5.5 [mmol/l]
Chloride	106.1	98.0–107.0 [mmol/l]
Total calcium	2.19	2.25–2.75 [mmol/l]
Phosphorus	0.87	0.90–1.60 [mmol/l]
PTH	122.5	5.0–80.0[pg/ml]
APTT	34.0	24.0–36.0 [sec]
INR	1.14	0.90–1.20

Abbreviations: WBC – white blood count; RBC – red blood count; PLT – platelets; HGB – hemoglobin; Ht – hematocrit; PCT – procalcitonin; AST – serum aspartate aminotransferase; ALT – serum alanine aminotransferase; PTH – parathyroid hormone; BUN – blood urea nitrogen; eGFR – estimated glomerular filtration rate; APTT – activated partial thromboplastin time; INR – international normalized ratio.

Results

Medical procedures performed on the patient

We started the initial treatment with broad-spectrum antibiotics consisting of cefazolin 2.0 g and ceftazidime 2.0 g intraperitoneally. We prescribed antibiotics in 2.0 liters of icodextrin (Extraneal, Baxter) for an 8-hour dwell time. *Candida parapsilosis* was identified in the collected dialysate culture.

The laboratory aspect of the study included testing the obtained peritoneal fluid for routine microbiological diagnostic purposes. The isolates were cultured on Sabouraud agar with gentamicin and chloramphenicol (Becton Dickinson) at 30°C in air atmosphere after two days of incubation.

Strain identification was performed with MALDI Biotyper (Bruker) according to the manufacturer's instructions. Antifungal susceptibility testing was performed using Etest (bioMérieux). Tests were performed according to the manufacturer's instructions, and the obtained results were interpreted according to EUCAST (breakpoint tables for interpretation of minimum inhibitory concentration [MIC] for antifungal agents, version 10.0, valid from 2020-02-04. [www.eucast.org/astoffungi/clinicalbreakpointsforantifungals]). Application of the MALDI Biotyper identified the isolates as *Candida parapsilosis*, with an identification score of 2.000 and category A — a reliable identification at the species level. The isolates were susceptible to fluconazole (MIC = 0.75 µg/ml). *Candida parapsilosis* under microscopic examination is shown in Figure 1, and a 48-hour culture is shown in Figure 2.

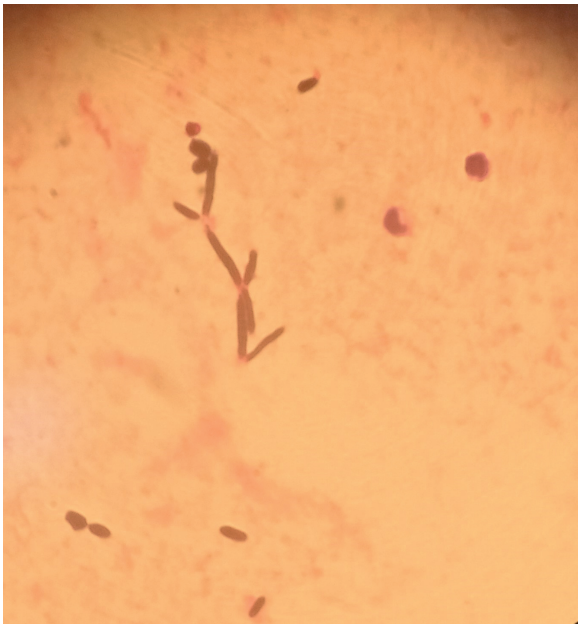

Figure 1. *Candida parapsilosis* under microscopic examination

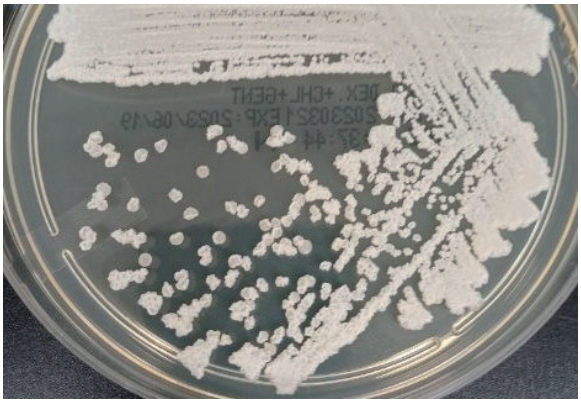

Figure 2. *Candida parapsilosis* in 48-hour culture

We decided to remove the peritoneal catheter, as in his previous episodes of peritonitis. The previous antibiotic therapy was discontinued, and fluconazole was used in accordance with drug sensitivity. Flucona-

zole was administered intravenously at a dose of 200 mg per day and then orally at a dose of 100 mg daily beginning at the time of hospital discharge. Hemodialysis sessions were started on a permanent catheter inserted into the right jugular vein. According to the prescribed treatment, the patient's clinical condition gradually improved. There was no longer any abdominal pain. A decrease in inflammatory markers was observed. Because this was another incidence of peritonitis (this time fungal peritonitis), and he had been on long-term PD treatment (more than five years), we decided to finish PD treatment and transfer the patient for chronic in-center hemodialysis. After two weeks of hospitalization, he was discharged in good clinical condition. He was prescribed fluconazole orally for the next two weeks.

Discussion

Key results

Fungal peritonitis caused by *Candida parapsilosis* is a rare complication of PD. It should be considered in patients who have been on long-term antibiotic treatment.

Interpretation

Infectious peritonitis is one of the main disadvantages of PD treatment. The most common pathogens are coagulase-negative staphylococcal species (i.e., *Staphylococcus epidermidis* and *Staphylococcus aureus*, which together are responsible for more than 50% of infections). Less commonly, an intra-abdominal source with Gram-negative enteric bacteria, streptococci, or anaerobic bacteria may cause peritonitis. Thanks to the application of novel microbiological techniques, it is possible to promptly identify pathogenic microorganisms causing peritonitis [4].

Peritonitis with negative dialysis fluid cultures, chemical peritonitis, tuberculous peritonitis, and fungal peritonitis are rare. In bacterial peritonitis, after the initiation of the recommended antibiotic therapy, clinical improvement should occur within 72 hours. Lack of improvement after five days of therapy (resistant peritonitis) is a strong indication for peritoneal catheter removal. According to current ISPD 2022 peritonitis guidelines, the decision to remove a peritoneal catheter should not exceed five days. The incidence of fungal peritonitis varies from center to center, ranging from <5 to 15% of cases. [5]. There are no specific symptoms of fungal peritonitis. The most common clinical symptoms include cloudy dialysate, abdominal pain, and fever. The clinical course of fungal peritonitis resembles bacterial peritonitis.

Candida species are responsible for 90% or more of episodes of fungal peritonitis. In previous studies, most cases of *Candida* peritonitis were caused by *Candida albicans*. Today, *Candida albicans* is not the most common *Candida* species identified. Recent studies indicate that *Candida albicans* is responsible for less than half of all fungal peritonitis cases. Non-*albicans Candida*, such as *Candida parapsilosis*, *Candida tropicalis*, and *Candida krusei*, are more commonly isolated [6]. *Candida* species are part of the natural flora of the skin and gastrointestinal tract of most people, and the use of antibiotic therapy increases the density of colonization. *Candida* species are responsible for most systemic fungal infections, especially in intensive care unit patients [7,8,9]. According to epidemiological studies, *Candida parapsilosis* is the second most isolated species in southern Europe, in some regions of Asia, and in Latin American countries. *Candida parapsilosis* is considered to cause a much higher rate of peritoneal complications (fungal abscesses, adhesions, sclerosing peritonitis, and bowel perforations have been observed) and therefore requires decisive and more aggressive treatment [10,11]. Removal of the peritoneal catheter and transfer to hemodialysis is mandatory, and fluconazole administration, especially oral administration, is recommended due to its high bioavailability compared to the intravenous route. The echinocandins (caspofungin, micafungin, and anidulafungin) or voriconazole are also recommended for the treatment of *Candida parapsilosis* [12,13].

The main risk factor for fungal peritonitis in our patient was long-term antibiotic therapy due to relapsing bacterial peritonitis (*Enterobacter cloacae* was isolated). Other risk factors include diabetes, immunosuppressive treatment, malnutrition, hypoalbuminemia, and long-term PD. The clinical course of fungal peritonitis in our patient was rather mild, without any local or general complications. This was related to immediate peritoneal catheter removal. It is worth mentioning that some studies recommend antifungal prophylaxis with nystatin or fluconazole during bacterial peritonitis. Amphotericin B and ketoconazole have also been recommended [1]. The most important factor for successful treatment of fungal peritonitis is PD catheter removal. This should be performed as soon as possible because of rapid biofilm formation in fungal peritonitis. Previous studies have reported high mortality rates (between 50% and 91%) in cases of patients without catheter removal [1]. Therefore, this procedure is important for successful treatment. Resumption of PD after catheter reinsertion has been reported in approximately 30% of patients after a median period of 15 weeks [1].

It should be emphasized that, until now, in our PD center, we have reported several cases of fungal

peritonitis caused by *Candida albicans*; this is the first time we have recorded peritonitis caused by the rare pathogen *Candida parapsilosis*. Between 2007 and 2022, in our PD center, we reported three cases of *Candida* peritonitis, one each involving *Candida albicans*, *Candida dubliniensis*, and *Candida parapsilosis*. In the same timeframe, between 2007 and 2022, we performed peritoneal fluid cultures in 128 patients, of which 85 (66.4%) revealed positive results. A total of 685 peritoneal fluid samples were collected, of which 150 (21.9%) were positive. Gram-positive bacteria were isolated from 86 (57.3%) samples, Gram-negative bacteria from 42 (28.0%) samples, and mixed cultures of Gram-positive and Gram-negative bacteria from 17 (11.3%) samples. *Candida* spp. were derived from five (3.3%) samples — twice in monocultures and three times in mixed cultures with bacteria.

Generalizability

An appropriate diagnostics approach (quick microbiological tests) and management (antifungal treatment and peritoneal catheter removal) are mandatory in fungal peritonitis.

Study limitations

The limitation of the study is that there was only one participant.

Recommendations

Nephrologists should keep fungal peritonitis in mind, especially after an episode of relapsing/recurrent bacterial peritonitis.

Conclusions

Fungal peritonitis is a rare complication of PD. Infections caused by non-*albicans Candida* species, such as *Candida parapsilosis*, are an emerging clinical problem. *Candida parapsilosis* infection may result in life-threatening complications. Immediate PD catheter removal and antifungal treatment for at least two weeks after removal of the catheter are mandatory. The main risk factor accounting for the increasing number of cases of *Candida parapsilosis* infections is long-term antibiotic usage for recurrent/relapsing bacterial peritonitis.

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ASSESSMENT OF THE STATE OF KNOWLEDGE ABOUT OSTEOPOROSIS AND ITS NUTRITIONAL RISK FACTORS AMONG ADULTS AGED 18–65

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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: Osteoporosis is a disease of modern civilization. It represents an ever-growing medical problem, with a steadily increasing number of cases and complications. The disease is becoming more common every year as people lead unhealthy lifestyles and, above all, people are getting older. Over the past twenty years, an increase in the incidence of osteoporosis has been observed in European Union countries, including Poland. This phenomenon causes many significant consequences, both from a health and economic perspective. The World Health Organization has classified osteoporosis as a disease of civilization and called it "the epidemic of the 21st century" and "the silent thief of bones."

Aim of the study: This study aimed to assess the knowledge of adults aged 18–65 about osteoporosis and its nutritional risk factors.

Material and methods: The study included 150 participants. The study group was characterized by gender, age, education, and declared body weight and height. The survey included questions about one's knowledge of the disease and about osteoporosis risk factors and those which protect against it.

Results: The level of knowledge about osteoporosis among female and male respondents was rated as good. The level of knowledge about nutritional risk factors for the development of osteoporosis among men and women was also classified as good.

Conclusions: The deficient areas in terms of osteoporosis knowledge are a lack of knowledge about the effects of mineral deficiencies and the estimated incidence of osteoporosis in Poland. Additionally, a lack of knowledge about the role of calcium and vitamin D in the etiology of the disease was observed.

KEYWORDS: osteoporosis, nutritional factors, prevention, risk factors

Background

The National Institutes of Health Consensus Development Panel on Osteoporosis defined osteoporosis as a disease of the skeleton characterized by reduced bone strength that significantly increases the risk of fracture [1]. Osteoporotic fractures contribute to a reduced quality of life and increased mortality rate. They occur at varying rates around the world, regardless of the geographic location and socioeconomic status of patients [2]. An estimated 200 million people suffer from osteoporosis and osteopenia worldwide, and the

disease causes about 9 million fractures a year. A low-energy fracture occurs every 3 seconds and the highest number is recorded in Europe [3]. The number of new fractures in 2010 in the EU was estimated at 3.5 million, comprising approximately 610,000 hip fractures, 520,000 vertebral fractures, 560,000 forearm fractures, and 1,800,000 other fractures (i.e., pelvis, rib, humerus, tibia, fibula, clavicle, scapula, sternum, and other femoral fractures). Due to changes in population demographics, the annual number of fragility fractures will rise from 3.5 million in 2010 to 4.5 million in 2025, corresponding to an increase of 28% [4]. On the Old Continent, osteoporosis and its complications are ranked as the fourth most common chronic disease, contributing to more than 2.6 million years lived with disability (DALY's) annually. A higher percentage of people suffer from osteoporosis than from high blood pressure or rheumatoid arthritis [5]. The estimated number of people with osteoporosis in Poland in 2018, based on epidemiological indicators, was 2.1 million, of which 1.7 million were women. According to numerous studies on predisposing factors for osteoporosis, the following are mentioned: advanced age, female gender, family predisposition, Caucasian race, history of fractures in adulthood, dementia, poor health, and slim body build.

Potentially modifiable risk factors for the development of osteoporosis include vitamin D deficiency, smoking, drinking alcohol, inadequate calcium intake, low or excessive phosphorus intake, protein deficiency or protein-rich diet, excessive coffee drinking, sedentary lifestyle, and prolonged immobilization. The nutritional factors favoring the development of osteoporosis also include excessive consumption of vitamin A, low vitamin K2 and isoflavones, and the use of unbalanced acidifying diets. [6,7].

Aim of the study

The purpose of this study was to determine the level of knowledge about osteoporosis among adults. In addition, the hypothesis was verified whether gender affects osteoporosis knowledge and what factors determine it.

Material and methods

Study design and settings

The research was conducted using a diagnostic survey method with the help of the author's survey questionnaire during February and March 2020 in a group of 150 people aged 18 to 65 living in the Opolskie and Dolnośląskie Voivodeships (Table 1). Participation in the study was voluntary and anonymous, and the sample selection was intentional. The indirect *Computer-Assisted Web Interview* (CAVI) was used and the questionnaire was validated [8]. There was no missing data.

The survey questionnaire consisted of two parts. The first part included questions about socio-demographic (gender, age, education) and anthropometric data (body weight, height). The data on body weight and body height were declared by the respondents and this data was obtained within the last 3 months. The data was used to calculate BMI, the respondent's weight was divided by the square of height, and determine the nutritional status of the subjects (Table 2). The current WHO criteria for adults were adopted for the analysis [9]. In addition, questions were asked about the sources used for obtaining knowledge about osteoporosis.

The second part of the questionnaire contained 12 questions related to the knowledge of the disease itself and 12 questions about osteoporosis risk factors, which could be answered correctly (1 point scored) or incorrectly (0 points scored). The percentage of correct answers given by the respondents was calculated for each question separately. The achieved percentages of the maximum available score were presented in Table 3 and Table 4.

The level of knowledge about osteoporosis and nutritional risk factors for osteoporosis was assessed using the following scale [10]:

– 75% and above of correct answers indicated a rating of very good (vg),

– 74.9–50% of correct answers indicated a grade of good (g),

– 49.9–25% of correct answers indicated a grade of sufficient (s),

– 24.9% and below of correct answers indicated a grade of inadequate (i).

Participants

The survey included 150 participants, including 87 women and 63 men. Responders were characterized in terms of gender, age, education, and declared nutritional status (Table 1 and Table 2).

Statistical analysis

Pearson's Chi^2 test of independence was performed to determine the relationship between the gender of the subjects and knowledge of osteoporosis and knowledge of nutritional risk factors for the development of osteoporosis. The level of significance was set at a p-value of <0.05. All analyses were performed with the use of the Statistica program, version 13.

Table 1. BMI and sex of the research group

Parameter		Total N=150	Women N=87	Men N=63	Chi^2 Pearsona p
		N (%)			
BMI	underweight	5 (3%)	5 (6%)	0 (0%)	0.000*
	normal body weight	78 (52%)	65 (74%)	13 (21%)	
	overweight	57 (38%)	14 (16%)	43 (68%)	
	obesity	10 (7%)	3 (3%)	7 (11%)	

* Significance at a *p*-value <0.05.

Table 2. Correct answers about osteoporosis relevant to the sex of the research group

Questions (correct answer)	Total		Women		Man		Chi^2 Pearsona p
	%	scale	%	scale	%	scale	
What is osteoporosis? (A systemic disease of the skeleton characterized by low bone mass and a disturbed microarchitecture of bone tissue, leading to an increased susceptibility to fractures)	93	vg	93	vg	94	vg	0.53029
Who is more likely to suffer from osteoporosis? (adult women)	87	vg	92	vg	79	vg	0.06479
Which of the listed minerals play an important role in bone mineralization? (calcium, phosphorus, and magnesium)	79	vg	87	vg	67	g	0.00365*
Deficiency of which of these vitamins can lead to the development of osteoporosis? (vitamin D)	89	vg	89	vg	90	vg	0.91964
Deficiency of which hormone increases the risk of developing osteoporosis in women? (estrogen)	71	g	80	vg	57	g	0.00701*
Deficiency of which of the listed hormones increases the risk of developing osteoporosis in men? (testosterone)	81	vg	89	vg	70	g	0.00422*
Bone atrophy begins (around age 40)	42	s	41	s	43	s	0.88467
The characteristic symptom of osteoporosis is (bone fracture with minor trauma or fall)	82	vg	80	vg	84	vg	0.36369
Which of the following diseases increases the risk of developing osteoporosis? (Type 2 diabetes)	58	g	61	g	54	g	0.53052
Deficiency of which element in the body is the least common? (phosphorus)	24	i	25	s	22	i	0.89809
Treatment of osteoporosis includes (prevention and pharmacotherapy)	83	vg	83	vg	83	vg	0.68964
It is estimated that there are currently (2.1 million) people in Poland suffering from osteoporosis	46	s	49	s	41	s	0.28538
Knowledge assessment (average value)	**70**	**g**	**72**	**g**	**65**	**g**	—

* Significance was set at a p-value <0.05.

Results

Participants

The people surveyed were divided into three age groups: 18–30 year olds (50 people – 33% of the group), 31–50 year olds (60 people – 40% of the group), 51–65 year olds (40 people – 27% of the group). The group of 18–30 year olds consisted of 37 women and 13 men. The group of people aged 31–50 consisted of 30 women and 30 men. The group of people aged 51–65 consisted of 20 women and 20 men.

Statistical analysis showed that women aged 18–30 (43%) more significantly participated in the study than men of the same age (20%). In contrast, men aged over 30 (80%) more significantly participated in the study than women of the same age (57%, Table 1).

The people surveyed were divided into four groups in terms of education: primary (3 people – 2% of the group), vocational (28 people – 18% of the group), secondary (58 people – 39% of the group), and higher (61 people – 41% of the group). In the group of women, primary education was declared by 3 people, vocational education by 10 people, secondary educa-

tion by 39 people, and higher education by 35 people. In the male group, vocational education was declared by 18 people, secondary education by 19 people, and higher education by 26 people.

Statistical analysis showed that more women with secondary education (45%) than men took part in the surveys (30%). On the other hand, men with a vocational education statistically significantly participated more often (29%) in this study than women (12%, Table 1).

The people surveyed were divided into four groups in terms of nutritional status depending on BMI: underweight (5 people – 3% of the group), normal weight (78 people – 52% of the group), overweight (57 people – 38% of the group) and obesity (10 people – 7% of the group).

Among women, underweight was found in 5 people, normal weight in 65 people, overweight in 14 people, and obesity in 3 people, and among men, normal weight was found in 13 people, overweight in 43 people, and obesity in 7 people. Underweight was not reported in the group of men.

Statistical analysis showed that significantly more women (75%) than men (21%) were of a normal body weight. In contrast, significantly more men (79%) than women (19%) were overweight and obese (Table 2).

Detailed analysis of selected survey questions regarding one's knowledge about osteoporosis depending on the gender of respondents

In general, the knowledge of osteoporosis for women and men was determined to be at a good level (an average value of 70% correct answers). Considering the number of correct answers among women, it was shown that they had a higher percentage of correct answers (72%) than men (65%, Table 3).

Table 3. Correct answers about nutritional risk factors of osteoporosis relevant to the sex of the research group

Questions (correct answer)	Total		Women		Man		Chi^2 Pearsona *p*
	%	scale	%	scale	%	scale	
The group of major dietary risk factors for the development of osteoporosis includes: (low dietary calcium supply)	97	vg	98	vg	95	vg	0.47025
Which nutrient consumed in excess interferes with the absorption of vitamin D: (dietary fiber)	29	s	31	s	25	s	0.02944*
The best sources of easily digestible calcium are: (dairy products).	91	vg	93	vg	89	vg	0.24739
Which nutrient is beneficial for calcium absorption? (lactose)	41	s	40	s	41	s	0.16207
People at risk of developing osteoporosis should limit their intake of (salt)	94	vg	94	vg	94	vg	0.97236
The ratio of calcium intake to phosphorus intake for adults should be (1:1)	33	s	36	s	30	s	0.66464
The ratio of calcium intake to phosphorus intake for children should be (2:1)	30	s	30	s	30	s	0.68384
Beneficial effect on bone mass is (moderate physical activity)	91	vg	92	vg	90	vg	0.89265
The standard for vitamin D for all population groups in Poland is (15 µg/person/day)	31	s	28	s	37	s	0.47395
Which of the following is false? (Adults are not required to consume milk and milk products)	54	g	48	s	62	g	0.19355
The body's demand for calcium doers what with age? (increases)	49	s	47	s	51	g	0.08397
In the prevention and treatment of osteoporosis, a calcium supply of (at least 1200 mg/day) is recommended	44	s	46	s	41	s	0.38816
Knowledge assessment (average value)	**57**	**g**	**57**	**g**	**57**	**g**	—

* Significance was set at a p-value <0.05.

Statistical analysis showed that significantly more women (87%) than men (67%) know that calcium, phosphorus, and magnesium are minerals that play an important role in bone mineralization. Statistically, women were significantly more likely (80%) than men (57%) to correctly answer which hormone increases the risk of developing osteoporosis in women (estrogen). Similarly, in the case of which hormone increases the risk of osteoporosis in men (testosterone), women (89%) answered correctly more often than men (70%).

Most of the respondents gave correct answers indicating the definition of osteoporosis or determining who is more likely to suffer from osteoporosis. General respondents correctly marked the vitamin deficiency that can lead to the development of osteoporosis and indicated the characteristic symptom of the disease. The surveyed group also gave correct answers on determining how osteoporosis is treated.

The question about what age bone atrophy begins was difficult and only 42% of the group answered it correctly. Respondents also found it difficult to estimate the current number of people with osteoporosis in Poland (46% with correct answers, Table 3).

Detailed analysis of selected survey questions regarding nutritional risk factors for osteoporosis depending on the gender of respondents

The analysis of responses showed that one's knowledge of the nutritional risk factors for developing osteoporosis in women and men is at a good level (average value of 57% correct answers, Table 4). It should be noted that the questions on one's knowledge of nutritional risk factors for the development of osteoporosis caused respondents more difficulty than the general questions on osteoporosis.

Table 4. Sources of knowledge on osteoporosis relevant to the sex of the research group

From what sources do you obtain knowledge about osteoporosis?	Total		Women		Man		Chi^2 Pearsona *p*
	N	%	N	%	N	%	
TV	43	29	22	25	21	33	0.3721
Papers	36	24	17	20	19	30	0.1905
Internet	103	69	61	70	42	67	0.7864
Friends, family	41	27	23	26	18	29	0.9172
Family doctor	19	13	11	13	8	13	0.8113
Dietician	7	5	3	3	4	6	0.2309

Respondents participating in the study answered well with questions about the most important nutritional risk factors for the development of osteoporosis. They were able to indicate the best source of easily assimilable calcium and the ingredient whose consumption should be limited by people at risk of developing osteoporosis. Respondents were also able to determine what factors have a beneficial effect on bone mass.

The questions that caused the greatest difficulty concerned the ingredient that interferes with the absorption of vitamin D, the ratio of calcium intake to phosphorus intake in adults and children, and the norms of vitamin D. When asked about a nutrient consumed in excess that interferes with vitamin D absorption, the correct answer was significantly more often given by women (31%) than men (25%, Table 4).

In the surveyed group, the most popular source of obtaining knowledge about osteoporosis was the Internet (69%), followed by television (29%) and information received from friends or family (27%). The lowest percentage of respondents in the survey cited a nutritionist as a source of knowledge about osteoporosis (5%). Among the women surveyed, the most popular sources included the Internet (70%), information received from friends or family (26%), and television (25%). The least common source of knowledge was from a qualified nutritionist (3%). Among the male respondents, the Internet was the most popular source of knowledge (67%), followed by television (33%) and newspapers (30%). As with women, the least common source of knowledge was from a qualified nutritionist (6%, Table 4).

Statistical analysis did not confirm a relationship between gender and the source of acquiring knowledge about osteoporosis.

Discussion

Key results

Prevention is key in the control of osteoporosis and its associated fragility fractures. Successful prevention strategies depend on the patient's knowledge and self-efficacy, which work together to affect healthful behavioral modifications. Numerous individual studies have reported good knowledge and attitudes about osteoporosis [11]. Similarly, our study showed a generally good level of knowledge about osteoporosis and risk factors in both groups in terms of gender. Knowledge about risk factors for the development of osteoporosis and understanding their impact on the occurrence of the disease are the most important components of public education.

Interpretations

Although osteoporosis is primarily a health disorder diagnosed among postmenopausal women, ag-

ing men should also be familiar with its causes and treatment options as part of prevention. In a study by Janiszewska et al. [12], a group of 205 men from Lublin, aged 20–60, were found to have an average level of knowledge about osteoporosis. Gaines et al. [13] also analyzed the knowledge of 1,535 US men (mean age 79) about osteoporosis. Only 39% of respondents were able to answer questions about osteoporosis correctly.

In our study, men's and women's knowledge of osteoporosis and its nutritional risk factors did not differ between genders and was at an average level. Female gender is an independent risk factor for osteoporosis which is physiologically determined by hormonal balance. Many authors evaluate the knowledge of osteoporosis among women of different ages in the context of developing the most effective prevention programs. A study conducted by Srokowska et al. [14] among 72 patients of a rehabilitation clinic in Sierpc found that the respondents (57 women and 18 men over 30 years old) had a low level of knowledge about osteoporosis. No statistical differences were shown between genders. A study by Paplaczyk et al. [15] conducted in a group of 105 women aged 40–76 from the Silesian province showed that half of the subjects had a very good level of knowledge regarding osteoporosis risk factors. In a group of 100 women surveyed by Podbielska et al. [16] from Grodzisk and Warsaw counties, it was shown that the overall knowledge of the women surveyed regarding osteoporosis symptoms was very good in 13%, good in 19%, sufficient in 37%, and insufficient in 31% of respondents. In contrast, knowledge of the risk factors for the development of the disease was very good in 47%, good in 21%, sufficient in 18%, and insufficient in only 14% of respondents [16]. A study by Pawlikowska-Lagód et al. [17] showed that 137 women (37–91 years old) from the Lublin area had an average level of knowledge about osteoporosis. Women living in the countryside had a poorer knowledge than those living in the city.

The most common risk factors for osteoporosis cited by the respondents were low dietary calcium intake, female gender, and early menopause. Ochota and Mroczek [18], on the other hand, compared the knowledge and health-promoting behaviors of female physiotherapy students and women over 40. They showed that the study group had a high level of knowledge about the factors affecting the development of osteoporosis and its basic symptoms. In a study of women (n = 100) over 50 years of age conducted by Misiak [19], it was found that 87% of them knew and understood the term osteoporosis and 66% knew the causes of the condition. The women surveyed reported that the most common causes of osteoporosis were a lack of calcium (29.49%), improper diet and genetic conditions (14.10% each), as well as a lack of physical activities (11.54%). Much smaller percentages were responses such as bone decalcification (6.41%), bone fragility (5.13%), menopause and immobilization (2.56% each). The smallest percentage of correct answers (1.28%) was poor calcium absorption.

Among all listed sources of knowledge about osteoporosis, respondents most often chose the Internet (Table 4). It should be noted that not all information provided from this source is reliable and true. About 20% of the respondents said that they get their knowledge about osteoporosis and risk factors from medical and dietary advice. These results may be cause for concern. The involvement of primary healthcare utilizers by doctors and health authorities is highly recommended to increase awareness of osteoporosis [20].

Determining the level of knowledge on osteoporosis and its risk factors may be helpful in creating prevention programs aimed at men. The opinion that osteoporosis is mainly a problem of women is prevalent in the male population. Insufficient knowledge about the basic risk factors and health behaviors doubles the mortality rate in men due to osteoporotic complications in comparison to women. In connection with the rapid growth in osteoporosis incidence, it is necessary to start a campaign focused on education, forming the proper health behaviors, prevention, and treatment of osteoporosis [12].

Limitations

Limitations of the research include the small number of respondents. In the next research, it is worth comparing the knowledge of osteoporosis and risk factors among people with osteoporosis and healthy people. This will enable the development of more detailed educational and health programs. As a limitation, it should also be added that the data on body weight and height provided by the respondents was subjective, so the BMI calculated was not objective, so anthropometric tests should be performed.

Conclusions

The respondent's level of knowledge about osteoporosis and its risk factors can be estimated as average. The polled women showed better general osteoporosis knowledge (72%) than men (65%). Knowledge of osteoporosis risk factors was generally on the same level between the genders (average 57%). Significant differences were found between gender and the respondents' knowledge about the lack of minerals, hormones that influence the development of osteoporosis, and ingredients that, when consumed in excess, can interfere with vitamin D absorption. It is advisable to launch prevention programs geared toward all people focusing on this issue.

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THE USE OF THERAPEUTIC MASSAGE IN BENIGN PROSTATIC HYPERPLASIA: A CASE STUDY

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ABSTRACT

Background: Benign prostatic hyperplasia (BPH) is one of the most common urological diseases affecting men of all ages, and the incidence increases with age. Due to the location of the prostate in the lower urinary tract area, changes within it can impair urinary function. Therefore, early intervention, accurate diagnostics, and appropriate treatment are crucial, especially conservative methods in the first stage.

Aim of the study: The study aimed to use and evaluate the effectiveness of therapeutic massage in BPH.

Case report: A 55-year-old patient diagnosed with BPH received a course of therapeutic massage lasting three weeks, with the procedure performed twice a week. Each massage lasted twenty minutes and involved manipulation of the stomach lining. The patient underwent imaging tests before and after the therapy. On the International Prostate Symptom Score scale, the patient scored three points before the therapy and two points after it, which indicates mild symptoms. Prostate-specific antigen level was 1.421 ng/ml, and the patient had normal uroflowmetry results [Q_{max}=19 ml/s and Q_{medium}=12 ml/s] before and after treatment. Urine retention after micturition was 0 ml at both intervals. A transrectal ultrasound examination revealed a reduced prostate volume of around 30% after the therapeutic intervention.

Conclusions: In the current case, the positive effect of reduced prostate volume obtained after therapeutic intervention shows that massage can serve as a complementary method to reduce BPH symptoms. In the future, it is advisable to continue testing on more patients.

KEYWORDS: benign prostatic hyperplasia, massage, diagnostic, and uroflowmetry

Background

Benign prostatic hyperplasia (BPH) is one of the most common urological diseases in men of all ages. It mainly occurs after age 50, and its incidence increases with age [1,2]. World Health Organization (WHO) data show that it affects 50% of the male population in European countries. Estimates n Poland indicate that the disease occurs in 30%, or even 50%, of men aged 50-69 years, 50%-70% of those aged 70-79, and 90% of the male population aged over 90 [1,3]. Furthermore, the incidence of prostate cancer

is constantly increasing and was diagnosed in around 11,000 men in 2012, while nearly 16,000 cases are currently recorded annually. In Poland, forecasts indicate that BPH incidence may increase by almost one-third over the next twelve years [1,3].

Prostate gland functioning is determined by estrogens and testosterone, with aging playing a central role in the pathogenesis of the disease by disrupting the hormonal balance. Moreover, due to the organ's location in the lower urinary tract, changes within it may impair urinary tract function [4].

BPH is associated with specific changes in prostate structure that can manifest as symptoms of varying severity or be completely asymptomatic [3]. In the first phase of the disease, the prostate, glandular tubules, and stroma enlarge [5]. As the disease progresses, prostate volume increases further, impairing adjacent urinary tract component functioning, which manifests as polyuria. The next stage in the development of the disease is increasing the frequency of urination, delayed or prolonged micturition, urinary retention, incontinence, a decrease in urinary pressure, and weakening of contractile function of the detrusor muscle [1,3]. In the next phase of the disease, there is urinary retention in the bladder due to the pressure of the enlarging gland on the urethra [6]. The final period of changes is called decompensation and generally manifests as urine retention after micturition and the development of various complications, such as urinary tract infections, hematuria, urolithiasis, and chronic renal failure [1,3].

In the phase of the disease during which multiple symptoms occur, histopathological and structural changes occur in the form of fibrous muscle tumors in the transitional zone or prostate adenoma [7].

Early diagnosis and appropriate treatment of BPH are thus very important. Taking into account the guidelines of the American Association of Urology (AAU), the European Association of Urology (EAU) has created a standard for dealing with patients diagnosed with the disease.

The EAU set the goals of treatment and indicated treatment options for each stage of the disease [8,9].

Comprehensive treatment of BPH, adapted to disease stage and symptom complexity, involves pharmacotherapy with hormonal and nonhormonal agents, including alpha-adrenergic blockers, 5-alpha reductase inhibitors, cholinergic inhibitors, and phytotherapeutics [10-13]. The most recent 2019-2020 EAU guidelines on the pharmacological treatment of prostate hyperplasia describe the use of new drugs, namely phosphodiesterase-5 inhibitors such as Viagra, vardenafil, mirabegron, and tadalafil) [14,15]. These guidelines result from the fact that an enlarged prostate gland is very often accompanied by erectile dysfunction.

Treatment strategies also include surgical removal of the whole or part of the prostate. Transurethral resection of the prostate (TURP) is currently the gold standard treatment for BPH due to its long-term effectiveness, low cost, and minimal damage [2]. Modern BPH treatment methods can involve medical lasers, which minimize bleeding, reduce hospitalization time, and decrease the likelihood of postoperative complications [16]. Other therapeutic approaches for BPH include radial extracorporeal shock wave therapy (rESWT), magnetic fields, and thermotherapy [17-19].

There is an assumption that massage is an effective complementary therapy that alleviates subjective BPH-related symptoms. Whether or not subjective changes caused by massage are accompanied by objective changes remains unknown. Therefore, this paper presents the case of a patient who received massage therapy, with its impact assessed using subjective and objective methods.

Aim of the study

The study aimed to use and evaluate the effectiveness of therapeutic massage in BPH.

Material and methods

Study design, setting, duration, and participant

The patient, 55 years old and with a BPH diagnosis, was qualified by a primary care physician for examination and referred to a physiotherapist. The visit to the physiotherapist was preceded by urinary system function diagnostic tests performed by a urologist in a clinical hospital in Wrocław. The patient had coexisting nephrolithiasis and urolithiasis. Ultrasound examination (BK Medical 400 ultrasound) of the abdomen showed an unenlarged liver with normal and homogeneous echogenicity, without focal lesions, and a portal vein of regular diameter with normal vessels in its basin. A control ultrasound scan at three months suggested a 10 mm hypoechoic focal lesion visible at the outline of the pancreatic tail, what was most likely a pancreatic cyst at the spleen (to be differentiated from an accessory spleen), a thin-walled gallbladder, no deposits, undilated intrahepatic and extrahepatic bile ducts, and an unenlarged spleen with a normal echostructure. Additional findings included two typically located kidneys of normal size, with preserved parenchymal–sinus differentiation and a 6 mm concrement visible in the middle part of the left kidney. Neither kidney had focal changes or features of stasis. The suprarenal areas had no obvi-

ous pathological changes, the urinary bladder was medium-filled, without internal echoes, and lymph nodes in the periaortic retroperitoneal space were visible during the examination and not enlarged. Meanwhile, the prostate gland had increased to around 43 ml, with heterogeneous echogenicity. The patient was also diagnosed with a degenerative disease of the spine and soft-tissue overload in the cervical spine.

The patient works in a warehouse, lives in a city, and does not undertake regular physical activity. He falls into the underweight body mass index (BMI) category and has not had any previous surgery, physiotherapy, or pharmacological treatment.

Ethical considerations

The University of Physical Education in Wroclaw Ethics Committee approved the research (Number 20/2018). Before participating in the study, the patient signed a form to consent to participate in the project.

Data sources/ measurements

Before and immediately after the massage therapy, the patient was referred to a urologist. As part of the diagnostics, the urologist performed:

– a transrectal ultrasound (TRUS) of the lower urinary tract (bladder, prostate including residual urine volume, and prostate measurement),

– uroflowmetry: a noninvasive examination of urine flow during micturition,

– a blood test to determine prostate-specific antigen (PSA) level.

After the urological diagnosis, the patient received a therapeutic massage of the stomach lining. The massage sessions were scheduled for 20 minutes each, in the afternoon, twice a week, for three weeks [20-21].

Before beginning massage therapy, the patient completed a questionnaire on sociodemographic variables and the International Prostate Symptom Score (IPSS) [22].

During the massage, the patient lay on his back with his head bent forward on the roller to relax the sternocleidomastoid muscles. Wedges were placed under the shoulders to support them and to give a balanced chest muscle tone. The lower limbs were laid on the rollers, bent slightly at the knee and iliac joints to relieve lumbar lordosis, relax the iliolumbar muscles, and normalize the function of the nerves passing through these muscles [21]. Each massage was performed by a male therapist to reduce any feelings of discomfort or embarrassment. Only the stomach lining was exposed for the massage, with the body parts not subjected to treatment covered by a sheet. The massage was performed according to the following methodology:

The initial stage:

– brushing in the direction of hair growth along the innervated skin area of the genitofemoral and lateral femoral cutaneous nerves to normalize the tone of the hair arrector muscles in this area; elastic deformation of the spinatus muscle to relax the cribriform fascia and improve the trophic state in the true pelvic floor;

– superficial and deep stroking towards the hiatus saphenous to improve venous blood and lymphatic fluid outflow from the superficial epigastric vein, superficial circumflex iliac vein, and external vulvar vein.

The main stage involved:

– massage of the bladder and umbilical ligaments in the form of gentle circular movements from the lower part of the white line to the navel to normalize tissue tension within the bladder and urogenital diaphragm;

– indirect elastic deformation of the ligament and muscle system of the prostate to normalize its resting tone, since this affects the flow of venous blood and lymphatic fluid in the prostatic area (superior and inferior pubic symphysis ligaments, bladder and umbilical ligaments, the pubic prostatic ligament, and urogenital diaphragm ligament);

– modulated pressure on the edge of the upper pubic bone towards the navel to encourage the outflow of venous blood from the prostatic plexus through the bladder and internal iliac veins;

– circular movements tightened the skin within the range of its displacement within one-third of the upper medial thigh, towards the gluteus maximus muscle and the piriformis muscle, to exert increased peristaltic movement in the lymph vessels draining lymphatic fluid from the prostate area.

The final stage of the massage involved the patient performing several repetitions of isometric exercises, including stretching and pulling the buttocks to strengthen the levator ani muscle [20-21].

Results

The patient scored three on the IPSS before therapy and two afterward, indicating mild prostatic hyperplasia symptoms based on the guidelines. After urological consultation, the patient was qualified for observational 'watch and wait' treatment, along with supplemental measurement and imaging diagnostics. The PSA level (1.421 ng/ml) was within the normal range for an adult male. An ultrasound examination using convex and transrectal transducers measured the prostate gland in three dimensions:

Table 1. Results of ultrasound examination of the prostate using convex and transrectal transducers before and after therapy

Variable	Before therapy				After therapy			
	volume [cm³]	width	height	length	volume [cm³]	width	height	length
		[cm]				[cm]		
V_c	~38	4.7	3.7	4.1	~22	4.2	3.1	3.4
V_t	~34	4.7	3.2	4.3	~24	4.4	2.7	3.8

V_c – volume measured using a convex transducer; V_t – volume measured using a transrectal transducer.

width, height, and length, and the gland volume was calculated using specialist software. The results are shown in Table 1.

After massage therapy, a reduction in prostate volume of about 30% was observed using the transrectal transducer. An elastic and smooth prostate with a noticeable interlobar furrow was also observed.

Urine retention after voiding was assessed before and after therapy and was ~0 ml in both cases. Uroflowmetry showed normal results before and after therapy [Q_{max}=19 ml/s and Q_{medium}=12 ml/s]. An ultrasound of the retroperitoneal space showed a 6 mm concrement in the middle calyx of the left kidney.

Discussion

Key results

The positive effect of the therapy indicates that massage can be used as an alternative method for reducing BPH symptoms.

Interpretation

Many studies have demonstrated the effectiveness of massage in relieving symptoms and ailments in the lower urinary tract caused by BPH. In one study, 21 patients diagnosed with BPH were divided into two groups. One group was treated pharmacologically and received a massage of the stomach lining, while the other group only received the massage. The massage was provided twice a week for three weeks. Symptoms were reduced by 46% in all participants, based on IPSS, and well-being improved by 39% using the Quality of Life Questionnaire (QoLQ) [22]. Similar results were obtained in another study conducted in 2007 on a larger number of participants. The 43 patients were also divided into two groups: one received combined therapy of massage and drug treatment, and the other received only massage. After treatment, all patients reported symptom relief by an average of 52% in the massage group and 53% in the massage and pharmacotherapy group. Quality of life improved by 34% in the drug group and 43% in the massage-only group [21].

The high incidence of BPH makes it a significant social problem, and the intensifying complaints gradually exert lifestyle changes that significantly reduce the quality of life [3, 22].

Aside from pharmacotherapy and surgical treatment, standard treatment includes physiotherapeutic methods, especially in the initial stages of the disease. A common form of physiotherapy is pelvic floor exercises that aim to strengthen the muscles, improve circulation, and alleviate abdominal pressure to reduce prostate compression [23]. However, there are few reports in the available literature on the physiotherapeutic methods used in BPH. A study by Silva stated that "in the case of lower urinary tract symptoms (LUTS) that accompany benign prostatic obstruction, the use of physical activity is possible and may be the first-line intervention in the treatment of these symptoms" [24]. Nonetheless, we found no conclusive evidence in the literature for a beneficial effect of physical activity reducing symptoms coexisting with prostatic hypertrophy, such as urinary incontinence.

Although physical activity does not prevent BPH, prophylaxis in the form of exercises can reduce the risk of symptoms [25]. Regular physical activity, such as long-distance running, prevents the accumulation of excessive amounts of fat, which ensures the correct spatial system for the prostate and rectal zones, creating optimal conditions for blood flow in this area [25].

A study by Liu et al. confirmed that using exercise in early BPH intervention is advisable and justified. Researchers from China proposed using two popular traditional Chinese exercise systems in therapy: yi jin jing and tai chi. These differ in movements and techniques, but both methods emphasize functional homeostasis regulation and the maintenance of harmony throughout the body. One group performed thirty-minute tai chi exercises five times a week for six months, while another did yi jin jing exercises on the same schedule. The authors showed that it is advisable to perform exercises as part of the benign prostate lesion prevention and strategy treatment strategy [26].

Physiotherapeutic methods include the physical treatments mentioned earlier, using lasers, magnetic fields, or shock waves. In one study of 29 males with lower urinary tract symptoms suggestive of BPH,

shockwave therapy was performed once a week for eight weeks using the following treatment parameters: 2000 impulses at 2.0 bar and 10 hertz. A reduction in clinical symptoms and significant improvements in the patient's quality of life were observed [19].

The work of Elgohara et al. assessed the effects of combining pulsed magnetic field therapy and physical exercises. Participants were divided into three groups. The first group used combination therapy: pulsed magnetic field, pelvic floor exercises (performed daily for 15 minutes while standing, sitting, and lying down), and aerobic exercises (20 to 60 minutes, five times a week). The second group only performed pelvic floor muscle exercises. The third group was a control group that received a placebo. The amount of urine retained and urine flow rate after four weeks of intervention was observed. The greatest changes occurred in the group undergoing the complex therapy, confirming that it is reliable to use selected forms of physiotherapy and that further research should be carried out on a larger number of patients. As the authors emphasized, physiotherapy is, to some extent, an alternative form of therapeutic management because the method is safe and noninvasive [18].

Massage is another form of physiotherapy that can be used in BPH. It is performed on the stomach lining to relax the muscles and ligaments in the prostate and bladder regions to ensure normal trophic status in the true pelvic region. The effectiveness of the method has been confirmed in research that assessed the effects of massage on BPH symptoms [27-28].

The present study used massage, where, in addition to subjective assessment, objective methods were used, including TRUS of the lower urinary tract, uroflowmetry, and blood tests aimed at determining PSA concentration. The results indicate that therapy had a positive effect, with a significant change in the patient's prostate volume observed. The impact was comparable to that found in the case of pharmacological treatment, the aim of which is to reduce prostate gland volume, improve blood supply to the prostate, and increase the contraction of the fibers comprising the gland. A reduction in prostate volume and lack of urine retention were demonstrated after massage therapy. Undoubtedly, the positive outcome was due to the fact that the patient had mild symptoms, based on the IPSS. Nonetheless, the results indicate that massage is an effective therapeutic measure for the symptoms accompanying BPH.

All authors dealing with this topic emphasize that somatic symptoms in BPH patients are associated with a decline in quality of life [22]. Therefore, improving the quality of patients' lives should thus be one of the main goals of therapeutic management. Moreover, education on BPH and initiatives to create preventive programs are extremely important [29].

The results of this research appear to confirm the effectiveness of massage therapy in improving functional parameters and enhancing quality of life.

Generalizability

An appropriate response to complaints reported by patients allows for quick diagnosis and identification of underlying causes, as well as the implementation of treatment. The most important aspect is the cooperation of a physiotherapist with a urology specialist.

Study limitations

The study was limited by having only one patient. This should be expanded in future research to include additional case studies that allow comparison of diagnostic and therapeutic management processes.

Recommendations

Developing a standard diagnosis and treatment protocol is crucial to increasing the level of care provided.

Conclusions

The positive effect of massage therapy in the case described herein, in the form of reduced prostate volume, indicates that massage can be used as an alternative method to reduce BPH symptoms.

In the future, it is advisable to continue research on a larger number of patients with mild and moderate BPH symptoms. It would be worth including multiparametric magnetic resonance imaging (MRI) of the true pelvis, not only to obtain the most accurate assessment of prostate dimensions before and after therapeutic intervention but also to determine its structure.

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DRY NEEDLING ACCORDING TO THE FIVE REGULATORY SYSTEMS CONCEPT PERFORMED ON THE CRUCIATE AND PELVIC LIGAMENTS IN LOWER BACK PAIN: A CASE REPORT

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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: Lower back pain (LBP) is a social problem that affects people all over the world and negatively impacts the quality of life of patients. Its associated symptoms can be effectively reduced using manual therapy, osteopathy, and physiotherapy, among other modalities. One of the methods of therapy being used more and more often by practitioners is dry needling (DN) according to the Five Regulatory Systems concept (FRSc).

Aim of the study: The aim of the study was to assess the effectiveness of the dry needling (DN) method according to the FRSc performed on the cruciate and pelvic ligaments in LBP.

Case report: A 55-year-old man with LBP was examined. The following tests were performed before and after therapy: the Oswestry Disability Index (ODI) was used to assess functional efficiency, the visual analog scale (VAS) was used for subjective pain assessment, and the Schober test was used to measure the range of spinal mobility. During the course of therapy, six DN procedures were performed (twice a week for 3 weeks). The application included the cruciate and pelvic ligaments. After the applied therapy, there was a significant reduction in pain (VAS reduced by 4 points). The patient also experienced an increase in the range of motion of his spine (Schober test increased by 2 cm) and an improvement in the ODI assessment of his degree of disability (by 17 points).

Conclusions: The DN method is presented in this work. The FRSc was shown to be effective in the treatment of LBP in the short term. The completed therapy significantly reduced pain, increased the range of motion of the spine, and improved the patient's functional efficiency.

KEYWORDS: low back pain, dry needling, visual analog scale, Oswestry Disability Index (ODI), Schober test

Background

The problem of lower back pain (LBP) affects 80% of the population worldwide [1]. Chronic pain and reduced range of motion of the spine negatively affect mobility and reduce the quality of life of patients [2]. Many physiotherapeutic treatments effectively reduce the occurrence of symptoms [3]. Among the popular methods are manual therapy [4,5], the McKenzie method [6], and osteopathy [7]. Physical therapy treatments are often successfully used. Rajfur et al. conducted a study using electrotherapy treatments (DD, IFC, TENS, and HVS) on a group of 80 people with LBP. They showed that all treatments

had a positive impact on the reduction of pain and an improvement in the quality of life of patients. Treatments using currents turned out to be the most effective [8]. An effective type of therapy often used in LBP is shockwave therapy. Walewicz et al. studied a group of 20 people with LBP and showed that radial shockwave therapy significantly reduced pain parameters, which had a positive effect on the efficiency of patients compared to the placebo group [9]. In another research project using focused shockwave therapy, the authors also found a positive effect of the treatments applied to the group of patients with LBP compared to the placebo group [10].

An alternative form of therapy for musculoskeletal disorders such as LBP is dry needling (DN), as indicated by clinical trials evaluating the effectiveness of this technique as a type of therapy [1,2].

A literature search revealed that there are different techniques for applying this method [11]. DN involves inserting a thin needle into the subcutaneous tissues and muscles in order to mechanically stimulate the tissue [12].

Superficial and deep needling [13], with or without peppering [14], are frequently used DN techniques in which the type and size of the needles and the depth of their application vary. In superficial DN, the needle is punctured subcutaneously, while in deep DN, the needle penetrates further structures (e.g., trigger points, myogeloses, and ligaments). Researchers from the USA used two deep DN techniques in their project. The first technique used needle manipulation, which consisted of inserting the needle into the tissue and then advancing and withdrawing it for 10 seconds. In the second technique, without manipulation, the needle was placed in the tissue for 10 minutes. Both applied techniques proved to be effective in LBP therapy [15]. A different DN technique used in LBP is the puncture of trigger points by rapid needle entry and exit until the first local twitch response is obtained [16].

Another technique that uses needle therapy is DN according to the Five Regulatory Systems concept (FRSc), which in its assumptions, includes five key mechanisms of behavior in the aspects of the formation of musculoskeletal pathologies [11,17]. This technique is increasingly being used by practitioners in the treatment of LBP, and its clinical effectiveness has been confirmed by Polish researchers in their studies of LBP treatment. The therapy consists of applying the treatment to the L1–L5 segment on both sides of the spine with the technique of rhythmically inserting and pulling back the needle (without removing it) into palpable thickenings in order to induce a reflex contraction reaction. In addition, punctures are made along the intersection of the superior gluteal nerve with the following muscles: gluteus maximus, gluteus medius, and tensor fascia latae; it also aims to alleviate myogelosis of the piriformis muscle. This applied DN technique turned out to be effective therapy [18].

In order to verify the effectiveness of the DN technique according to the Five Regulatory Systems concept (FRSc), we attempted to apply and evaluate its effects in a patient with chronic LBP performed on the sacroiliac ligaments and pelvis, as different structures are needled depending on the reported symptoms in the medical history (in this case, the ligaments).

Aim of the study

The aim of this study was to assess the effectiveness of the dry needling (DN) method according to the FRSc performed on the ligaments of the sacrum and pelvis for pain in the lower spine (LBP).

Material and methods

Study design

The study was conducted in November 2021 at the Functional Research Laboratory of the Institute of Health Sciences at the University of Opole. Prior to the study, the participant was informed about the purpose and principles of the therapy. The benefits and possible side effects were presented. The patient was informed that at any stage of the study, he could resign from further participation. He provided written consent to participate in the study. The study was approved by the Bioethics Committee of the State Medical University of Applied Sciences in Opole (KB/260/FI/2020) and complied with the principles of the Declaration of Helsinki.

Participant

The patient was a 55-year-old man (height 172 cm, weight 85 kg, and BMI 28.7) with chronic LBP. The participant reported experiencing symptoms for several years, and despite undergoing physiotherapy (physical therapy, manual therapy, and exercises) and taking analgesic medications, the pain only temporarily subsided and then returned.

The participant reported complaints in the area of the back when initiating movement after a long period of immobility (e.g., getting up after sitting for a long time or in the morning when getting up). He described a problem with assuming an upright position after prolonged sitting or squatting. Extension was possible gradually and took a long time. In addition, the patient reported having pain symptoms when standing or lying for a long time.

The above medical history suggested considering the presence of a problem at the second regulator according to the FRSc, namely compartmental [17]. In such cases, both the upper gluteal nerve neurocompartment and the ligaments of the pelvis and sacrum are assessed for the presence of tenderness upon palpation. The examination of the patient ruled out any activity in the neurocompartment of the upper gluteal nerve. However, tenderness in the area of the lower spinal ligaments and pelvis was noted on both sides.

Inclusion criteria

Discopathy at the level of L5–S1, chronic pain with radiating features, and persistence for at least 3 months. The patient had current MRI examinations that confirmed the diagnosis of LBP syndrome (lesions at the level of the third degree according to the Modic classification in the L5–S1 segment). He had no previous DN procedures and no surgical interventions in the spine.

Exclusion criteria

Absence of pain and no reduced mobility in the lumbosacral section, other diseases of the spine (spondylolisthesis, fractures, tumors, rheumatic diseases, and cauda equina syndrome), blood clotting disorders, steroid therapy, metal implants within the application site, sensory disturbances, mental illnesses, cancer, skin changes in the area of the treatment site, viral and bacterial infections, fever, taking painkillers and/or anti-inflammatory drugs, fear of needles, and lack of consent for the procedure.

Study scheme

The patient had DN treatments performed twice a week for 3 weeks for a total of six treatments. The treatments were performed using disposable sterile SOMA needles with a needle thickness of 0.3 mm and a needle length of 75 mm (Figure 1).

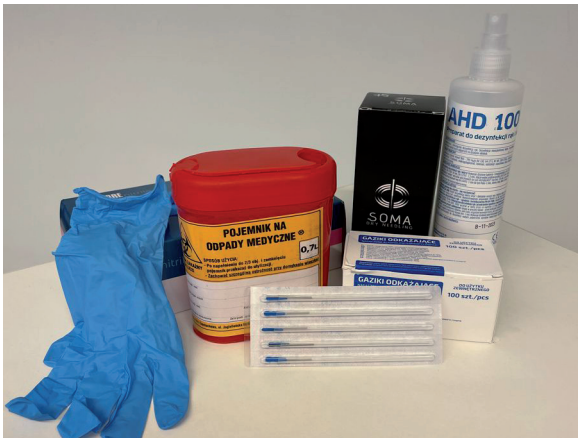

Figure 1. Equipment for the DN procedure

All needles were screwed up to the stop, tightened every 15 minutes, and twisted four times in total. The duration of a single treatment from the moment of needle application was 1 hour. The DN application during each therapy session included the following:

Iliopsoas ligament

Puncture at the level of the L4 vertebra with one needle on the outer edge of the erector spinae and the second needle between the first puncture and the line of the spinous processes with a caudal needle direction.

Sacroiliac ligament

Insert two needles medially from the posterior superior iliac spine with a caudal needle direction until resting against the sacrum.

Sacrotuberous ligament

Insert two needles along the line between the distal end of the outer edge of the sacrum and the ischial tuberosity at the height of the greatest tenderness. The direction of the needles should be perpendicular to the surface, and the depth of insertion should be until resistance is felt in the ligament.

The application procedure is presented in Figures 2 and 3.

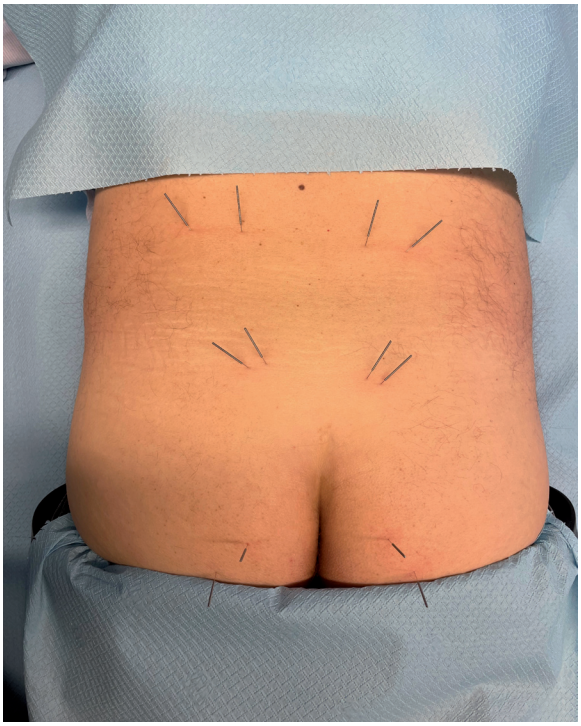

Figure 2. Patient DN application

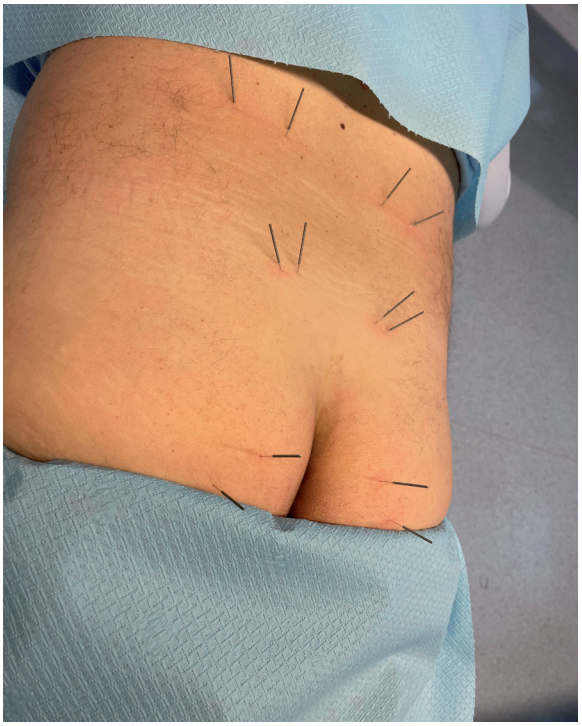

Figure 3. Patient DN application

Due to the possible proximity of, for example, the sciatic nerve in the area of the sacrotuberous ligament, as well as in order to maintain general safety rules during dry needling, the needles were applied according to the 2/1 rule (inserting 2 mm into tissues, then smoothly extending 1 mm up) to allow vessels and nerves to move away from the needle and to give the patient a chance to report a possible pain reaction. During therapy, the health and safety rules for needle work were followed: disinfection of the surface of the examination couch and the patient's body with dedicated preparations and the use of disinfected medical gloves by the therapist.

Data sources/measurements

Research was conducted before the therapeutic intervention, which began with the patient completing the Oswestry Disability Index (ODI) questionnaire, on the basis of which the patient's functional efficiency was assessed [2]. The questionnaire consists of 10 questions regarding symptoms and daily activities. When answering each question, the patient can choose one of six scored responses ranging from 0 to 5. A: 0 points, B: 1 point, C: 2 points, D: 3 points, E: 4 points, and F: 5 points. By summing up the points from each question, the disability assessment according to the Oswestry scale is as follows: 0–4 points indicates no disability, 5–14 points indicates slight disability, 15–24 points indicates moderate disability, 25–34 points indicates severe disability, and 35–50 points indicates total disability [2].

Subjective pain sensations in the LBP area were determined using a visual analog scale (VAS), on which the patient rated the pain intensity from 0 to 10 (0 means "no pain" and 10 means "the strongest pain") [19]. The range of motion of the lower spine was measured with the Schober test [20]. Tests and measurements were made before and immediately after therapy. During the study period, the patient did not use any other forms of therapy.

Results

The primary outcome was the pain score, as measured by the VAS. The secondary outcome was disability, as measured by the Oswestry questionnaire and the Schober test. The patient's results before and after therapy are presented in Tables 1 and 2.

Table 1. Results of the patient's tests before and after therapy

Variables	Before therapy	After therapy
Visual Analogue Scale (VAS)	7	3
Oswestry Disability Index (ODI)	33	16
Schober Test	3	5

Table 2. Detailed results of the patient's ODI before and after therapy

Variables	Before therapy	After therapy
Pain intensity	4	2
Personal care	3	1
Lifting	4	2
Walking	3	1
Sitting	3	2
Standing	4	2
Sleeping	4	2
Sex life	2	1
Social life	3	2
Travelling	3	1
Total points	**33**	**16**

Conducting DN therapy in this patient with LBP turned out to be effective in reducing pain, increasing the range of motion of the lower spine, and improving functional efficiency. In the study, short-term therapy was performed, which included a total of six applications (two times a week for a period of 3 weeks).

The applied therapy resulted in a 4-point reduction in pain, as measured by the VAS. Before therapy, the patient rated the pain at a level of 7 points, which

may indicate severe pain; after the therapy, he rated the pain at 3 points.

In the assessment of the degree of disability using the ODI, an improvement of 17 points was noted. Before the therapy, the total number of points was 33, while after the therapy, the point total was 16. In addition, the range of motion of the lower spine increased by 2 cm, as measured with the Schober test.

Discussion

Key results

DN procedures, according to the FRSc, performed on the cruciate and pelvic ligaments are effective in LBP therapy.

Interpretation

A series of DN treatments, according to the FRSc, contributed to a reduction in pain in the lower spine. In addition, the treatments had a positive effect on improving the functional efficiency and range of motion of the spine.

The efficacy of the DN technique, according to the FRSc, has been confirmed in studies by researchers who have applied this form of therapy to treat LBP. For example, Rajfur et al. conducted studies on patients with LBP and demonstrated that the use of DN therapy contributed to a reduction in LBP symptoms and improvements in the patients' functional status. In these studies, each individual underwent eight sessions of DN treatment (twice a week for 4 weeks), and the results were evaluated immediately after therapy, as well as 1 and 3 months after its completion. The outcome measures used were the VAS, ODI, and Schober test [18]. Similarly, Mahmoudzadeh et al. applied the DN method to treat LBP and showed that the intensity of pain and disability significantly decreased after the completed therapy and at the 2-month follow-up [2]. Deshpande et al. also found an improvement in the perception of pain symptoms in their study in which they treated 40 LBP patients with DN therapy. Each individual received five treatment sessions (every 3 days), and the effects were assessed after 1, 4, and 12 weeks [21]. The effectiveness of DN therapy in LBP patients regarding pain intensity and improvement in functional mobility has also been highlighted by other scientists in their studies [22, 23].

There is a study conducted by Griswold et al. that compared DN with manual therapy techniques in patients with chronic LBP. In both groups, therapy was performed twice a week for a period of 3 weeks (a total of six treatments). The level of pain intensity and ODI were evaluated at the beginning of the study and during the second, fourth, and sixth visits. Improvements in the assessed indicators were observed in patients in both groups at all time points. However, no significant differences were found between the DN and manual therapy techniques groups [1]. Similar conclusions were presented in another study in which no statistically significant difference was found between groups in the assessment of disability. Martín-Corrales et al. examined 36 randomly assigned patients divided into two groups. In the first group, a single DN treatment was performed, while the second group received simulated DN treatment. Additionally, patients from both groups followed a 4-week exercise program. The results showed statistically significant reductions in disability parameters measured by the Roland–Morris Questionnaire immediately after therapy and 3 months after its completion in both groups, but without significant differences between groups [24].

Gattie et al. (2017), in a meta-analysis, showed that there is very low and moderate evidence of a significant impact of DN on functional capacity in the short term. However, in long-term observations, DN did not surpass other treatment methods [12].

Study limitations

The results of our study are limited to only one patient and being focused on the assessment of pain and functional capacity. In the future, it would be worth conducting studies with a larger number of participants and a longer observation period, such as 1 month after the end of treatment, to evaluate distant outcomes and determine the durability of the applied therapy's effects. It would also be important to consider assessing movement-related anxiety (e.g., using the Tampa Scale of Kinesiophobia) and the level of depression (e.g., using the Beck Depression Inventory) in future studies. Subsequent studies plan to incorporate the recommendations of the Polish Chamber of Physiotherapy, including the inclusion of DN as an adjunctive method for LBP therapy [25].

Recommendations

The results of our study confirm the usefulness of DN procedures performed on the cruciate and pelvic ligaments in LBP. It may be reasonable to use this method as a non-pharmacological and increasingly accessible therapy.

Conclusions

The DN method studied in the work (i.e., DN according to the FRSc) performed on the cruciate and

pelvic ligaments was shown to be effective in the treatment of LBP in the short-term observation of our patient. The conducted research shows that the completed therapy significantly reduced pain, increased the range of motion of the spine, and improved functional efficiency in the described case.

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CARDIOVASCULAR DISEASE RISK PREDICTOR ANALYSIS AMONG MEDICAL STUDENTS: A SINGLE CENTER OBSERVATIONAL STUDY

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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: Cardiovascular diseases are a leading cause of death. The growing problem of lipid disorders, hypertension, and overweight among young people may lead to dangerous cardiovascular disease-related consequences.

Aim of the study: Assess the prevalence of selected cardiovascular disease risk factors among medical students.

Material and methods: The study included 201 medical students from the Faculty of Medicine and Health Sciences of the University of Technology and Humanities (UTH) in Radom. A diagnostic proprietary survey method collected heart rate, blood pressure, and body composition data using a TANITA device. The results were analyzed by analysis of variance (ANOVA) and the Shapiro-Wilk test using R statistical software, while the post hoc analysis employed t-tests with Bonferoni's correction.

Results: Heart rate and blood pressure were within normal limits in most subjects. Low physical activity and increased fat mass were confirmed in the students with a higher metabolic than metric age. Furthermore, nursing students had higher mean fat mass and lower mean basal metabolism values than students of other majors, especially medicine.

Conclusions: The health-promoting aspects of behaviors favoring a healthy body weight and sleep hygiene, as well as not smoking and having low alcohol consumption, were observed in the study group. However, some lifestyle elements, including eating habits, must be modified.

KEYWORDS: cardiovascular disease, risk factors, medical students, health behaviors

Background

Cardiovascular diseases are one of the leading causes of death in Poland. A World Health Organization (WHO) report found that 17.5 million people die annually from cardiovascular disease, accounting for 31% of all deaths globally. Furthermore, the cause of death for 7.4 million people is

ischemic heart disease, and 6.7 million die from stroke [1].

Aortic atherosclerosis is found in autopsy studies in children, and thickening of the inner membrane of the coronary arteries occurs in 15% of people between the ages of 10 and 20. However, clinical signs of atherosclerosis usually appear between the 5th and 6th decades of life [2].

There is a growing problem of lipid disorders, hypertension, and obesity among young people, which can lead to dangerous future cardiovascular disease-related health consequences. Scientific studies by specialist teams in various regions of Poland show that an increasing number of young people are affected by **overweight, obesity,** and elevated blood pressure. Risk factors for cardiovascular disease include poor diet, smoking, physical inactivity, alcohol abuse, stress, obesity, hypertension, type 2 diabetes, and dyslipidemia. Healthy eating habits should be instilled in young people in their homes, schools, and colleges. Indeed, only public education implemented at an early age can improve health and reduce premature deaths from cardiovascular causes.

Primary and secondary cardiovascular disease prevention begins with creating healthy behaviors and changing unhealthy behaviors related to smoking, nutrition, physical activity, response to stress, and the active control of one's health. Lifestyle is one of the factors influencing people's health, with health knowledge and healthy behaviors shaped socially and professionally. Such behaviors are also acquired during studies that prepare students for medical and paramedical professions aimed at health promotion activities, including future physicians, nurses, paramedics, and physiotherapists. The healthy behaviors developed at the threshold of adulthood remain in the consciousness during the later years of life [3-5].

Aim of the study

This study aimed to assess selected risk factors for cardiovascular disease among medical students.

Material and methods

The study included 201 randomly selected subjects, including 175 females and 26 males, who were students of the Faculty of Medical and Health Sciences at the University of Technology and Humanities (UTH) in Radom. The participants were stratified by field of study, including nursing (n=84; 42%), physical therapy (n=43; 21%), medicine (n=35; 17%), and cosmetology (n=39; 20%).

Data were collected using a self-administered questionnaire created for the study and by measuring heart rate, systolic blood pressure, diastolic blood pressure, and body composition using a TANITA device. In addition, the questionnaire included a metric section that collected demographic data and lifestyle questions, including declared physical activity, nutrition, smoking, and family history of cardiovascular risk factors. The study was anonymous, with each respondent giving their consent.

Statistical analyses

The results were analyzed using R statistical software and presented as graphs. Statistical analysis used analysis of variance (ANOVA), the Shapiro-Wilk test assessed normality of data distribution, the F-test (test of variance) analyzed the equality of variance, and post hoc analysis employed t-tests with Bonferoni's correction.

Results

The largest group (n=62; 31%) were students aged 21, and around 40% of respondents (n=81) resided in the countryside. The remaining respondents lived in large cities with over 200,000 residents (n=61; 30%), cities of 50-200,000 residents (n=30; 15%), or small cities with up to 50,000 residents (n=29; 15%).

Most respondents (147 people; 73%) had a normal body mass index (BMI) (18.5-24.9). However, overweight (BMI=25.0-29.9) was found in 39 subjects (19.5%), while obesity (BMI ≥30) was found in 15 subjects (7.5%). The minimum BMI was 18.5 kg/m^2, and the maximum was 34 kg/m^2.

Heart rate and blood pressure were measured in the study group and reached typical values in approximately 90% of subjects, with only 6% of respondents having blood pressure levels of 140/90-160/100 mmHg. Medical students reported that hypertension was the most common (42% of the total) cardiovascular disease in their immediate family.

The research indicated normal body fat mass in around 50% of the general population, with 10-20% body fat the norm for males and 20-30% the norm for females. It should be highlighted that 56% of physiotherapy students had elevated body fat mass, even though most students in this group (63%) had a BMI in the normal range. However, there was a statistically significant difference between medical and nursing students, with the latter demonstrating an increased mean body fat percentage (among 84 students in this group, only 35% had a body fat mass value in the normal range).

More than 80% of all students had a high level of hydration, and over half of the respondents only ate food when they felt hungry, with meat dishes con-

sumed most often and fish dishes much less so. Furthermore, sweets and sweetened drinks such as Coca-Cola were a daily pleasure for one-third of students, 33% of whom were nursing students. Energy drinks, on the other hand, were very rarely drunk. Students did not admit to frequent alcohol consumption, and only 14% stated that they smoked tobacco.

Almost 60% of respondents had a higher metabolic age than their metric age (n=118). In this group, only 50% of the students engaged in physical activity, less than 30% consumed sweets daily, had fast food meals at least once a week, declared low fish consumption (at least once a week), and ingested sweetened carbonated beverages most often. In the metabolic age group, 78% of the subjects were characterized by increased body fat mass, while 80% had normal hydration levels.

One-hundred thirty-six (68%) respondents declared an ability to cope with stress, with physiotherapy performing best (36 out of 43 physiotherapy students) and cosmetology performing the worst (23 out of 39 cosmetology students). Most respondents considered playing sports and pursuing passions the most effective stress management methods.

Difficulty sleeping was cited by 35% of respondents (n=71), with the most problems reported by cosmetology students. Meanwhile, the medical students had the least difficulty sleeping, even though they slept less than the other groups (5-6 hours/day).

Respondents answered questions about possible cardiovascular disease risk factors and pointed most often to reducing weight and limiting salt in meals. At the same time, students cited the media (the press, television, and the internet) and medical literature as the primary sources of their cardiovascular disease prevention knowledge.

Analysis of percent body fat box plot graphs showed no statistically significant differences between physiotherapy (F), cosmetology (K), and medical (M) students. However, there was a statistically significant difference between medical students (M) and nursing students (P), with an increase in the mean body fat percentage found in nursing students (Figure 1).

Analysis of systolic blood pressure box plots demonstrated no statistically significant differences between physiotherapy (F), cosmetology (K), and medical (M) students. However, there was a statistically significant difference between medical students (M) and nursing students (P), with lower mean systolic blood pressure found in nursing students (Figure 2).

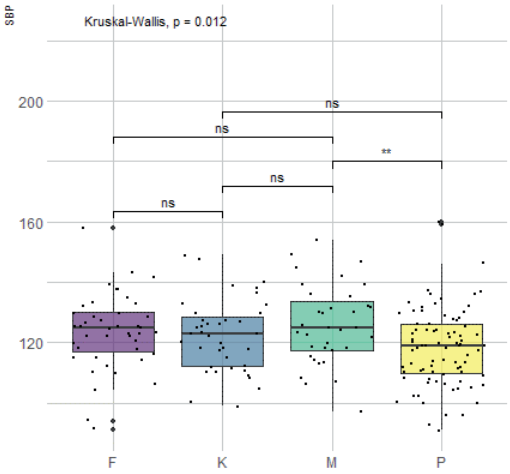

Figure 2. Systolic blood pressure analysis

Basal metabolism analysis found no statistically significant differences between physiotherapy (F), cosmetology (K), and medical (M) students. However, there was a statistically significant difference between medical (M) and nursing students (P), with a reduced mean basal metabolism found in nursing students (Figure 3).

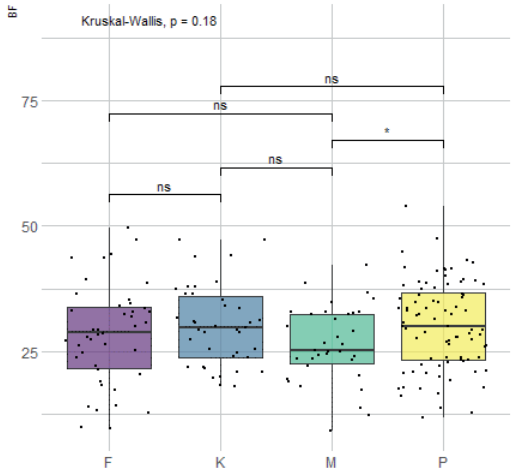

Figure 1. Body fat analysis

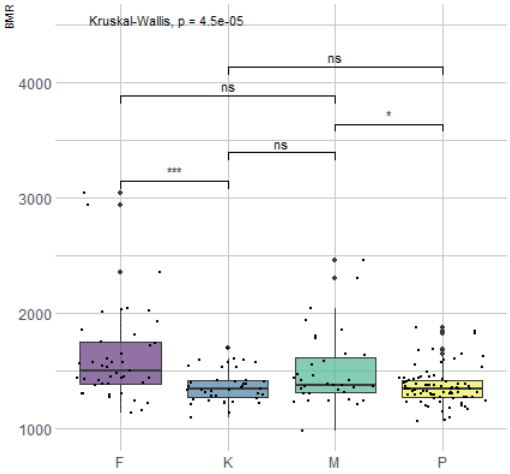

Figure 3. Basal metabolism analysis

Analysis of heart rate box plots showed no statistically significant differences between physiotherapy (F), cosmetology (K), and medical students (M). However, there was a statistically significant difference between physiotherapy students (F) and cosmetology students (K), with the latter showing a higher mean heart rate (Figure 4). In addition, there were no statistically significant differences in body weight, BMI, body water percentage, and metabolic age between physical therapy (F), cosmetology (K), medical (M), and nursing (P) students.

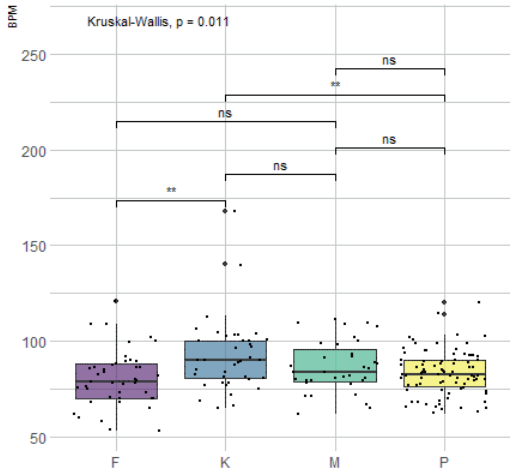

Figure 4. Heart rate analysis

Discussion

The coexistence of multiple cardiovascular risk factors at a young age, especially those related to lifestyle, may contribute to the prevalence of cardiovascular disease in the adult population.

Obesity is recognized as a disease of civilization, is a consequence of storing excess energy in white adipose tissue, and is responsible for excess body weight.

A WHO report conducted in 2014 found that overweight and obesity are prevalent in 1.9 billion (39%) of the global population. In our study, 30% of the students were overweight or obese, which are major risk factors for cardiovascular disease, including heart attacks, strokes, diabetes, and some cancers [6].

Scientific data show that physical activity can improve insulin sensitivity, alleviate plasma dyslipidemia, normalize elevated blood pressure, and reduce blood viscosity to protect the heart and blood vessels. As such, the American Heart Association recommends 30 minutes of moderate exercise five times a week (preventive) [7, 8]. By analyzing the health behaviors of medical students at the UTH in Radom, it was found that approximately 50% of subjects performed physical activity once a week for 60 minutes, while only 22% exercised daily. However, research conducted in the Polish youth community shows an increasing tendency for regular physical activity to reduce the risk of cardiovascular disease.

Based on a review of the current medical literature, there is increased awareness of the harms of smoking and alcohol abuse among young people in Poland, especially among medical students [9]. The present study confirms this trend, as 86% of respondents did not use cigarettes.

To correctly determine the prevalence of overweight and obesity, it is necessary to measure the body fat content since the risk of diseases of civilization is primarily due to excess fat and not body weight [10, 11]. Based on the anthropometric data, the vast majority of medical students (73%) had a normal BMI, with up to 50% of the total population having elevated body fat mass. It was also found that 56% of physiotherapy students had elevated body fat mass with normal body weight. These findings are in agreement with the literature. Since BMI only assesses total weight and does not account for body composition, the results can be misinterpreted. Slim people described as skinny-fat at low body weight have higher body fat values with concomitant low levels of muscle tissue. No weight gain index can replace the direct determination of body fat, especially with the widespread availability of inexpensive bioimpedance measurement devices [10, 12].

Study limitations

Limitations of this study include the relatively small sample size and the fact that it involved only one medical institution, which may limit the generalizability of the results. In the future, a multicentre study of cardiovascular disease risk factors can be conducted on a larger population of medical students, and the studies to date expanded to include laboratory tests, such as determining glucose, homocysteine, and fibrinogen levels alongside a lipidogram.

Conclusions

Study participants reported health-promoting behaviors that help maintain a healthy body weight, improve sleep hygiene, avoid tobacco smoking, and involve low alcohol consumption. However, some lifestyle elements, including students' eating habits, require modification. In students with an increased metabolic age relative to their metric age, low physical activity, increased body fat mass, and occasional consumption of fish rich in omega-3 fatty acids were confirmed. Therefore, more emphasis should be placed on educating students on the benefits of a low-intake animal-free diet rich in fruits and vegetables.

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