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Case report

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A NOVEL APPROACH FOR ABDOMINAL SONOGRAPHIC EVALUATION OF THE PROSTATE, MEDIAN LOBE HYPERTROPHY AND HUGE PROSTATIC HYPERPLASIA

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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: The formula used for the calculation of prostate volume is roughly the three dimensions of prostate (L×W×H) multiplied by 0.52. Indeed, this is the formula for calculating the volume of a sphere. However, almost all of the papers on this topic describe the shape of the prostate as a pyramid. As the true prostate shape is a rhombohedral regular tetrahedron with a median lobe, a more effective calculation method is needed.

Aim of the study: This paper aims to develop a different approach for sonographic measurement of the prostate through mathematical models.

Case report: We present a 74-year-old patient with HPH and median lobe hypertrophy.

Conclusions: The classical method is insufficient for accurate measurement in patients with median lobe hypertrophy. In prostates with median lobes, the measurement should be calculated as the median lobe volume plus the spheric prostate volume.

KEYWORDS: ultrasound, prostate, benign prostate hyperplasia, median lobe

Background

Benign prostatic hyperplasia (BPH) is one of the most common urological problems in older men [1]. Enlargement of the prostate by more than 200 g is known as huge prostatic hyperplasia (HPH) [2]. Patients with this condition are evaluated before treatment and accurate measurement of the prostate is important for developing a treatment plan. The formula used to calculate prostate volume is roughly the three dimensions of the prostate (length [L] × width [W] × height [H]) multiplied by 0.52, which is the formula used to determine the volume of a sphere. However, almost all of the papers on this topic describe the shape of the prostate as a pyramid. In addition, HPH can occur with or without median lobe hypertropia. The median lobe is not a true lobe of the prostate and refers to an area of indentation towards the bladder. The prostate shape becomes a rhombohedral regular tetrahedron with the inclusion of the median lobe [3–5]. In all of these situations, prostate measurement is still made by the classic method using ultrasonography. In our opinion, the method outlined below is more accurate for HPH with median lobe

hypertrophy, given the mathematical models. Here, we describe the sonographic evaluation of a 74-year-old patient with HPH and median lobe hypertrophy, accompanied by clinical findings.

Aim of the study

This paper aims to develop a different approach for sonographic measurement of the prostate through mathematical models.

Material and methods

The medical records of a 74-year-old male with prostate hyperplasia were used. The patient signed a consent form prior to the start of the study.

Case report

The patient was initially admitted to the hospital with acute urinary retention. There were no urinary problems described by the patient in the anamnesis. The patient had several medical comorbidities, including hypertension and depression. Physical examination of the scrotum and testicles revealed tenderness and bilateral swelling, and Prehn's sign was positive. On manual rectal examination, the anal tonus was normal and the prostate was large without palpable hard nodules. The patient's urea level was 31 mg/dL and creatinine was 1.02 mg/dL, both within the normal range. The C-reactive protein (CRP) level was 231 mg/L, the half-hour sedimentation was 22 mm, and the one hour sedimentation rate was 49 mm. These test values were elevated but the white blood cell (WBC) count (7.38 × 109 mg/L) was within the normal range. The prostate-specific antigen (PSA) level was high (18.46 ng/ml), and the results of the urinary analysis were normal.

An abdominopelvic ultrasound examination revealed that the kidneys were normal bilaterally. However, the prostate was enlarged, measuring 83 mm × × 70 mm × 114 mm with a volume of 344 ml. The parenchyma was heterogeneous, and calcifications and cystic degeneration areas were present. The median lobe was indented to the bladder from the posterior and trabeculation was increased on the bladder's wall. The wall was also thick (5 mm), likely due long-term prostate hyperplasia (Figure 1).

Disconcertingly, while the pre micturition bladder volume was 800 ml, the post micturition volume was 80 ml. The patient was able to void a large amount of urine.

With cystoscopy, the enlarged prostate with a large median lobe and a trabeculated bladder

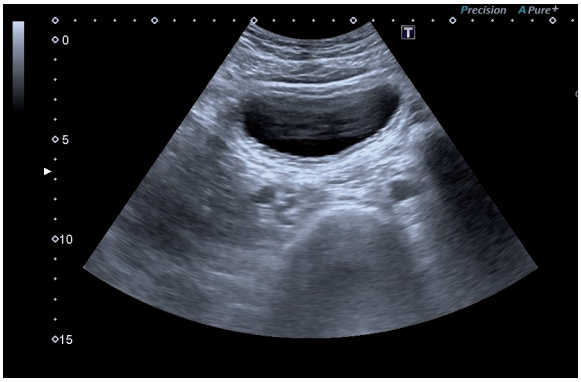

Figure 1. In the transverse sonographic plane, the bladder wall was not smooth and was trabeculated

were seen. Due to the high PSA levels, a transrectal ultrasound-guided (TRUS) prostate biopsy was performed using a 12-gauge Tru-Cut® biopsy needle prior to surgery. The histopathological findings were compatible with BPH. A transvesical open prostatectomy was performed and the gland was enucleated completely. Haematuria continued for two days and, on the second postoperative day, hemoglobin measured 7.8 g/dL. Three units of blood were transfused. The urethral catheter was removed on the seventh postoperative day and the patient was discharged from the hospital nine days after the operation. Two months later, the patient was continent and was voiding adequately.

After excision, the prostate specimen was sent for histopathological examination. The specimen measured 110 mm × 80 mm × 79 mm and weighted 360 g after peripheral tissues were removed. The histopathological findings were compatible with BPH. HE (hematoxylin-eosin) pathologic preparations showed hyperplastic benign glands in the fibromuscular prostatic stroma under the light microscope. There was also evidence supporting induration and necrosis. Prostatitis or carcinoma were not considered (Figure 2).

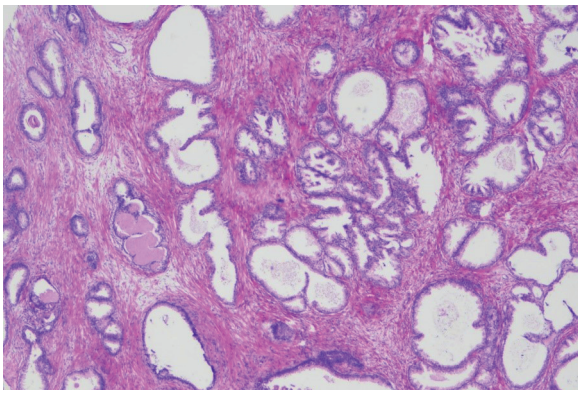

Figure 2. In the histopathological examination of the prostate, HE (hematoxylin-eosin) pathologic preparations showed hyperplastic benign glands in fibromuscular prostatic stroma under the light microscope

Discussion

The prostate gland is the largest accessory gland of the male urogenital system. Its normal weight is ~20–40 g and its mean dimensions are 30 mm × × 40 mm × 20 mm. The prostate shape resembles an upside down pyramid, with its base at the bladder neck and its top at the apex.

Transrectal ultrasound provides detailed information during prostate evaluation. It is used as a guide in interventional procedures, such as prostate biopsy, and shows the prostate anatomy in detail [6]. The prostate can also be measured using an abdominal approach. This procedure is easier and more rapid, and is therefore preferred for general evaluations of the prostate. In our country, abdominal ultrasound is a routine imaging procedure, and prostate evaluation is an important part of abdominal sonographic evaluation [7]. Prostate volume calculation is indispensable during this examination, especially for patients with BPH.

The prostate is comprised of both glandular and fibromuscular tissues. The transitional zone constitutes 5% of the normal prostate tissue, and BPH typically originates from this region. The transitional zone, which is normally located in the central area, enlarges and becomes indented at the base of the bladder. This indentation is called the median lobe; however, this is not a true anatomical structure. In fact, it is the indentation of the transitional lobe between the preprostatic sphincter and the urethra towards the bladder floor, as shown in Figure 3 [8,9].

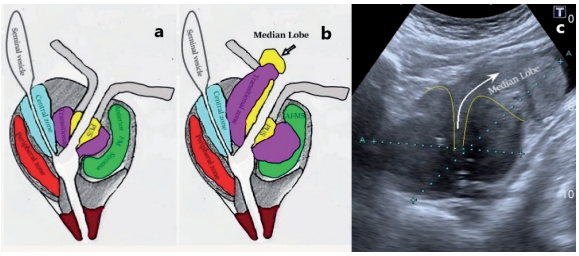

Figure 3. a – Normal anatomy of prostate; b – Median lobe hypertrophy; c – Median lobe hypertrophy in our patient

Although there are various prostate measurement methods installed on sonography devices [10], the main formula for calculating prostate size

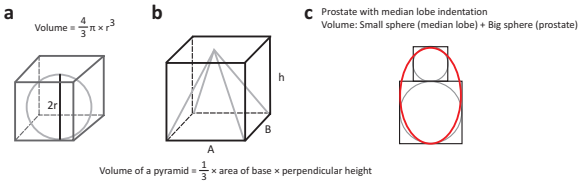

Figure 4. a – The calculation of sphere volume (The formula of prostate volume); b – The calculation of Pyramid volume; c – Red oval is the calculated prostate volume in the classic method, small sphere+ big sphere = prostate volume in our method

is volume =L×W×H×0.52 [11]. Considering that the volume of a sphere is $V=\frac{4}{3}\pi r^3$ $1\times\pi\times\frac{3}{4}=4.18$, if the volume of the sphere placed in this cube is calculated as R^3, $2^3=8$, sphere volume / cube volume =4.18/8=0.52 (Figure 4a).

In other words, the prostate is considered to be a regular sphere when the measurements are made. However, if the prostate is considered as a pyramid in the calculations, the three dimensions would have to be multiplied by 0.33, since a cube would create a pyramid equal to 1/3 of the base and height (Figure 4b).

As for the prostate, which includes the median lobe, if we consider that the upper sphere is the median lobe and the lower sphere is the prostate, the red oval is our measurement using the classical 3-dimensional measurement (Figure 4c) [12]. In other words, the volumes should be calculated separately and added.

In fact, our proposed method can be used in other complex situations encountered in daily medical practice. For example, this technique has been applied to an ultrasound from a patient with a trans ureteral resection. In this case, the central defect in the operation zone was subtracted from total volume to find the exact volume of the remaining prostate tissue [13,14].

Conclusions

Prostate volume is typically calculated as a sphere, and not a pyramid. The median lobe changes the shape of the prostate. Therefore, under these conditions, the classic formula not adequate for calculating prostate volume. In prostates with median lobes, the volume should be calculated as the median lobe volume + spheric prostate volume.

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Original papers

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EVIDENCE-BASED PUBLIC HEALTH BA CURRICULUM REVISION: AN EXAMPLE OF GOOD PRACTICE

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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: The Medical University of Warsaw began teaching at the faculty of Public Health at the Division of Health Science in the academic year 2000/2001. Initially, it only offered M.A. studies; however B.A. degrees were introduced in 2003. Student self-assessment of their level of preparedness to embark on a career path upon completion of their studies, as well as their opinion on the degree to which specific education outcomes were achieved in their course of studies can be of high practical significance and can become a launchpad for the improvement and excellence of the quality of education at the faculty of Public Health.

Aim of the study: The purpose of the study was to compare opinions on achieving education outcomes and self-assessments of the perceived level of readiness to start a job of B.A. graduates at the Faculty of Public Health, Division of Health Sciences, Medical University of Warsaw.

Material and methods: The anonymous questionnaire consisted of two parts: 1. Students' self-assessment of reaching the assumed education outcomes; 2. Students' assessment of reaching the assumed education outcomes in the course of their studies. Each statement was assessed in a 5-point Likert scale. The studied population included 85 B.A. graduates (2015/16) (82 female, 3 males – 96% female). The mean age of students in the studied group was 23±7.2 years.

Results: The most important result was the high degree of compliance identified between the students' self-assessments and the assessment of the level of education outcomes achieved in the course of their studies.

Conclusions: Graduate self-assessments and opinions on the level of achieving education outcomes during B.A. studies can help to modify the curriculum in question following the principles of evidence-based education. Such studies should be carried out regularly to adapt to current graduate needs and labour market requirements.

KEYWORDS: evidence-based education, curriculum, quality of education, BA program, public health

Background

Public health education in Poland dates back to 1991 and was initiated in Krakow to cater for the needs of the dynamically changing health protection system [1]. In the majority of European countries, education in this field had started much earlier – and is believed to be marked by the foun-

dation of the first school of public health in 1924, the London School of Hygiene and Tropical Medicine [2].

Following the provisions of the Bologna Process, courses are offered in a two-degree system. The time requirement to complete the Bachelor's degree studies (academic degree I) is three years (six semesters, 180 points of the European Credit Transfer System – ECTS) and graduates obtain an undergraduate Bachelor's degree. Master's degree studies (academic degree II) extend over two years (four semesters, 120 ECTS points) and graduates are awarded a postgraduate Master's degree [3].

Currently education is provided based on the list of the education outcomes stipulated in Resolution No. 77/2012 of the Senate of the Medical University of Warsaw of 24 September 2012, which is valid for the Medical University of Warsaw since 2013/2014 [4]. The list of education outcomes is based on the European standards developed by ASPHER: *Main chapters of ASPHER's list of European Public Health Core Competences* [5]. Each University specifies the list of education outcomes, which are divided into major cognitive domains: knowledge (W), skills (U) and social competences (KS). From this, the curriculum and syllabi are developed.

Since 2000, there has been a significant increase in undergraduate and postgraduate courses within Public Health, which are now available in approximately thirty universities.

Following a considerable initial interest in studying Public Health in Poland, recent years have seen a decline, similar to other European countries, which has been caused by a variety of interconnected factors described in detail in the international literature [6-9]. These include, in particular, a lack of legal regulations concerning the public health specialist's profession, the lack of a clear definition of the professional competences of Public Health graduates and their recognition on the job market.

In the last few years, public health courses were suspended in many universities. Often all applicants are accepted, uncritically, lowering the quality of education. This applies to both undergraduate and postgraduate studies. Moreover, owing to a lack of specified competencies for public health graduates, it is often the case that the curriculum and contents taught at postgraduate level overlap with those taught at undergraduate level [10].

The Medical University of Warsaw, the largest medical university in Poland and one of the twelve medical state universities, inaugurated the faculty of Public Health at the Division of Health Science in 2000/2001. Initially, it only offered M.A. studies (first offered in the academic year 2000/2001); however, B.A. degrees were introduced in 2003 (academic year 2003/2004).

Recently, the curriculum of the B.A. at the Department of Public Health, at the Faculty of Health Sciences of the Medical University of Warsaw was updated according to the guidelines covering the suggestions of the representatives of the students and Employers' Council. The curriculum has also been evaluated by the Polish Accreditation Committee; however, this needs to be updated regularly to consider economic needs.

This study sets out to elicit the views of public health undergraduates around specific educational outcomes and their self-assessment of their readiness to start work. The graduates' opinions on the degree of achieving specific educational outcomes from their studies and their self-assessment related to their readiness for employment upon completion has practical implications, as it can become a launchpad for the improvement of the quality of education at the Faculty of Public Health. That is why, according to the principles of evidence-based education, the intended modification of Bachelor's degree studies at the Faculty of Public Health, Division of Health Sciences, Medical University of Warsaw was preceded by a detailed analysis of the opinions of graduates completing their studies in the academic year 2015/2016 on the subject.

Aim of the study

The purpose of the study was to compare opinions on achieving education outcomes and self-assessments of the perceived level of readiness to start a job of B.A. graduates at the Faculty of Public Health, Division of Health Sciences, Medical University of Warsaw.

Material and methods

Study design and setting

This study was carried out over a three-month period in the summer of 2016. Students were asked to fill in the questionnaires after graduation, when collecting the documents confirming completion of their studies in the Dean's Office. The study was conducted using the PAPI (Paper and Pen Personal Interview) method. A separate private area was used to ensure confidentiality and anonymity.

Participants

The studied population included 85 B.A. Public Health graduates (2015/16) from Division of Health Sciences, Medical University of Warsaw.

Data sources

An anonymous questionnaire was developed based on the list of education outcomes published pursuant to the resolution of the Senate of the Medical University of Warsaw and effective while developing the curricula of studies at the Faculty of Public Health, Division of Health Sciences, Medical University of Warsaw [4]. Additionally, the education outcomes in knowledge and skills were divided according to the *Main chapters of ASPHER's list of European Public Health Core Competences* [5]. ASPHER identifies seven different areas of education, within which 29 statements apply to the Knowledge (W) domain and 30 to the Skills (U) domain: methods in public health (W–4, U–3); population health and its social and economic determinants (W–4, U–4); population health and its material – physical, radiological, chemical and biological-environmental determinants (W–4, U–1); health policy, economics, organisational theory and management (W–11, U–9); health promotion: health education, health protection and disease prevention (W–2, U–3); ethics (W–4, U–2); and others (W–0, U–9).

The questionnaire consisted of two parts: 1. Students' self-assessment of reaching the assumed education outcomes; 2. Students' assessment of the level of reaching the assumed education outcomes in the course of their studies. In both areas, three cognitive domains were identified, related to knowledge (29 statements), skills (30 statements) and social competences (13 statements). Each of the statements was assessed on a 5-point Likert scale (where 1 was "I completely disagree" and 5 "I absolutely agree"). The text of each statement applied to detailed educational outcomes set out in the Senate's regulation [4].

Statistical methods

The return rate of the questionnaires was 96.6% (85/88), including not completely filled-out questionnaires, which constituted 5.0%. According to Schafer's [11] recommendation, such a percentage can be regarded as neutral. Incomplete questionnaires were excluded from the analysis. The data were digitised using an optic reader and developed as a database using the ABBYY FlexiCapture programme.

The compliance of the respondents' opinion between evaluation of achievement and self-assessment of their competence was identified using the Guttmann's split-half reliability method, and calculating the coefficient of correlation [12]. The intraclass correlation coefficient (ICC) was applied to evaluate the degree of consistency of achievement and self-assessment in each cognitive domain. The minimum value of 0.75 was taken as the limit of sufficient consistency for ICC [13]. The analysis of the degree of achieving each education outcome and the graduates' competence self-assessment was carried out using descriptive statistics (mean and standard deviation (M ± SD)). With regard to the diagonal distribution, the data were subjected to a non-parametrical analysis. The Wilcoxon signed-rank test was applied to compare the results of achievement and self-assessment [14]. The value of the outcome for significant differences was estimated using the r coefficient according to the formula proposed by Cohen [15]. Cohen's guidelines for r specify that a large outcome is 0.5, a medium outcome is 0.3 and a small outcome is 0.1 [16].

A statistical analysis was performed using the STATISTICA 12.5 software (licence of the Medical University of Warsaw). The statistical significance level was assumed in advance at 0.05.

Ethical considerations

The authors sought advice from the Ethics Committee of the Medical University of Warsaw to conduct the presented study. In the opinion of the Bioethics Committee 'non-interventional studies do not require the opinion of the Bioethics Committee in accordance with Art. 37al Pharmaceutical Law Act (Journal of Laws 2001, No. 126, item 1381)' [17].

RESULTS

Participants

The studied population included 85 B.A. Public Health graduates (2015/16) (82 females, 3 males – 96% female) from Division of Health Sciences, Medical University of Warsaw. The mean age of students in the studied group was 23 ± 7.2 years. The majority of the respondents were single (97%), while only 3% were married.

Main result

The most important result was identifying a high degree of compliance between the results of the students' self-assessments and the assessment of the level of education outcomes during the course of the studies.

Other analyses

The sum of the average [NJR1] results for the learning outcomes in the aforementioned three do-

mains in the context of their implementation during the studies and the students' self-esteem is as follows (implementation of learning outcomes vs self-assessment): Knowledge (104.8 vs 103.3; p=0.516, r coefficient=0.08), Skills (107.2 vs 110.3; p=0.019, r coefficient=0.28), and Social competences (49.3 vs 51.4; p=0.013, r coefficient=0.32).

The analysis of compliance between the evaluation of the degree of achieving education outcomes and the graduates' competence self-assessment also revealed high reliability. The reliability of Guttmann's analysis carried out in the Knowledge domain was 0.878 (ICC=0.969), in the Skills domain it was 0.864 (ICC=0.976), and for Social competence it was 0.853 (ICC=0.959).

The differences, however, were statistically insignificant in the majority of cases. Only for five of the 29 analysed statements were statistically significant differences observed (p<0.05). In the section entitled *Population health and its material – physical, radiological, chemical and biological – environmental determinants* the comparison of the implementation level with the students' self-assessment turned out to be statistically significant for the two variables. It is worth emphasising that the rest of the education outcomes presented in the section entitled *Population health and its material – physical, radiological, chemical and biological – environmental determinants* turned out to be the only one in the analysis related to the Knowledge domain for which the students evaluated their self-assessment level higher than its implementation level. The last education outcome with a statistically significant difference between the students' opinion on achieving the outcomes and the students' self-assessment applied to the education outcome in *Health promotion* (Table 1).

Table 1. Evaluation of achieving the education outcomes and self-assessment of graduates' knowledge-related competences

List of education outcomes related to the students' knowledge	Area	Mean	SD	Mean	SD	p-value[a]	Effect size[b]
		Evaluation of achieving education outcomes		Graduates' competence self-assessment			
Methods in public health[c]							
Knows theoretical and methodological basics of building health and social programme strategies	Z	3.5	1.34	3.5	1.32	0.910	0.02
Defines qualitative and quantitative methods of social studies	Z	3.6	1.27	3.2	1.36	0.024	0.40
Describes the methods used for evaluation and quality assurance in the protection system	Z	3.6	1.22	3.2	1.39	0.011	0.44
Describes institutions and IT systems used for public health related analyses	Z	3.3	1.36	3.3	1.32	0.837	0.03
Population health and its social and economic determinants							
Defines basic terms describing the health condition of the population	Z	4.4	0.85	4.2	0.97	0.236	0.25
Describes the methods of identifying the health needs of society	Z	3.9	1.28	3.8	1.26	0.784	0.05
Presents major health hazards and health problems of the Polish population, including that of local societies	Z	4.1	1.16	4.0	1.11	0.772	0.05
Presents domestic and European sources of information and population health monitoring systems	Z	3.6	1.20	3.4	1.31	0.294	0.17
Population health and its material – physical, radiological, chemical and biological – environmental determinants							
Defines the impact of behavioural and environmental factors on the health condition	Z	4.3	1.01	3.9	1.26	0.010	0.45
Correctly interprets the relationships between health and working environment	Z	4.0	1.23	4.0	1.19	0.829	0.04
Describes biological processes in the human body, as well as the structure and functions of the systems and organs in a healthy and ill body	I	3.3	1.28	3.7	1.06	0.006	0.47
Has a general knowledge of etiopathogenesis, diagnostics and treatment of selected diseases, in particular the ones with social significance	I	3.7	1.11	3.7	1.14	0.931	0.02
Health policy; economics; organisational theory and management							
Mentions the foundations of economic evaluation of health protection programmes	E	3.1	1.35	3.1	1.44	0.931	0.01

Table 1 contd.

List of education outcomes related to the students' knowledge	Area	Mean	SD	Mean	SD	p-value[a]	Effect size[b]
		Evaluation of achieving education outcomes		Graduates' competence self-assessment			
Defines economic conditions for operation of the health protection system and entities	E	3.3	1.30	3.2	1.36	0.421	0.12
Explains the impact of economic stimuli on human behaviour	E	3.5	1.27	3.5	1.38	0.979	0.00
Describes the functions of the main organisational forms of health services	Z	3.2	1.37	3.4	1.42	0.176	0.22
Presents the rules of cooperation with local authorities and local governments and other entities dealing with social prevention	Z	3.2	1.38	3.4	1.27	0.197	0.20
Enumerates all elements of the social and health insurance system	P	3.4	1.32	3.4	1.33	0.868	0.03
Describes organisational and legal aspects of the Polish health care system	EP	3.5	1.25	3.3	1.36	0.094	0.27
Presents the assumptions and directions of the health protection system reform in Poland, considering legal and financial aspects	EP	3.2	1.25	3.1	1.35	0.562	0.09
Defines legal and financial aspects of providing health benefits and implementation of health programmes	EP	3.2	1.32	3.1	1.42	0.378	0.16
Discusses the basic terms related to social communication	Z	4.1	0.99	4.0	1.21	0.882	0.03
Describes the rules of proceeding in the case of natural disasters	I	3.4	1.41	3.6	1.42	0.153	0.25
Health promotion: health education, health protection and disease prevention							
Defines concepts related to health and lifestyle	Z	4.5	0.86	4.2	1.07	0.018	0.52
Defines strategies used on different levels of preventive and health promotion interactions	Z	3.8	1.26	4.0	1.21	0.218	0.21
Ethics							
Presents the rules of law related to the protection of patients' rights and job ethics with a special consideration for the medical profession	P	3.7	1.31	3.6	1.21	0.281	0.19
Presents fundamental legal principles concerning assistance for the excluded, victims of violence, social re-adaptation etc.	P	4.0	1.20	3.9	1.14	0.845	0.04
Defines the rules of protection of intellectual property and property rights	I	3.5	1.30	3.5	1.32	0.808	0.04
Identifies legal consequences of basic formal and legal provisions related to administrative law	P	3.2	1.36	3.2	1.33	0.873	0.03

[a] Wilcoxon signed-rank test; [b] r coefficient proposed by Cohen; [c] Main chapters of ASPHER's list of European Public Health Core Competences; Z – education outcomes in public health; E – education outcomes in economy; P – education outcomes in law; EP – education outcomes in law and economy; I – education outcomes in other sciences.

Another analysis involved the comparison of the evaluation of achieving education outcomes with the self-assessment of the graduates' competences related to skills. The analysis revealed that in reference to skills, for half of the education outcomes (15/30 statements, 50%), the students rated their preparation level higher than achieving the education outcomes of their studies. For eight statements (8/30 statements, 27%) the mean evaluation of achieving the outcomes and self-assessment were on the same level, while for seven statements (7/30, 23%) the students ranked achieving the outcomes higher than their preparation. In most cases, the differences were not statistically significant. A statistically significant difference was observed for five education outcomes (Table 2).

The final analysis presented in the paper applied to the comparison of the evaluation of achieving education outcomes with the self-assessment of the graduates' social competences. The analysis revealed that in relation to social competences, for 11 out of 13 education outcomes, the students ranked their owns skills higher than achieving the outcomes in the studies. The level of two educational outcomes in

Table 2. Evaluation of achieving the education outcomes and self-assessment of graduates' skill-related competences

List of education outcomes related to the students' skills	Area	Mean	SD	Mean	SD	p-value[a]	Effect size[b]
		Evaluation of achieving education outcomes		Graduates' competence self-assessment			
Methods in public health[c]							
Develops epidemiological data using simple statistical and analytical tools	Z	3.6	1.27	3.6	1.32	0.654	0.08
Finds necessary information in professional literature, databases and other health-related sources	Z	3.9	1.26	4.1	1.18	0.044	0.37
Develops a preventive programme according to the methods	Z	3.5	1.40	3.6	1.35	0.207	0.21
Population health and its social and economic determinants							
Uses health condition measures to analyse the population's health and defines population health problems	Z	3.8	1.22	3.6	1.31	0.339	0.17
Makes a diagnosis and indicates key problems for the population health in different social groups	Z	3.8	1.29	3.7	1.36	0.597	0.10
Analyses health condition with regard to social and demographic processes	Z	3.8	1.26	3.7	1.26	0.309	0.17
Has sufficient skills to cooperate with media, the local community and NGOs in implementing health-promoting measures	Z	2.9	1.50	3.2	1.44	0.187	0.20
Population health and its material – physical, radiological, chemical and biological – environmental determinants							
Identifies environmental hazards for the population health	Z	4.1	1.11	4.0	1.15	0.527	0.13
Health policy; economics; organisational theory and management							
Identifies factors affecting the health policy of the state	Z	3.6	1.34	3.6	1.30	0.977	0.01
Categorises basic costs of health care units	E	3.4	1.32	3.4	1.34	0.883	0.03
Uses the results of analyses to propose specific (alternative) solutions in the health protection sector	Z	3.3	1.38	3.4	1.32	0.570	0.09
Analyses selected conditions of health and social problems	Z	3.8	1.23	4.0	1.11	0.065	0.38
Knows the differences between various types of contract for providing health services between payers and service providers	P	3.3	1.40	3.3	1.44	0.858	0.03
Practically follows the rules of law affecting health care business operations	P	3.1	1.42	3.3	1.37	0.105	0.27
Is able to identify political processes and defines their impact on health and health sector problems	Z	3.4	1.27	3.4	1.27	0.396	0.15
Draws conclusions from observations of basic economic phenomena in a micro- and macro-economy scale	E	3.5	1.35	3.4	1.30	0.472	0.12
Uses information about institutions developing a hazard monitoring system and methods for sharing data and communicating information to institutions	Z	3.2	1.38	3.2	1.40	0.980	0.00
Health promotion: health education, health protection and disease prevention							
Presents and evaluates different health promotion concepts and models	Z	4.0	1.07	3.9	1.15	0.886	0.03
Is able to participate in the development and implementation of local projects and actions in the public health area	Z	3.4	1.41	3.3	1.45	0.372	0.14
Uses epidemiological and sociomedical studies to evaluate patients' health needs and expectations	Z	3.5	1.27	3.7	1.28	0.768	0.28
Ethics							
Formulates opinions on social issues	Z	3.5	1.47	3.9	1.14	0.004	0.57
Follows regulations related to property rights and the protection of databases used in the everyday running of health protection entities	P	3.3	1.42	3.3	1.37	0.614	0.09

Table 2 contd.

List of education outcomes related to the students' skills	Area	Mean	SD	Mean	SD	p-value[a]	Effect size[b]
		Evaluation of achieving education outcomes		Graduates' competence self-assessment			
Others							
Applies the methods and techniques learnt to solve specific problems related to communication	I	3.6	1.36	4.0	1.20	0.008	0.44
Is able to use the acquired knowledge for interpersonal purposes when working in a group	I	3.8	1.23	4.1	1.07	0.030	0.37
Improves his/her effectiveness in contacts with other people	I	3.7	1.34	4.1	1.25	0.022	0.38
Formulates own conclusions based on theoretical knowledge	I	3.8	1.38	3.9	1.27	0.305	0.19
Justifies the need to change strategies or priorities	I	3.4	1.36	3.6	1.33	0.312	0.16
Presents his/her knowledge in writing and orally (e.g. giving presentations) on an academic level	I	3.9	1.21	4.0	1.12	0.471	0.14
Works in a team taking relevant group roles	I	3.9	1.20	4.1	1.14	0.128	0.28
Speaks a foreign language – understands the main message in complex texts in specific and abstract topics; understands discussions on topics related to public health	I	3.8	1.26	3.8	1.23	0.768	0.06

[a] Wilcoxon signed-rank test; [b] r coefficient proposed by Cohen; [c] Main chapters of ASPHER's list of European Public Health Core Competences; Z – education outcomes in public health; E – education outcomes in economy P – education outcomes in law; EP – education outcomes in law and economy; I – education outcomes in other sciences.

the social competence domain, in the context of their implementation within the curriculum, as compared to the students' self-assessment, was characterised by the same mean values (Table 3).

Table 3. Evaluation of achieving the education outcomes and self-assessment of graduates' competences related to social competences

List of education outcomes related to the students' social competences	Mean	SD	Mean	SD	p-value[a]	Effect size[b]
	Evaluation of achieving education outcomes		Graduates' competence self-assessment			
Knows his/her competence level and limitations to perform certain job tasks	3.7	1.27	3.9	1.20	0.064	0.34
Identifies problems beyond his/her competences and knows who to ask for help, considering the skills to cooperate with an interdisciplinary team	3.7	1.25	3.8	1.24	0.288	0.19
Demonstrates responsibility for local environment problems	3.6	1.30	3.8	1.26	0.087	0.29
Demonstrates respect towards patients/customers and understands their difficulties	4.3	0.93	4.4	1.03	0.095	0.36
Initiates development and implementation of local projects and activities in the public health protection area	3.5	1.36	3.6	1.36	0.433	0.12
Is an efficient time manager	3.6	1.33	4.0	1.22	0.010	0.48
Spreads the knowledge about public health objectives and tasks	3.9	1.18	4.0	1.15	0.719	0.07
Designs and completes job tasks responsibly, following the rules of OHS	3.9	1.30	3.9	1.25	0.918	0.02
Is able to complement knowledge with skills critically and independently, extending both with an interdisciplinary dimension	3.7	1.29	4.1	1.04	0.013	0.43
Is tolerant and open towards different opinions and stances, determined by different social and cultural factors	4.0	1.15	4.1	1.11	0.456	0.14
Effectively presents his/her opinions, doubts and suggestions, supporting them with arguments but observing the rules of ethics	3.8	1.29	4.0	1.09	0.229	0.22
Acknowledges the role of measures aimed to reduce occupational stress and its negative impact	3.8	1.38	3.9	1.16	0.385	0.15
Demonstrates recognition of the role of lifelong learning and caring for one's own and others' health	3.9	1.30	3.9	1.23	0.992	0.00

[a] Wilcoxon signed-rank test; [b] r coefficient proposed by Cohen.

A statistical analysis revealed that only for the two following education outcomes: *is able to complete the knowledge and skills critically and independently, extending the knowledge and skills with an interdisciplinary dimension* (mean 3.7 vs 4.1; p=0.013); and *is an efficient time manager* (mean 3.6 vs 4.0; p=0.010), the students evaluated their skills higher than the level of achieving the outcomes in the curriculum.

All analysed education outcomes, which turned out to be statistically significant, were characterised by a mean value of Cohen's d standard outcome (from 0.37 to 0.57).

Discussion

Key results

1. Despite the fact that studies in the field of Public Health at the Medical University of Warsaw have for many years a positive opinion of the Polish Accreditation Committee, the study program should be regularly modified depending on the ever-changing economic needs.

2. The results showed the urgent need to modify the first cycle programs, due to the insufficient degree of implementation of learning outcomes and the overwhelming low self-esteem of graduates in the analyzed cognitive domains: knowledge, skills and social competences

3. Introduction of changes in the study program, which will be consistent with the students' needs and labor market requirements, will result in an increase in the quality of education in the field of public health.

4. The increase in the quality of education in the field of public health and the unification of legal aspects of the profession at the health policy level may contribute to better student preparation for work and to the development of new employment opportunities for public health graduates.

Interpretation

The analysis of the obtained results revealed that the questionnaire used in the presented studies is a reliable measurement tool for students' opinions and self-assessment related to achieving education outcomes during the course of Bachelor's degree studies at the faculty of Public Health, Department of Public Health, Division of Health Science, Medical University of Warsaw.

The results of a survey conducted among graduates of B.A. degree studies at the faculty of Public Health, Department of Public Health, Faculty of Health Sciences, Medical University of Warsaw and are presented in the paper revealed an urgent need to modify the curriculum of B.A. degree studies with regard to an insufficient degree of achieving education outcomes and the prevailing negative opinion of graduates in the cognitive domains under scrutiny here: knowledge, skills and social competences.

Evaluation of the level of achieving education outcomes and graduates' self-assessment related to knowledge and skills

In the studied group, six out of 29 statements concerning the evaluation of implementing knowledge on public health in the curriculum were ranked over 4. Similar results were obtained for the students' self-assessment – the students ranked six statements over 4. It should be highlighted that for five statements the ranking was the same and this can be attributed to the majors in the public health area.

In the opinion of the authors, such consistent results are testimony to the superior quality of the courses in the degree and constitute the strength of the B.A. programme. Moreover, the content is repeated in different courses and consolidated throughout the studies, which can also contribute to such a high opinion. With regard to the fact that the outcomes apply to teaching the majors, the result is particularly important from the point of view of the provision of high-quality education at the faculty of Public Health.

Nevertheless, high rating of the educational outcome and graduates' self-assessment applied to only six of the 29 achieved outcomes, while the rest of the educational outcomes ranked much lower. According to the authors, the low self-assessment in the cognitive domain can be attributed to the fact that most of the subjects and the majority of course hours in the B.A. programme are executed in late afternoon, the time of day with the lowest efficiency level when it comes to knowledge absorption. Moreover, attending the lectures is not always obligatory. The statement is also confirmed by the results of a study concerning the graduates' skills, which turned out to be much poorer, in particular when it came to achieving educational outcomes in the public health area. In this case, self-assessment for only three statements was ranked over 4, while achieving the outcomes during the studies was ranked over 4 only in two cases.

The obtained results can confirm that the number of classes motivating the students was not sufficient in the previous curriculum. These included case seminars, classes, project assignments and practical classes in which students could acquire knowledge and develop their skills.

The results concerning the education outcome in the area of law and economy demonstrated that both the evaluation of achieving the outcome within

knowledge and skills, and the graduates' self-assessment were ranked well below 4, and ranged from 3.1 to 3.5. According to the authors, the results are not surprising, since they apply to difficult knowledge areas as are law and economy. As mentioned above, the subjects were mainly taught in theoretical classes and the students did not have enough practical courses to develop relevant skills.

Evaluating the level of achieving the education outcome and graduates' self-assessment in relation to social competences

Another element of the study included an analysis of the graduates' opinion on implementing the content related to developing social skills in the curriculum and the graduates' self-assessment in the area. When comparing the results of self-assessment in the social competences area with the results of studies on knowledge and skills, one notes that they are ranked the highest of all the scales analysed in the questionnaire. The authors are of the opinion that the graduates' self-assessment related to social competences is extremely satisfactory, as it is among the most important factors conditioning success on the labour market. According to the authors, this ranking is surprising, as it contradicts opinions traditionally expressed by employers, who emphasise a lack of skills related to teamwork, communication, negotiation, conflict resolution and creativity in Public Health graduates [18]. In an attempt to interpret this, the authors have identified several possible factors. One of them is that graduates are able to verify their competence level during an internship or their performance while still studying. The literature confirms this thesis but, also, students themselves as well as internship supervisors or employers notice a positive impact of the internship experience on the level of social competences [19]. Due to the nature of social competences, their list is only partly related to public health and is far more universal than the outcomes related to knowledge and skills. Since all students complete their internship, and many of them start working when still studying, it can provide an opportunity for a positive review of one's social competences, which are very important for any profession irrespective of discipline.

Notwithstanding the factors contributing to students' self-esteem in the area of social competences, there is one more important element which needs to be emphasised from the point of view of the curriculum, i.e. the students' opinion of education outcomes in developing their social competences during their studies. In the previous curriculum, the number of classes devoted to the development of social competences was insufficient. The competences were only developed in psychosocial skills courses, comprising 20 seminar hours in year one of studies.

Generalisability of the study results

Following an analysis of the graduate's self-assessment and their opinions on achieving the assumed education outcomes during the Bachelor's degree at the Faculty of Public Health, Medical University of Warsaw, a number of changes which could improve the quality of education were introduced into the curriculum for the academic year 2017/2018. First and foremost, the total number of lecture hours was reduced from 2,900 to 2,600 in favour of seminars and classes to improve students' skills. Moreover, subjects not directly related to achieving education outcomes in the area of public health were removed from the curriculum. These included: *Elements of medical engineering*, *Mathematical methods* and *Biometrology*. The order in which subjects were taught was also changed, e.g. *Microbiology* is now taught in year I instead of year III, as students should complete a course in *Microbiology* before they learn *Epidemiology*. With regard to the low self-esteem of the graduates in relation to economy, a new subject appeared in the curriculum – *Introduction to economic mathematics,* comprising ten hours of classes to be completed directly before *Introduction to economy*.

Modifications in the curriculum also covered the teaching of foreign languages. From 2017/2018 onwards, students will learn two foreign languages for the duration of their B.A.: English and a second foreign language of their choice.

Taking into consideration the very low rating of achieving the outcomes of classes developing social competences, a module called: *Competences expected by employers* was introduced into the B.A. curriculum for 2017/2018. During three years of studies, students will complete a total of 124 hours of the following classes devoted to the development of social competence: *Learning techniques* (10 hours), *Interpersonal communication* (16 hours), *Coping with stress* (10 hours), *Self-management in time* (16 hours), *Speaking in public and giving presentations* (16 hours), *Media communication* (16 hours), *Intercultural competences* (10 hours), *Networking* (10 hours), *Team-building* (10 hours), and *Negotiations and mediations* (10 hours).

Furthermore, changes were implemented not only in the B.A. curriculum but also in teaching methods. According to global trends of student-oriented teaching, the following seven subjects will be taught following the blended-learning formula: *Philosophy and introduction to ethics, Introduction to law, Civil law, Microeconomy, Macroeconomy, Introduction to demography* and *Propaedeutics of public health*. The literature

provides evidence of the positive impact of this form of education on its quality and students' involvement in the educational process [20].

Limitations

A possible limitation of the presented results may be the research tool used, which is an original non-standardized questionnaire. Due to the characteristics of the questionnaire and the study group, the obtained results cannot be compared with any study. However, the construction of the survey and the type of questions asked allows for the introduction of specific solutions in the public health curriculum at Medical University of Warsaw.

Recommendations

The module introduced in the Department of Public Health, Faculty of Health Sciences, Public Health Division, at the Medical University of Warsaw is the only module in Poland, on a B.A. level, which is so innovative and responding to the needs of employers. It also develops students' social competences according to the expectations of the social and economic environment, and external stakeholders. The research presented in this paper will be continued in the coming years in order to assess the effectiveness and efficiency of the education program modified in terms of employers' expectations.

Conclusions

Studies of graduates' self-assessment and opinions on the level of achieving education outcomes during B.A studies can help to modify the academic curriculum following the principles of evidence-based education, and should be carried out regularly in order to keep up with the current needs of the graduates themselves and the labour market requirements. The analysis will be repeated in three years' time among graduates who complete their B.A. programme according to the modified curriculum.

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THE ASSESSMENT OF EXPOSURES OF PRETERM NEWBORNS WITH RESPIRATORY DISORDERS TO SELECTED TRAUMATIC FACTORS GENERATED IN THE PROCESS OF NURSING CARE: AN 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: The hospitalization of preterm newborns carries a risk of frequent exposure to traumatizing factors generated by the hospital environment and multi-specialty services.

Aim of the study: The assessment of premature newborns with respiratory failure and exposure to traumatic factors such as pain and touch generated during nursing procedures.

Material and methods: The study was conducted on the 1st and 7th days of hospitalization during 2020 of a group of 10 premature newborns with respiratory disorders at the Department of Newborn Pathology of the Clinical Department of Neonatology at the University Hospital in Krakow (Poland). The research method was based on the 24-hour observation of newborns for exposures to factors generating pain and traumatic touch. The research tools included scales for assessing pain expression – Neonatal/Infant Pain Scale (NIPS), CRIES, and an original questionnaire.

Results: On the first day of hospitalization, the study group was subjected to 541 nursing procedures exposing the newborns to touch and generating pain. On the 7th day of hospitalization, the number of the procedures was 388. The average intensity level of procedural pain on the 1st day of hospitalization was 4.1 points (NIPS) and 2.5 points (CRIES), while the 7th day of hospitalization was 4.0 points and 1.8 points, respectively. The highest average pain intensity was generated by venous blood sampling for diagnostic tests and peripheral vessel cannulation.

Conclusions: Preterm newborns with respiratory failure are exposed to a significant number of procedures and actions considered traumatic. Therefore, it is reasonable to use more than one pain assessment scale for more objective results.

KEYWORDS: prematurity, traumatic factors, pain, touch

Background

The hospitalization of preterm newborns carries the risk of adaptive disorders [1] due to the frequent exposure to traumatizing factors generated by the hospital environment and life-saving procedures by specialists necessary to restore, maintain, and enhance the well-being of patients. The problem is particularly important in preterm newborns with respiratory failure due to the need for invasive procedures, such as intubation, mechanical ventilation, tracheobronchial toilet, and frequent blood tests to monitor the effectiveness of treatment [1,2]. In newborns, nociceptive nerve pathways are very well developed. Premature babies and infants are 30% to 50% more sensitive to pain stimuli than adults. Therefore, assessing the relationship between traumatic factors and neurobehavioral disorders that appear in the early stages of development has become an important area of interest for scientists from many research centers [3]. It has been proven that the more immature a newborn child is, the longer the time of pain perception and the higher the level of its intensity. This phenomenon has been observed despite limitations resulting from the immaturity of the central nervous system leading to incomplete expression of feelings and states [4]. The newborns increased sensitivity to pain coupled with continuous or frequent exposure to factors generating procedural pain, such as multiple invasive procedures, may cause unfavorable [5] short- and long-term health and developmental consequences. During the early response to pain, the newborn's condition is destabilized by an accelerated heart rate, reduced number of breaths, as well as metabolic and hormonal abnormalities [6]. The long-term consequences of chronic or frequent exposure to pain are an altered pain threshold and impaired motor and neurocognitive development, including changes in behavior, cognitive abilities, and the structure of the brain [7]. Previous research has indicated that the long-term consequences of exposure to pain during the first months of life may influence human functioning in the future [8]. Experiencing pain in childhood increases the tendency to develop depression and anxiety in adulthood [7,9]. It also causes changes to the personality development pathway [7,10].

Soothing tactile stimulation and the use of non-pharmacological (oral sucrose, breast milk, reduction of environmental stress, swaddling, and skin-to-skin care) and pharmacological methods of eliminating/relieving pain can significantly block nociception, providing newborns with a fundamental sense of security before, during, and after invasive procedures [11,12]. Therapeutic touch is also a stimulus for the development of other sensory organs, as well as for proper physical, mental, and neurophysiological development. However, experiencing frequent and intense pain has a destructive effect on the newborn, as it becomes one of the main traumatizing factors during hospitalization [13].

Aim of the study

This study aimed to assess the exposure of premature newborns with respiratory failure to traumatic factors, such as pain and touch generated during nursing procedures on the first and seventh days of hospitalization.

Material and methods

Study design and setting

The study was conducted in 2020 in a group of preterm newborns with respiratory disorders caused by surfactant deficiency without comorbidities or defects, hospitalized in the Department of Newborn Pathology of the Clinical Department of Neonatology at the University Hospital in Krakow (Poland).

The study was approved by the Director of the University Hospital in Krakow, the Head of the Clinical Department of Neonatology, and the parents of the newborns participating in the study. The research was conducted in accordance with the relevant legal regulations and ethical principles of the Declaration of Helsinki. Consent was obtained from the Bioethics Committee of the Jagiellonian University in Krakow (No. 1072.6120.134.2019).

Participants

The study group included 10 newborns on the 1st day of life, with body weights ranging from 1570 g to 2400 g. The children were born between 31 (+3/7) and 36 (+0/7) weeks of pregnancy. Each of them was in a similar clinical condition based on medical records that documented the perinatal period until the newborn was admitted to the ward. We also reviewed the results of the physical examination performed by the medical team.

Organization and course of the study

The study was conducted on the first and seventh days of life, i.e. the first and seventh days of hospitalization. The research method was based on the direct, round-the-clock observation of the newborns and a diagnostic survey using a weighted sample. The study included a day shift (7 a.m.–7 p.m.) and a night

shift (7 p.m.–7 a.m.). We assessed the exposure to factors generating pain and traumatic touch during nursing procedures. These factors included diagnostic, therapeutic, and nursing activities, such as body weight measurements, dressings, changing diapers, evening groomings, feedings, physical examinations performed by a nurse, intravenous administration of drugs, putting on and changing the nCPAP masks, repositioning of the pulse oximeter sensors, changing the positions of a newborn, changing dressings, and insertion of a G-tubes, as well as other actions carried out during the process of care and therapy (e.g. washing of the mouth and navel).

We also evaluated the reaction to pain during invasive procedures, for instance, capillary and venous blood collection for diagnostic tests, intramuscular administration of drugs (vitamin K), cannulation of vessels, aspiration of nasopharyngeal secretions, G-tube insertions, insertion or removal of arterial lines.

The newborns were re-examined on the 7th day of hospitalization. An additional complete, 24-hour continuous evaluation for exposure to pain and touch was performed. On the 7th day of hospitalization, 8 newborns were still in closed incubators and 2 babies were staying in their beds. In addition, 8 newborns did not require breathing support, and 2 required treatment using a high-flow nasal cannula (HFNC).

Data Sources

Analysis of medical records revealed the following information: birth weight, pregnancy termination week, type of delivery, diagnosis on admission to the ward, presence of comorbidities/other disorders, body weight on day 7 of life, medications ordered and administered, as well as procedures and activities performed.

Tools used in the study

1. An original observation questionnaire collecting data to assess the type and number of procedures performed during the day (divided into day and night shifts) generating traumatic touch and pain.

2. The Neonatal/Infant Pain Scale (NIPS) for assessing pain expressions, including 6 behavioral parameters, such as facial expression, crying, breathing pattern, arm and leg position, and the state of agitation. Each parameter (except for crying) was assigned 0 or 1 points. Crying was rated from 0 to 2 points. The maximum number of points was 7, which is interpreted as the highest intensity of pain. A score of 0 points means the absence of pain [14].

3. The CRIES scale for the assessment of pain expressions covers 5 behavioral and physiological parameters: crying, a need for additional oxygen supply, sleep pattern, facial expression, and vital signs (blood pressure, heart rate). Each parameter was assessed on a scale from 0 to 2 points. The maximum number of points was 10, which is the highest level of pain intensity. A score of 0 points is interpreted as the absence of pain [14].

Statistical methods

Due to the size of the study group and the nature of the study only descriptive statistics were used in the analysis.

Results

The assessment of nursing, diagnostic, and therapeutic activities performed by the nursing team generating pain and traumatic touch

On the first day of hospitalization, which was the newborn's first day of life, the study group underwent 541 diagnostic and therapeutic activities performed by the nursing team generating traumatic touch and pain (Me=52; Q1–Q3: 51–57).

On the seventh day of hospitalization, the number of the procedures was 1.5 times lower than the first day and amounted to 388 (Me=38; Q1–Q3: 37–40). Both on the 1st and the 7th day of hospitalization, more touch-related and pain-generating activities were performed during the day shift (7 a.m.–7 p.m.) than the night shift (7 p.m.–7 a.m.) – Table 1.

Table 1. The number of nursing activities related to pain and traumatic touch on the 1st and 7th days of hospitalization

Exposure factors	Day 1		Day 7	
	Day shift	Night shift	Day shift	Night shift
Pain	49	13	10	0
Touch	251	228	197	181
Total	**300**	**241**	**207**	**181**

Pain-generating activities performed by the nursing team

In the group of newborns, 62 (Me=6; Q1–Q3: 4–8) and 10 (Me=2; Q1–Q3: 1–3) pain-generating procedures were performed on the first and seventh days of hospitalization, respectively. On the 1st day of hospitalization, the number of pain-generating interventions was 49 during the day shift and 13 during the night shift. On the 7th day of their stay in the

ward, all pain-generating invasive procedures were performed during the day shift (7 a.m.–7 p.m.).

On the 1st day of hospitalization, each newborn underwent venous blood collection and a single intramuscular injection of vitamin K. In 9 patients, peripheral vein cannulation was performed and seven newborns required insertion of a G-tube. On the 7th day of hospitalization, four newborns required insertion of a G-tube, venous blood was collected in two patients, and nasopharyngeal discharge was aspirated in one patient (Table 2).

Table 2. The number of nursing activities related to pain on the 1st and 7th days of hospitalization

Activities	Number of newborns exposed to pain		Total number of pain-generating nursing activities	
Day of hospitalization	**1**	**7**	**1**	**7**
Capillary blood sampling for laboratory testing	4	0	6	0
Venous blood collection	10	2	13	3
Administration of drugs (IV)	10	0	10	0
Peripheral vein cannulation	9	0	12	0
Suction of nasopharyngeal secretion	5	2	8	2
Introduction of intragastric tube	7	4	12	4
Other (introduction/removal of an arterial line)	1	1	1	1
Total	**46**	**9**	**62**	**10**

The average pain intensity during the invasive procedures performed in newborns on the 1st day of hospitalization was 4.1 (Me=3.9; Q1–Q3: 3.5–4.6) on the 7-point NIPS scale and 2.5 (Me=2.6; Q1–Q3: 2–3.1) on the 10-point CRIES scale. On the 7th day of hospitalization, the pain intensity assessed using the NIPS and CRIES scales was 4.0 points and 1.8 points, respectively (Me=2.3; Q1–Q3: 2–2.5 vs. Me=1.1; Q1–Q3: 0.9–1.2).

On the first day of hospitalization, the highest mean pain intensity in newborns, both on the NIPS and CRIES scale, was generated during peripheral vessel cannulation – 5.6 points vs. 3.5 points (Me=5.5; Q1–Q3: 5–6 vs. Me=4; Q1–Q3: 3–4). On the 7th day of hospitalization, the highest average pain intensity on the NIPS and CRIES scales was caused by venous blood sampling for diagnostic tests – 5.7 points vs. 2.7 points (Me=6; Q1–Q3: 5–6.5 vs. Me=3; Q1–Q3: 2–3.5) – Fig. 1 and Fig. 2.

The mean neonatal pain intensity induced during the majority of invasive procedures was higher on the NIPS scale than on the CRIES scale. On the 1st day of hospitalization, these differences mainly involved venous blood sampling for diagnostic tests – 5.3 points

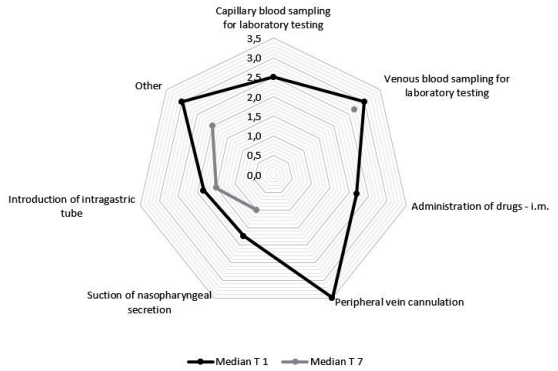

Fig. 1. The assessment of procedural pain in newborns on the 1st and 7th days of hospitalization based on the CRIES scale

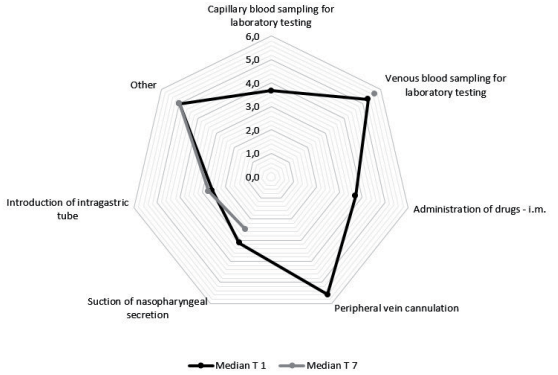

Fig. 2. The assessment of procedural pain in newborns on the 1st and 7th days of hospitalization based on the NIPS scale

vs. 3.0 points (Me=5; Q1–Q3: 4–6 vs. Me=3; Q1–Q3: 2–4), while on the 7th day, removal of an arterial line – 5.0 points vs. 2.0 points (Me=5; Q1–Q3: 5–5 vs. Me=2; Q1–Q3: 2–2).

Nursing activities exposing newborns to traumatic touch

During the 1st day of hospitalization, the nursing team performed 479 procedures that exposed the children to traumatic touch (Me=47; Q1–Q3: 46–52). The most frequent tactile activities carried out on the 1st day of hospitalization were: repositioning of the pulse oximeter sensor (9 times), changing the position of the newborn (9 times), changing diapers (8 times), and putting on/changing the nCPAP mask (8 times). All newborns were subjected to anthropometric measurements and body toilet once. On two occasions a nurse performed a physical examination in response to a change in the condition of two newborns.

On the 7th day of hospitalization, the nursing team performed a total of 378 procedures that exposed the children to traumatic touch (Me=38; Q1–Q3: 36–40) – 101 less than on the 1st day. The tactile activities performed most often on the 7th day of

hospitalization included: changing the position of the newborn (9 times), repositioning the pulse oximeter sensor (8 times), and changing diapers (8 times). On the 7th day of hospitalization, the body weight was taken and toilet was done once a day, one patient had a nCPAP mask changed. In addition, nCPAP therapy ended and the treatment with HFNC (High-flow nasal cannula) was initiated. Four newborns required additional physical examination performed by a nurse (Table 3).

Table 3. The number of nursing activities related to traumatic touch on the 1st and 7th days of hospitalization

Activities	Number of newborns exposed to traumatic touch		Number of activities related to traumatic touch				Total number of activities related to traumatic touch	
			Day shift		Night shift			
Day of hospitalization	**1**	**7**	**1**	**7**	**1**	**7**	**1**	**7**
Measurements of body weight	10	10	2	0	10	10	12	10
Changing dressings	0	7	0	4	0	7	0	11
Changing diapers	10	10	41	41	40	40	81	81
Bath	10	10	3	0	10	10	13	10
Feeding	10	10	27	32	25	24	52	56
Physical examination	2	4	1	4	1	0	2	4
Administration of drugs–IV	9	4	9	3	3	2	12	5
Putting on a nCPAP mask	10	1	40	1	38	0	78	1
Changing the pulse oximeter sensor	10	10	50	44	46	40	96	84
Change in the position newborn	10	10	51	50	41	40	92	90
Changing patches/ bandages	7	7	9	13	9	6	18	19
Other (washing the mouth/navel)	6	3	18	5	5	2	23	7
Total	**94**	**86**	**629**	**197**	**228**	**181**	**479**	**378**

Discussion

Key results

The hospitalization of preterm newborns is associated with their exposure to many traumatic factors, including pain and touch [15]. These, in turn, may lead to permanent and irreversible health and developmental consequences.

The results of our study show that care, nursing, and diagnostic procedures, as well as treatment, generated pain and traumatic touch in premature newborns with respiratory failure. The outcomes of this research are consistent with scientific reports from other authors [15–18].

Interpretation

In our study, the first day of hospitalization was the most active in nursing activities generating pain and exposing the newborn to touch. During this time, a group of 10 preterm newborns underwent a total of 541 traumatic nursing interventions. The first and subsequent days of hospitalization were full of traumatic activities, especially during the day shift. A similar, though a slightly lower number of procedures, were described in a study of preterm newborns with respiratory disorders treated at another center [19]. Even though the research covered a very similar group of children, differences in the results could have been influenced by different inclusion criteria, as well as different protocols for the care of these newborns used by each department. The results of a study conducted in the pediatric cardiology department evaluating a group of full-term newborns confirmed high exposure to traumatic factors, such as pain and procedural touch, in the study group especially during the first day of hospitalization [20].

During the 1st day of hospitalization, newborns underwent 62 activities likely to trigger pain. These mainly included admission procedures and related invasive procedures, such as collecting venous and/or capillary blood for diagnostic tests and peripheral vein cannulation. According to Carbajal [21], newborns admitted to the NICU undergo up to 10 pain-generating treatments per day, with pain relief often not considered. The results of our study confirm the reports of other authors who found the day of admitting a newborn to the ward was burdened with numerous traumatizing activities [16,18,22,23]. Preterm newborns with breathing disorders requiring respiratory support or mechanical ventilation deserve special attention. These methods expose children to toxic stress associated with intubation [24], removal of secretions from an endotracheal/nasopharyngeal tube, and the need to regularly collect blood samples for laboratory analysis to monitor the effectiveness of therapy [25].

In our study, the results obtained using the NIPS scale were higher in terms of pain intensity than those based on the CRIES scale. These differences may be a result of different parameters used to evaluate procedural pain. However, given the absence of universal guidelines on the use of pain assessment tools in newborns, it is necessary to conduct future research in this area to determine whether it is a permanent feature or an incidental result.

The levels of pain intensity evaluated using the NIPS scale during invasive procedures were comparable with the results presented by Cepuch et al. [20]. Both studies demonstrated that venous blood sampling and peripheral vessel cannulation generated the highest intensity of pain in newborns. On the other hand, according to the authors who used the CRIES scale to study a group of newborns with a heart defect, removal of secretions from the nasopharynx generated the most severe pain [20]. Rohan et al. showed [17,26] that the number of pain-generating procedures in newborns is significant, but the expression of pain may be limited. High daily exposure to pain-generating procedures in premature ventilated infants is rarely associated with elevated pain scores or analgesic administration [17]**.** According to the author, low pain scores obtained during regular reassessments do not correlate with fewer exposures to pain. Due to the low yield of clinical adjustments in care in this setting, the resources used in regular reassessments of newborns may need to be reconsidered. The discrepancies in the results of our study and the outcomes of the research conducted by Rohan et al. can be explained by different inclusion criteria and various research tools used for pain assessment (PIPP and N-PASS) [26]. The lack or limited expression of pain (verbally or behaviorally) by immature newborns may underestimate results, even though the exposure to invasive pain-generating procedures was significant. It seems it is particularly important to interpret the intensity level of pain in preterm newborns, to better use pharmacological and non-pharmacological methods of pain relief.

Therapeutic touch has a positive effect on a child's psychophysical development. It supports the development of the nervous system, cognitive functions, emotions, and social skills, as well as provides a sense of security, and calms the infant [27]. Touch can also be one of the methods of pain relief [28]. However, too intense and too frequent touching may induce toxic stress [13,28]. The "*minimal handling*" principle, which advocates for reducing the number of nursing and treatment activities and their consolidation, is used by medical staff caring for premature newborns [29]. Despite the introduction of this principle to neonatal intensive care units' practices, the number of activities generating touch on the first day of hospitalization was on average 48 per patient. Other reports have indicated a significant number of actions generating traumatic touch in newborns also occurs in wards of different specialties [19,20]. In our study, the touch was usually associated with changing a diaper, repositioning the pulse oximeter sensor, putting on the nCPAP mask, and changing the position of the baby. It is believed that given the immaturity of the newborns' nervous system and their need for continuous sleep [29]**,** all tactile and pain-generating activities destabilize the patient's condition [7, 29].

According to the American Pediatric Society and the Canadian Pediatric Society [30], standard pain management can improve the clinical and neurodevelopmental conditions of both full-term and premature infants [18,30]. Thus, we should call for the routine use of pain assessments utilizing standardized, objective research tools. Pain management ought to be based on the optimization of actions aimed at reducing and consolidating the number of invasive procedures. Because the expression of pain by immature neonates is incomplete, it is necessary to implement pharmacological, environmental, and/or behavioral pain relief measures prior to any invasive procedure by including the help of parents [31]. Consolidation and reductions in the number of procedures are associated with shorter hospitalization times and better long-term health and development results [32].

Generalisability

Practical implications

The results of our study can be used to improve nursing procedures, optimize the organization of care over newborns, and implement standardization in the area of pain management, using pain assessment and treatment with both non-pharmacological and pharmacological methods [33,34].

Study limitations

The authors aimed to direct medical staff's attention to the still-present problem of excessive exposure of premature babies to pain and touch on the first days of life. This is especially important for interdisciplinary teams working in pathology and neonatal intensive care units. The study included a small group of 10 newborns with respiratory failure. We have compared our results mainly to those reports using similar selection criteria for patients as our study. Due to the above limitations, the outcomes should be considered as an inspiration for further research in this area.

Conclusions

1. Preterm newborns with respiratory failure are exposed to a large number of procedures and actions considered traumatic.

2. The differences in the intensity level of pain obtained with available scales are due to the various parameters used by each scale, the individual reactions to pain, and the possible influence of the central nervous system immaturity.

3. In order to make the results of pain intensity more objective, it seems reasonable to use more than one scale to assess pain in newborns, though there are no universal recommendations at this time.

4. In preterm newborns, procedures commonly considered painful should be performed using pharmacological and non-pharmacological methods of analgesia, taking into account the limited ability to express pain by this group of patients.

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THE EFFICACY OF VIDEO COMPONENTS USED IN THE ONLINE EDUCATION OF HEALTHCARE STUDENTS

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ABSTRACT

Background: In healthcare education, practical learning and the application of knowledge are crucial for establishing professional skills and abilities. Throughout the COVID-19 pandemic, the practical form of education in medical schools faced great challenges, which resulted in the adoption of new digital teaching methods that allowed for distant learning. In our academic programs, video lessons were widely used and proved successful in terms of practical education. With the assistance of video materials and digital technologies, we were able to ensure a better visualization of resources and provide a space for developing professional habits and skills.

Aim of the study: To determine the extent to which this new e-learning process was effective with regards to gaining practical knowledge and how it was perceived by the students.

Material and methods: We carried out quantitative research among students who received both forms of education – in-person and online. Data was collected via a survey, where the students shared their views about the efficacy of the teaching methods on their practical education and their evaluations of the online learning. The results were based on the mathematical-statistical method.

Results: Overall, the students had a positive response towards the digital learning approach and 44% of them felt more motivated to study. Despite these findings, approximately three-quarters of the students (74%) believed that practical training should not be performed entirely via video materials.

Conclusions: The implementation of video components presents opportunities for practical training to be flexible, adaptive and stable given that the accompanying changes, challenges and problems are analyzed, comprehended, and solved.

KEYWORDS: practice, healthcare, online education, video

Background

Today, there are various educational methods and digital resources that enable students in the healthcare field to obtain, develop and improve their professional skills with the use of online courses and lectures. This view is also shared by other professionals. For example, Leisi Pei and Hongbin Wu, who carried out a similar study about online education in medical schools stated that "It has got its advantages and resources for improvement of the knowledge and skills of the students therefore it can be regarded as a potential method in the teaching in the college medical education as well" [1]. Efficient practical training is

of great importance in the education of healthcare experts. [2]. Over time, it's been undoubtedly proven that physical attendance and practical training are effective means of learning for healthcare professionals. Essentially, this well-established structure is stable; however, taking into account the changing conditions and thriving digital technologies, the need for modernization is inevitable. The development of practical skills through the use of interactive methods of study, such as interactive computer technologies (ICT), digital methods, simulation devices, roleplaying games, work on projects, etc. is ever more exigent [3]. Such modern methods play an important role in the education of healthcare professionals and allows them to be placed in situations closely related to real work environment, where they can be provoked into applying their knowledge and build problem solving skills in a professional setting. This 'novel' digital educational process requires the implementation of technical innovations in the healthcare field. The formation of a new of generation students is directly linked to the development of the digital world and the virtual assessment of practical skills, which separates current students from their predecessors. Based on this, the interactive methods of learning represent the next step in the upgrading of the current educational system [4].

Another key component in the education of the healthcare experts involves the establishment of professional habits and adequate actions in real-world situations. In the in-person form of education, there are already well-established models and methods to ensure this; however, it is unclear if this can be achieved in the online environment. Visualization of materials is one of the leading elements in the receipt of information. Studies have shown that when new information is provided, 10% of it is assimilated by hearing, 20% by vision, 40–50% with both senses, and up to 90% via active engagement and immediate participation in the educational process. In this aspect, interactive studying promotes understanding of the theoretical and practical value of newly acquired knowledge and skills [5]. Visualization is very important for practical learning, especially when it is aimed at the creation of new skills. When teaching practical exercises, the repetition of definite actions is used to form skills and habits according to a given standard. In this way, the knowledge is preserved, the professional skills are shaped, and a creative (not mechanical) comprehension of the material is achieved.

Teaching through instructive practice is crucial because of the great volume of theoretical knowledge used by medical specialists and because practical skills can only be developed via extensive training. This training is usually carried out in a specially equipped environment with models and mock-ups. Incorrectly formed practical skills, can have fatal consequences for patients [6]. Visualization, demonstration and the repetition of information are important methods used in face-to-face teaching, which assist with the formation of practical skills. The most suitable means of implementing these methods in an online environment is via video training or e-learning, where demonstrations can be visualized with video recordings or live streams to promote the teaching process and elicit feedback from students. The neuron network offers an innovative tool for analyzing online learning processes. It provides effective solutions for both data description and problem solving in relation to forecasting [7]. High- quality practical training is an element of the educational process that allows for the fast and effective professional development of students and ensures high standards in the healthcare industry.

Aim of the study

The purpose of the current study is to explore the views of healthcare students on the effectiveness of online practical learning via the use digital components, such as video recordings, video materials, and virtual conference calls. The students were taught in the Health Care Department at the Medical College of "Yordanka Filaretova" by experts in the fields of medical aesthetic care, radiology, and physiotherapy.

Materials and methods

Study design

To achieve the aim of the study, the following analyses were conducted:

1. Analysis of the participants based on the following demographic characteristics: degree, course, and age.
2. An evaluation of the students' opinions on the usefulness of video recordings, video materials and video conferencing as a means of acquiring knowledge and developing practical skills.
3. Analysis of the students' perceptions of the use of video materials for problem solving.
4. Comparison between the views of the students who were taught online and those who received in-person instruction.

Participants

The participants were 192 students from the specialties of medical aesthetic care, radiology, and physiotherapy.

Inclusion criteria

The basic criteria for the selection of the participants were: identical methods for practical training in the three specialties, and students from the 2nd and 3rd courses having participated in both forms of education (i.e., in-person and distance learning).

Exclusion criteria

The exclusion criterion was lack of a willingness to voluntarily participate in the study. The group of chosen students was based upon "accessibility" and the conclusions drawn are not representative for all college students.

Ethical considerations

The participants were informed about the principles and purpose of the study. Participation was voluntary and the responses were kept anonymous.

Data sources/measurements

A direct survey was administered at the end of the distance form of education in November 2020. The survey contains 24 open and closed form questions. Preliminary analysis of the answers to the closed questions clearly showed outlined opinions on the usefulness of the methods applied for learning via video materials and remedies for synchronous communications in real time (video-conference connection). The answers to the open questions only added to the student evaluations and did not contribute any additional informational value to the overall analysis. Thus, the responses the open questions were not analyzed in the present study.

Mathematical-statistical methods

The answers to the survey questions were on nominal, rank and ordinal scales, which allows for the use of Pearson's χ^2 tests and non-parametric tests for hypothesis testing (Kruskal–Wallis ANOVA and Mann–Whitney U tests, and contingency coefficients (C). The results were analyzed with the software package SPSS v.19. The significance level was set at α=0.05.

Results

Under the conditions of a continuous pandemic state, the education of students from the Medical College at the Medical University-Sofia was carried out at a distance. In view of the conditions, a teaching process known as the event-oriented design model was adopted for the web-based education. [8]. With the use of this model, the importance of the interrelationship between the teacher and the students is as equally valuable as in face-to-face instruction. This ensures an easier adaptation of the students to the teaching conditions, as, among other things, it creates the sensation of being a part of a team and increases the chances that the students will retain the study material. [9]. The characteristics of the distance teaching process required the application of methods and approaches for practical instruction that differ from those used for in-person learning.

Emphasis was placed on the use of various video components, such as films, recordings, video conferencing, etc. It should be noted that, in the distance form of instruction, the students had to rely on materials available at home. As such, the distance environment is different from the real educational environment, and the learning environment cannot be established equally for all students. This factor was taken into consideration at the time of assigning the tasks for self-instruction.

The main concerns in the current study were the assimilation of the practical material through video lessons, performing exercises via video conferencing, and self-instruction by video recordings of the required tasks.

In the instruction process, videos were presented that showed the performance of a practice exercise. There were several survey questions that evaluated the usefulness of such a an approach, including: "*Do you think that watching a video recording is a sufficient enough condition in order to acquire the necessary knowledge?*", "*To what extent watching video recordings contributes to the development of your practical skills (dexterity, organization and in-detail comprehension*", and "*In which cases the film is most useful for acquiring of the respective skills?*".

Distance education by means of video conferencing was also considered in the survey questions. The students were required to assess the usefulness of this method from an applicability point of view, and the impact on the development and enrichment of their knowledge.

The self-instruction via video recordings involved a process where the students were required to prepare and present to the teachers videos of the preparation and fulfilment of a previously assigned task. The survey questions also asked about the students' individual feelings regarding this form of learning. For example, students were asked "*Please, indicate as to the way you were feeling at the time of using the method for fulfilment of the assigned task*", and they were given the possibility of choosing among the fol-

lowing answers: *a) it is amusing to me, b) it is more of hard to me, c) it is boring to me, d) it is motivating,* and *e) other"*. There were also questions appraising the practical usefulness of the method, such as "*By preparing a video recording do you have an opportunity to additionally develop and enrich your knowledge and skills?*".

The preferences of the students for the distance vs. in-person forms of education were also considered in the survey with two questions. For example, "*Do you think that the practice materials replace in terms of usefulness the live performance of exercises (in a lab, study, auditorium)?*".

A total of 192 students from second and third year of education took part in the survey. 25.5% (n=49) of students were studying medical aesthetic care, 34.4% (n=66) radiology, and 40.1% (n=77) physiotherapy. The χ^2 test for one sample showed a statistically significant difference between the number of surveyed students from the different specialties (p=0.045).

The per cent ratio of the participants in the survey regarding the years of study did not show a statistically significant difference (p=0.083). 56.3% (n=108) of the surveyed students were in the second course and 43.8% (n=84) in the third course.

As for the age, the analysis indicated that the majority of the students fell into the age range of 18 to 30 years (76.6%, n=147). 14.1% (n=27) were aged between years 31 to 40 years, and 9.4% (n=18) were over 40. The χ^2 test for one sample showed that the numbers of students falling into the different age brackets was significantly different (p<0.001).

Video films aimed at exercising practical skills

In the process of instruction, videos were presented to the students that showed the performance of a practical exercise. The current study aimed appraise the opinion of the students on the practical usefulness of such a method of teaching. All of the 192 students answered the question: "*Do you assume that watching video films is an adequate condition to acquire the necessary skills?*". Sixty-three per cent of the students declared that it is not an adequate way to acquire the needed skills.

The students were also asked "*To what extent video film watching contributes to the development of your practical skills (dexterity, organization and in-detail knowledge?*" Answers were provided on a scale from 1 to 6, where 1 means minimum and 6 maximum usefulness. 21.4% of the 192 students rated this teaching method with a low degree of usefulness (rated between 1 and 2), 61.5% rated this method between 3 and 4 (medium high mark), and 17.2 % evaluated the method as having a high usefulness (between 5 and 6). It can be concluded from obtained results that the development of practical skills, such as dexterity, organization, and detailed knowledge, can be achieved by watching video films with an approximately medium-high degree of success. The question of whether the opinions of the students from the three specialties differ significantly is also of interest. The Kruskal–Wallis ANOVA showed that there was a statistically significant difference between the opinions of the students from the three specialties (p=0.002). In order to establish between which specialties the opinions differ, the Mann–Whitney U test was used, and the results are presented in Table 1.

Table 1. Opinion of the students from the three specialties about video films aimed at exercising practical skills

No	Specialties	Medium ranking (%)	Mann–Whitney U p-value
1	**Medical aesthetic care**	**76.56**	**0.001 (p<0.05)**
	Physiotherapy	**55.19**	
2	**Medical aesthetic care**	**65.81**	**0.023 (p<0.05)**
	Radiology	**52.20**	
3	Physiotherapy	67.03	0.110 (p>0.05)
	Radiology	77.80	

The analysis shows that the opinion (medium or high degree of usefulness) of the students from the medical aesthetic care specialty differs considerably from their colleagues in the other specialties. They share a similar opinion about the degree of usefulness of the method of instruction and its capability for development of their practical skills (nearly a medium degree of usefulness).

All 192 students answered the question "*Do you have the opportunity to additionally enrich and develop your knowledge and skills by watching video films?*" Analysis of the data showed that 39.1% thought that this method gives them a chance to enrich and additionally develop their knowledge and skills, and 45.8% thought that it gives them a chance to some extent. The distribution of the same students is rather impressive when answering the question "*Do you think that video film watching is a condition good enough so that you could acquire the needed skills?*". The proportion were of students replying negatively to this question were 68.3% for medical aesthetic care, 66.7% for physiotherapy, and 50% radiology. This gives us grounds to assume that video film watching allows for the students to enrich and develop already acquired practical skills but not to create new ones.

The students were also asked "*In which cases is the video film most useful for acquiring the corresponding skills?*" All of the 192 students answered this question. 70.5% of all answers gave the opinion that the video film is most useful for acquiring the corresponding skills at the time of exercise with explanations on

the part of the teacher and after a performed exercise for revising the procedure. 42.6% of the answers indicated that video films were useful as an ancillary material and a means for self-preparing prior to the exercise in the lab.

Video recording for the purpose for self-instruction

In the process of their education, the students were required to prepare video material for the self-instruction and fulfilment of a given task. The aim of the current analysis was to assess the opinions of the students regarding the practical usefulness of this method of learning.

All 192 students answered the question "*Do you think that the method is useful for the better understanding and assimilating of the study material?*". 45.3% of the participants responded affirmatively, 26% could not give an appraisal, and 28.6% claimed that it is not an adequate condition for assimilating the material studied. Kruskal–Wallis ANOVA showed a statistically significant difference between the opinions of the students from the three specialties ($p=0.036$). The respondents from medical aesthetic care had the highest percentage of positive answers (~ 90%), while, in the other two specialties, the answers were approximately equally divided between affirmative and negative answers (35.1% and 40.3% for physiotherapy), and between positive and those who could not make an appraisal (45.5% and 34.8% for radiology).

For the question "*To what extent does the method contribute for the development of your practical skills?*", the students were given the opportunity to answer on a scale from 1 to 6 (where 1 means minimum and 6 maximum usefulness). 24.5% of the surveyed students (192 respondents) rated this method of instruction as one with a low degree of usefulness for the development of their practical skills (marks 1 and 2), 55.2% rated this method between 3 and 4 (medium-high mark), and 20.4% between 5 and 6. From the obtained results it can be concluded that the development of practical skills can be achieved by means of preparing a video recording with an approximately medium-high degree of success.

The question about how students from the three specialties rated the usefulness of this method is also of interest. The results from the multi-measure frequency analysis showed that 80.4% of the respondents from medical aesthetic care rated the usefulness of this method as medium high to high, 62.6% of students from physiotherapy rated the usefulness as medium-high, and 61.9% of students from radiology rated the usefulness from poor to medium high.

As for the question "*By preparing a video recording do you have chance to additionally enrich and develop your knowledge and skills?*", 91.5% of the students from all three specialties declared that this method of education allowed them to enrich their knowledge and skills to a certain extent (95.1% from medical aesthetic care, 87.6% from physiotherapy, and 85.7% from radiology).

In order to establish how this method influenced the emotional state of the students, they were asked to do the following: "*Point out the way you feel at the time when using the method for performing the assigned task*." All 192 students provided answers. Students generally felt three types of sensations at the time of preparing a video clip for self-instruction: "*difficulty*" 35.9%, "*motivation*" 29.7%, and "*amusement*" 22.9%.

The question as to how much the feeling caused by using the method is linked to the way the students rate its usefulness is of interest to the present analysis. 43.7% of the surveyed students who thought that the use of video recording for self-instruction is useful for better comprehension and assimilation of the studied material also felt motivated during the time of its usage. The percentage of those who approved of the usefulness of the method and felt amused at the same time was also high (33.3%). 56.4% of the respondents who did not find the method to be useful declared that they also experienced difficulties at the time of its implementation. An examination of the correlations between the answers to these two questions indicates a moderate relationship ($C=0.426$, $p=0.001$). The results from the χ^2 test showed that there is a statistically significant dependency between the answers to both questions ($p<0.001$).

Video conferencing

A practical exercise was carried out through video conferencing between the students and teacher as part of the instruction process. The purpose of this analysis was to assess the opinions of the students regarding the practical value of this method of learning.

All 192 students answered the question "*Do you think that the method is useful for the better comprehension and assimilation of the studied material?*" 54.7% of the students replied affirmatively, 18.2% could not make an assessment, and 27.1% declared that performing a practical exercise through a video conferencing is not good enough for acquiring the necessary skills.

The students were also asked "*To what extent does the method contribute to the development of your practical skills?*" and gave their answers on a scale from 1 to 6 (where 1 means minimum and 6 maximum usefulness). 22.4% of the 192 students rated this method of teaching with a low degree of usefulness (marks 1 and 2), 49.4% rated this method between 3 and 4

(medium-high estimate), and 28.2% between 5 and 6 (a high degree of usefulness). Thus, the conclusion can be drawn that the development of practical skills can be achieved via video conferencing with an approximately high degree of success.

The question of whether the opinions of the students from the three specialties differed substantially deserves special attention. The Kruskal–Wallis ANOVA showed a statistically significant difference between the three groups of students. In order to establish which specialties differ significantly, the nonparametric Mann–Whitney U test was applied, and the results are presented in Table 2.

Table 2. Opinion of the students about the use of video conferencing to carry out a practical exercise

No	Specialty	Medium ranking (%)	Mann–Whitney U p-value
1	**Medical aesthetic care**	**75.66**	**0.002 (p<0.05)**
	Physiotherapy	**55.76**	
2	Medical aesthetic care	58.82	0.816 (p>0.05)
	Radiology	57.39	
3	**Physiotherapy**	**62.12**	**0.002 (p<0.05)**
	Radiology	**83.52**	

The analysis of the results shows that the opinions of the students from the three specialties differ substantially from one another. The students from medical aesthetic care and radiology thought that the usefulness of video conferencing for the development of practical skills ranged from small to medium-high, and their colleagues from physiotherapy rated the usefulness of the this method as medium-high.

The students were also asked "*Does the effectuation of an exercise by a video connection render the possibility for an ancillary enrichment and development of your knowledge and skills?*". All 192 students supplied answers. Analysis of the data shows that performing an exercise through video conferencing did enrich and develop their knowledge and skills (35.4%), while 45.3% thought that this was only possible to a certain extent.

It was also important for us to understand how and in what way the method produced an impact on their emotional state. Thus, the students were asked "*Point out the way you feel when using the method for performing an* exercise". 191 students gave answers. It was found that the students from the three specialties mainly felt three types of sensations at the time of using the method: "*difficulty*" 29.8%, "*motivation*" 30.9%, and "*amusement*" 20.9%.

Of interest for the present analysis is the question as to what extent the feeling caused by the use of the method is related to how the students rated its usefulness. 44.8% of the students who thought that doing a practical exercise by means of video conferencing is a useful method also felt motivated at the time of its implementation. Of those who responded affirmatively to the question of its usefulness, 24.8% simultaneously got amused. 51.9% of the participants who did not find the method useful also declared that they experienced difficulties when using it. An examination of the correlations between the answers to these two questions showed a moderate relationship (C =0.423, p<0.001). The results from the χ^2 test showed that there is a statistically significant dependency between the answers to both questions (p<0.001).

Video components

To evaluate the usefulness of video components in practical education, several more questions were included to clarify the penchant of the students to use them.

After posing the question "*Do you think that the use of video components is a useful approach for the better build-up of practical skills?*", 181 students gave answers. A half of them (49.7%) thought that the use of video components is a fruitful approach for the development of practical skills. Approximately one-third did not approve of the method (34.3%), and 15.5% were unable to make a judgement.

Also of interest for the present analysis is the question of whether the opinions of the students from the three specialties about the use of video components differed substantially. The Kruskal–Wallis ANOVA showed a statistically significant difference between the students from the three specialties (p=0.001). In order to establish between which specialties the opinions differ, the Mann–Whitney U test was implemented, and the results are presented in Table 3.

Table 3. Opinion of the students about the usefulness of video components in practical education

No	Specialties	Medium rank (%)	Mann–Whitney U p-value
1	**Medical aesthetic care**	**46.64**	**0.000 (p<0.05)**
	Physiotherapy	**71.18**	
2	Medical aesthetic care	48.61	0.164 (p>0.05)
	Radiology	55.59	
3	Physiotherapy	73.29	0.06 (p>0.05)
	Radiology	60.98	

The analysis shows that the opinions of the students from the three specialties substantially differ from one another. The students from medical aesthetic care stated that the use of video components is a helpful approach for the acquisition of practical skills. The better part of the participants from physiotherapy thought that they could not acquire practical skills this

way. The participants from radiology generally shared the opinion of their colleagues from medical aesthetic care, but the percentage of those who could not make a judgement was relatively high as compared to their colleagues from the other specialties.

The students were asked to rate on a scale from 1–6 "*To what extent can video materials replace in terms of being useful the performance of live exercises (in a lab, studio, auditorium)?*", with 1 meaning minimum and 6 maximum. 181 students supplied answers. 51.3% of the students stated that the usefulness of video materials compared to the in-person performance of the exercises is low (marks 1 and 2). Over one-third rated the usefulness as medium-high (marks 3 and 4), and only 10% as high (marks 5 and 6).

The student were also posed with the question "*Do you think that the practical education can be entirely carried out via video materials?*". 181 students gave answers. Approximately three-quarters of the students (74%) indicated that practical training cannot be carried out entirely using video materials. 15.5% found it possible, but only to a certain extent. 8.3% answered affirmatively and 2.2% were unsure in their judgement. These results show that, as a whole, the opinions of the students from all three specialties is similar. The only exception is the relatively high percentage (29.3%) of students from radiology who answered "*To some* extent". This was also confirmed by a Kruskal–Wallis ANOVA, which showed a statistically significant difference among the students from the three specialties (p=0.003). The analysis of the results showed that the opinion of the students from radiology substantially differed from that of the students from the other specialties. The difference is due to the relatively high percentage of students assuming that practical education can to some extent be carried out entirely by means of video materials. This, however, does not change the fact that, like their colleagues, the students from radiology also accept that this method cannot replace live practical instruction.

Discussion

One of the great challenges in modern times is the large scale insertion of new information and communication technologies (IT) into all aspects of social life, as well as in education. The IT sector offers a variety of methods and remedies that provide new opportunities for higher education. These technologies allow for the teaching process to be organized in a way that can take into account the individual needs of students, and that promotes the development of important digital competences necessary for our "knowledge based" economy [10].

The use of video components in the education process has also encouraged the development of active learning methods where the student plays the central role and the teacher is more of a partner in problem solving [11]. The variations in the preparation of lessons using the Cloudy medium are innumerable, depending upon the goals of the teacher, the level of the students, and the materials taught [12]. In this aspect, the use of video materials in various types and forms can help with the instruction of health experts, even in the development of practical skills. Colleagues investigating the web-based education of nurses in clinical practice have arrived at the same conclusion. According to these authors, the addition of visual-based materials to web-based teaching effectively helps in the education process as it can be used to reduce the differences between theory and practice, and to upgrade the knowledge of already qualified nurses [13].

Key results

The current results show a generally positive attitude on the part of students regarding the use of video components in practical education. For example, 61.5% of the students rated the usefulness of carrying out an exercise via a video recording as medium-high. In their opinion, the development of practical skills can be helped by watching video recordings as the students rated this teaching method at a medium degree of usefulness. These results show that the implementation of video lessons should be emphasized when developing instructive methods.

The results concerning the suitability of self-instruction by video recordings show that 43.7% of the students thought that this method was useful for improving comprehension and assimilation of the studied material, and they felt motivated at the time of its use. Taking into account the creative nature of the method, it has been shown that positive emotional memory leads also to a better assimilation of course material [14].

As for carrying out practical education by video conferencing, 49.4% of the students rated the value of this method of learning as medium-high. 44.8% of the students also felt motivated at the time of its application, but 51.9% of the students did not find it useful and they experienced difficulty with it. An analysis of the relationship between improvements in the material and the technical basis and the employment of interactive methods for instruction shows that it can positively influence the motivation of students to study [15]. This suggests that the method of teaching needs improvement in order to raise its usefulness as well.

Professional education involves a complex combination of intellectual and practical activities that mutually potentiate one another to accomplish the essence of a "professional qualification." Expansion of the students' potential and their self-affirmation as professionals at the time of instruction represents a challenge to the modern system of education, but it also provides an opportunity to ensure a suitably educated staff in the continuously developing field of healthcare.

Conclusions

One of the most important steps in the modernization of higher education is the introduction of innovative forms and methods of instruction that increase the activity of the students and their motivation to obtain a high-quality professional education. The methods of interactive instruction do not replace didactic learning, but only add to what is already known and they allow for more precision in the systems of instruction.

The current results indicate the positive attitudes of students regarding the use of video components as an ancillary method in practical education. However, half (51.3%) of the participants stated that the usefulness of video materials compared to in-person learning is low, while approximately three-quarters of the students (74%) thought that practical education cannot be entirely accomplished by only using video materials.

In conclusion, it can be stated that the implementation of video components enriches and contributes to the development of practical skills, but it is not suitable as a basic form of practical education. Their introduction presents opportunities for practical training to be flexible, adaptive and stable in its development when the accompanying changes, challenges and problems are analyzed, comprehended and solved.

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WEDGE RESECTION OR ENUCLEATION IN PULMONARY HAMARTOMA?

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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: Wedge resection and enucleation are the most commonly preferred surgical modalities for the treatment of pulmonary hamartomas. There is a concern about the safety and efficacy of enucleation for a pulmonary hamartoma.

Aim of the study: To compare wedge resection and enucleation for the surgical treatment of pulmonary hamartomas.

Material and methods: We retrospectively analyzed the data from patients who were surgically diagnosed with pulmonary hamartoma between January 2014 and December 2019. We obtained data on clinical findings, radiological features, surgical modality, postoperative complications, and follow-up results from the hospital electronic database. We compared all these features in the patients who underwent wedge resection with those who received enucleation.

Results: A total of 18 patients with pulmonary hamartoma were analyzed. The mean age of the patients was 60.56±9.25 years and 10 (55.6%) were male. Twelve (66.7%) patients had no respiratory symptoms. Ten (55.6%) of the patients underwent wedge resection and 8 (54.4%) patients had enucleation. There were no significant differences in age, gender, symptom distribution, prolonged air leakage, hospital stay length, intensive care unit stay length, mortality, or relapse rate between the patients with wedge resection and enucleation. Nodule size, calcification, metabolic activity, central or peripheral location, and lobar distribution were also similar.

Conclusions: We observed that there were no significant differences in the postoperative complications, hospital stay length, mortality or relapse between the patients with wedge resection and enucleation. Minimal parenchymal damage and resection should be the aim of surgical interventions for benign lung diseases. Therefore, we believe that enucleation should be the first choice for the surgical treatment pulmonary hamartomas.

KEYWORDS: hamartoma, wedge, enucleation

Background

Hamartoma is a kind of malformation composed of an unorganized combination of different tissues like cartilage, adipose tissue, smooth muscle, and respiratory epithelial cells [1,2]. Congenital malformations, hyperplasia of normal structures, benign tumors of the cartilage, and responses to inflammation are some of the proposed etiologies [1]. However, the exact etiology and pathogenesis is unknown. Patients are usually asymptomatic and cases are often detected on routine lung scans [3]. Tru-cut or fine-needle aspiration biopsy may be enough for treatment in cases with compatible radiological and clinical findings. However, surgery is inevitable in symptomatic cases or if malignancy cannot be ruled out.

Wedge resection and enucleation are the most commonly preferred surgical modalities for the treatment of hamartomas. There is a concern about the safety and efficacy of enucleation of a pulmonary

hamartoma. The amount and duration of air leakage in enucleation may be higher due to cutting of the lung parenchyma and suturing it afterward. Moreover, recurrence may occur as the safety margin is not clear and residual cells may cause relapse. On the other hand, the main target in surgery for benign lung diseases should be the minimal resection that preserves the most lung tissue. Enucleation may be better than wedge resection in this regard. Which of these two methods should be prioritized is currently uncertain.

Aim of the study

The aim of this study is to compare wedge resection and enucleation for the surgical treatment of pulmonary hamartomas.

Material and methods

Study design

This is a retrospective, single-center study. In this study, we included patients with pulmonary hamartoma diagnosed surgically in our hospital between January 2015 and December 2019.

Setting

We obtained the data about clinical features (age, gender, symptom distribution), radiological findings (nodule diameter, location, calcifications, metabolic activity), surgical procedures, postoperative complications (prolonged air leak, hospital stay length, intensive care unit [ICU] stay length, mortality) from the hospital electronic database.

Data sources/measurement

We compared enucleation with wedge resection in terms of postoperative complications, hospital stay length, ICU stay length, mortality, and long-term recurrence.

We received ethical approval for the study from the Akdeniz University Faculty of Medicine Clinical Research Ethics Committee (decision no: KAEK-448, date: 23.06.2021). We conducted the study under the principles of the Declaration of Helsinki.

Statistical methods

The collected data were entered into IBM SPSS v. 23 and all statistical analyses were performed with this program. Continuous variables were expressed as standard deviations, means, and minimum and maximum values, and categorical variables were expressed as percentages and frequencies. For comparisons between groups, the chi-squared test was used for categorical variables, the Student's t-test for parametric variables, and the Mann–Whitney U test for nonparametric variables. The relationships between the parameters were determined by Pearson's correlation analysis. A p-value of <0.05 was considered statistically significant.

Results

Descriptive data

The data from 18 patients with hamartoma who underwent surgical intervention were analyzed. The mean age of the patients was 60.56±9.25 years and 10 (55.6%) were male (Table 1).

Table 1. The characteristics of the study group

Variables		Total (n=18)
Age (years)		60.56±9.25
Gender	Female	8
	Male	10
Symptoms	Asymptomatic	12
	Symptomatic	6
	Cough	6
	Sputum	4
	Chest pain	2
Characteristic Calcification	Yes	3
	No	15
Nodule diameter [mm]		16.94±3.56
Hospital stay [days]		5.28±2.23
Localization	Peripheral	14
	Central	4
	Left lower lobe	4
	Left upper lobe	3
	Right lower lobe	5
	Right middle lobe	1
	Right upper lobe	4
Follow-up time [months]		34.39±12.05
SUV max		2.12±0.81

n – number; mm – millimeters; SUV max – maximal standardized uptake value.

There were no respiratory symptoms in 66.7% (n=12) of the patients. All of these patients were detected incidentally during radiological evaluation for another reason. The most frequent symptoms in symptomatic patients were cough (33.3%, n=6) and

sputum (22.2%, n=4). Fifteen (83.3%) patients did not have characteristic calcifications. In 77.8% (n=14) of patients, the hamartoma was located peripherally. Considering the lobar distribution, the right lower lobe (27.8%, n=5) was the most common localization. The mean nodule diameter was 16.94±3.56 mm. Wedge resection was performed in 55.6% (n=10) of patients and enucleation was performed in 44.4% (n=8).

There were no significant differences in age, gender, and symptom distribution between the patients who underwent wedge resection and those who underwent enucleation (Table 2).

Table 2. The comparison of enucleation and wedge resection.

Variables		Wedge (n=10)	Enucleatıon (n=8)	p
Age (year)		59.40±11.46	62.00±4.97	0.293
Gender	Female	6	2	0.313
	Male	4	6	
Symptoms	Asymptomatıc	6	6	0.866
	Symptomatıc	4	2	
	Cough	4	2	0.502
	Sputum	4	0	0.092
	Chest paın	2	0	0.473
Characterıstıc Calcification	Yes	2	1	0.832
	No	8	7	
Nodule dıameter [mm]		16.50±3.20	17.50±3.90	0.294
Hospıtal stay [day]		5.80±2.60	4.62±1.98	0.203
Localızatıon	Perıpheral	8	6	0.752
	Central	2	2	
	Left lower lobe	2	2	0.752
	Left upper lobe	2	1	0.834
	Rıght lower lobe	4	1	0.444
	Rıght mıddle lobe	1	0	0.943
	Rıght upper lobe	1	3	0.752
Follow-up tıme [months]		34.8±9.91	33.88±14.68	0.444
SUV max		2.06±0.59	2.17±0.98	0.266

n – number; mm – millimeters; SUV max – maximal standardized uptake value.

Nodule size, calcification, metabolic activity, location, and lobar distribution were also similar. There were no significant differences in prolonged air leakage, hospital stay length, ICU stay length, and mortality between the patients who underwent wedge resection and those who underwent enucleation. The mean follow-up time was 34.8±9.91 months in the patients who underwent wedge resection and 33.88±14.68 months in the patients who underwent enucleation. No recurrence occurred during the follow-up in both groups.

Discussion

Key results

Wedge resection and enucleation are the main surgical treatment modalities for pulmonary hamartomas. In this study, we found that there were no significant differences in prolonged air leakage, hospital stay length, ICU stay length, mortality and relapse between wedge resection and enucleation. We suggest that enucleation is as effective and as safe as wedge resection in the surgical treatment of pulmonary hamartomas. Therefore, enucleation can be prioritized for functional lung tissue preservation.

Hamartoma, which was first described by the German pathologist Eugen Albrecht in 1904, is a malformation that results from the disorganized proliferation of at least two mature mesenchymal tissues. The name is derived from the Greek word hamartia meaning faulty and is used in this instance to refer to faulty tissue development [4]. Hamartomas can be seen in many different parts of the body, but one of the most common sites is the lung. Pulmonary hamartoma is also the most common benign tumor of the lung. It is more common in men and usually develops between the ages of 30 and 60 years [5]. The mean age of the patients in our study was 60.56±9.25 years, and our youngest patient was 36 years old, while the oldest was 76 years old. Often patients with hamartomas are asymptomatic and are identified on lung screening [3]. Similarly, about two-thirds of our patients were asymptomatic and the most common complaints of the symptomatic patients were cough and sputum.

Pulmonary hamartoma usually presents as a solitary pulmonary nodule, smaller than 3 cm in diameter. However, it can also be in the form of diffuse lesions, starting from the endobronchial tree and spreading to the pulmonary parenchyma [3,6]. In our study, they were all in the form of solitary nodules. The mean diameter was 16.94±3.56 mm, with the smallest nodule being 11 mm in diameter and the largest 24 mm. Some pulmonary hamartomas may grow, but this growth generally tends to be very slow. Some studies have reported that there is a relationship between lesion diameter and patient age. However, in our study, we did not find a relationship between nodule size and age.

Besides being solitary, the pulmonary hamartoma is typically smooth-circumscribed or slightly

lobulated [7]. Fat within the nodule is diagnostic, but this finding is found in only half of the patients. Popcorn or comma-shaped calcification is pathognomonic, but they are only present in 5–50% of the patients [8,9]. A previous study found no hamartomas with popcorn calcifications and the authors suggested that these calcifications could not be considered characteristic for hamartoma [10]. There was no fat density or popcorn calcification in any of our patients either.

Pulmonary hamartoma is usually located in the periphery of the lungs [11–14]. In our study, we found that the right lower lobe was the most common localization, but there was no significant difference between being in the right lung and left lung. In our study, they were mostly located in the periphery of the lung.

The presence of popcorn calcification and a high-density outer margin with lobulation may be enough for the radiological diagnosis of pulmonary hamartoma [15]. However, 20–30% of lung cancers present as a solitary pulmonary nodule. Moreover, some pulmonary hamartomas does not show typical radiological features. Thus, it may be impossible to differentiate them from primary or metastatic lung cancer without tissue sampling. A percutaneous biopsy is preferred for cytological evaluation in such cases. The positive predictive value of cytology in diagnosis is about 85%. However, it should be kept in mind that cytological diagnosis can be reliable only if the diagnosis is supported by radiological and clinical findings [16]. It should be noted that up to 22% of false-positive cytological results occur in carcinoid tumors, adenocarcinomas, or small cell carcinomas [17].

Pulmonary hamartoma generally does not cause mortality or morbidity unless they grow to a large extent or they are localized in the bronchi. In these cases, they can cause a mass effect and obstructive pneumonia or atelectasis [18]. As pulmonary hamartoma is benign and grows slowly, they are suggested to be followed without any need for surgery in cases with a definitive diagnosis without surgery [19]. However, in symptomatic cases or if malignancy cannot be ruled out, a surgical procedure is inevitable for both diagnosis and treatment.

The definitive curative treatment for pulmonary hamartoma is absolutely surgery. Lobectomy, and rarely pneumonectomy, may be necessary if they are localized in the deep parts of the lobe, if the distal lung tissue is non-functional or if they are multiple and giant [18,20]. In other cases, wedge resection or mass enucleation is preferred to protect the lung [21]. Minimal parenchymal damage and resection are recommended in the surgery of benign diseases detected in the lung. Enucleation in pulmonary hamartoma is a surgical modality that can decrease lung parenchymal loss when compared to wedge resection. In our study, we did not find a statistically significant difference between enucleation and wedge resection in the length of hospital stay, need for intensive care, postoperative air-leakage, mortality, and recurrence in long-term follow-up. Enucleation seems to be safe and effective in the surgical treatment of pulmonary hamartomas. Thus, it should the first choice among the surgical modalities for pulmonary hamartoma management in order to prevent lung parenchymal loss as much as possible.

Limitations

This study has several limitations. It is a single-center study and a limited number of cases were analyzed. Our follow-up period was 3 years on average, but pulmonary hamartomas grow very slowly. Thus, the follow-up period in our study may not be enough to rule out recurrence.

Conclusions

In conclusion, the main goal in the surgical treatment of pulmonary hamartoma should be the preservation of functional lung tissue as much as possible. Enucleation should be the first choice among surgical modalities. This procedure is as effective and as safe as wedge resection and, moreover, it is better than wedge resection in preserving lung parenchymal loss.

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THE EFFECTIVENESS OF GREEN TEA AND SONOPHORESIS ON OILY SKIN: 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: Oily skin can be extremely problematic for sufferersand presents a great challenge for cosmetologists. This condition is characterized by an excessive amount of sebum on epidermal surface and enlarged skin pores.Modern cosmetology is able to offer a wide range of treatments that are able to reduce excess sebum secretion, and an appropriate diagnosis and cosmetic interview will allow for the selection of a suitable cosmetic treatment. If there are no contraindications for device treatments and the client is not allergic to cosmetic products, an ultrasound treatment called sonophoresis may be used. Green tea is obtained from both the leaves and buds of the *Camellia sinensis* plant. The active ingredients of green tea are polyphenols, which have antimicrobial, anti-inflammatory, and antineoplastic properties. Thanks to modern cosmetic devices, we are able to use green tea and sonophoresis to introduce this preparation into the skin.

Aim of the study: The aim of this study was to evaluate the effectiveness of a sonophoresis treatment on oily skin in a 20-year-old female.

Case report: The participant reported issues with too much sebum on the epidermis. The sebum level was measured before and after a series ofsonophoresistreatments using a sebumeter (DermaUnitSCC3). For the treatment, an ultrasound device and a cosmetic ampoule containing green tea extract were used. The entire cosmetic procedure consisted of 4 treatments performed at weekly intervals.

Conclusions: After the series of cosmetological treatments, there was a significant reduction in sebum secretion.Thus, the use ofsonophoresis and a green tea ampoule turned out to be a great help in reducing epidermal sebum. The participant also noticed that her skin had less sheenfollowing the series of treatments.The resultsindicate that the sonophoresis procedure is safe and effective.

KEYWORDS: sonophoresis, oily skin, sebumeter

Background

The problem of excessive sebum production begins in adolescence and can also be a problem in adulthood. It is a distinctive feature of oily skin, which is characterized by a "shining" of the skin and enlarged pores, most often in the T-zone (forehead, nose, and chin).Sebum is an oily material that is produced in the sebaceous glands. It is a mixture of triglycerides, wax esters, squalene and cholesterol esters. High levelsof sebum can be present on the face (forehead, nose, chin), and also on the shoulders and back. We know that a normal amount of sebum has a protective function, but too much can cause anincrease in acne. Thus, maintaining a normal level of sebum is very important forthe human body, and we shouldn't

reduce it too much withcosmetological procedures [1].Care for this type of skin is a great challenge for a cosmetologist, which is why apparatus treatments combined with cosmetics that contain active ingredients with sebum-regulating effects are increasingly used. An ingredient that has found a very good use in cosmetology is green tea,as it hasantimicrobial, anti-inflammatory, antioxidant, and antineoplastic properties [2,3].

Many cosmetological treatments can be used to effectively reduce the sebum discharged from sebaceous glands. Among the most popular are fruit acids. Chilicka et al. conducted research on the effects of azaleic and pyruvic acid on a group of 120 people. They showed that both acids had a positive effect on the reduction of sebum on the surface of the epidermis[4].

Another relatively new procedure used in cosmetology is hydrogen purification. Chilicka et al. examined a group of 60 people (30 people suffering from acne vulgaris and 30 healthy people) and showed that the treatment significantly reduced sebum and skin eruptions that occur in the course of acne vulgaris [5].

An additional treatment that effectively reduces sebum is ultrasound; more precisely, the sonophoresis procedure, which promotes the movement of active substances in the cosmetic preparation into the skin. Ultrasound is an acoustic wave with vibration frequencies exceeding 20 kHz. The range of these frequencies is not audible to humans, but may be perceived by some animals [6].

In cosmetology, ultrasound with a frequency of 750 kHz–3 MHz and an intensity of 0.5–2.0 W/cm^2 is used mainly for tissue micromassage, which leads to local hyperemia and thus improves the functioning of the lymphatic system. Sonophoresis increases the absorption of substances contained in the cosmetic and activates cellular metabolism [7–10]. The active action of acoustic waves within the matter is based on the use of medium and high intensity ultrasound, which has an impact on biological, physical and chemical processes in tissues. The energy absorbed by tissues is converted into heat, which increases the kinetic energy of carbohydrates, lipids and proteins. The ultrasonic waves improve metabolism, contribute to faster healing processes, and they are used in liposuction (non-surgical), body shaping and anti-cellulite treatments [11–13]. The influence of ultrasound on the plasma membranes of erythrocytes induces functional changes that can increase their permeability. The ultrasound waves may also contribute to increasing the kinetic energy of the cosmetic ampoule particles used in the sonophoresis treatment [14]. Sonophoresis treatments can be used for various skin types, including vascular, oily, sensitive, aging, or dehydrated, as well as for acne vulgaris. The effects obtained after the treatment are caused by the impact of the ultrasound waves on the tissues, as well as the active substances used in the cosmetic preparation [15, 16].

Aim of the study

The purpose of this study was to assess the efficacy of sonophoresisfor decreasing sebum levels.

Materials and methods

Study design

This study was conducted in September 2020 at Opole University in Poland.The participant was informedthatshecould abandon the studyatanygiventime, she was alsoinformed of intention of thisstudy, and providedwritteninformedconsent. Thisstudy was approved by the Human ResearchEthicsCommittee at the Opole Medical School (KB/59/NOZ/2019), and is in line with the principles of the Declaration of Helsinki.

Settings

For the treatment, an ultrasound device and a cosmetic ampoule containing green tea extract were used. The entire cosmetic procedure consisted of 4 treatments performed at weekly intervals. Before the treatment, face make-up was removed using micellar fluid and the skin was toned. The ampoule was then combined with the ultrasound gelto increase lubricationduring the procedure, and it was applied to the entire face. The ultrasound power used in the procedure was 0.25 W/cm^2, and the time for insertion of the ampoule was programmed to 10 minutes.

Participant

The participant was a 20-year-old female who reported problems with excessive sebum secretion. The patient reported that she has been struggling with excess sebum (Fig. 1) since the age of 15, and, despite the use of many cosmetics, the problem always returned after some time.

The patient met the following inclusion criteria: aged 19–23 years, a sebum secretion level >200 μg/cm^2, no hormonal contraception, no other cosmetological treatments during the study, and no dietary supplements that could reduce sebum secretion (seboregulating function).

Figure 1. Forehead before the series of of green tea ampoule and sonophoresis treatment

Figure 2. Forehead after the the series of green tea ampoule and sonophoresis treatment

The exclusion criteria were as follows: pregnancy, lactation, active skin inflammation, fungal or bacterial skin diseases, recent surgical procedures in the treatment areas, active herpes, allergies to any of the components in the cosmetics, hormonal contraception, active rosacea, eczema, psoriasis, numerous telangiectasis, having a pacemaker, heart problems, implants (metal, silicone, saline), active tuberculosis, severe acne and propensity to keloids, or any other cosmetological treatment.

Data sources/measurements

The participant was diagnosed with too high a sebum level.Sebum measurement was performed with aDermaUnitSCC 3 sebumeter (Courage+Khazaka electronic GmbH, Germany) before a series of cosmetic treatments and 14 days after the last treatment. The patient was asked to remove make-up and not to apply any cosmetics the evening before the examinations, which were carried out in the morning hours. The temperature in the room where the examination took place was 22 degrees Celsius and the humidity was 40–50%. The participant was acclimated to the conditions for 20 minutes before each examination. The level of sebum was checked between the eyebrows and on the chin.

The patient was informed that during the treatment and two weeks after it other cosmetic procedures, applying new cosmetics, going to a swimmingpool or solarium, or supplementation with any substances reducing sebum were forbidden. It was recommended that she use only micellar fluids and moisturizing creams for homecare. Cosmetics with mattifying or sebum-regulating effects were also strongly contraindicated.

Results

After the series of sonophoresis with green tea extract, there was a reduced sebum level (Table 1). These measurements showed the improvement in the condition of the skin. The level of sebum went down between the eyebrows from240to 160 μg/cm^2, and on the chin from210 to120 μg/cm^2 (Fig. 2).

Table 1. Sebum levels before and after treatment

Area of measurement	Sebum level before the treatment [μg/cm^2]	Sebum level 14 days after the end of the last treatment [μg/cm^2]
Between the eyebrows	240	160
On the chin	210	120

These results show that the applied treatments are very helpful when it comes to oily skin. They reduce sebum secretion and, thus, the amount of sebum on the surface of the epidermis. This gives hope to people who struggle with excessive oily skin, which can lead to significant discomfort.

Thanks to the use of a sebumeter, we were able to objectively assess the amount of secreted sebum on the surface of the epidermis. Pre-treatment measurements showed that the skin was very oily. Following a series of sonophoresis treatments with a green tea ampoule, the amount of sebum was reduced to 160 μg/cm^2. Thanks to the use of the professional measuring equipment, we have shown that our treatment brought about the expected results.

Discussion

Keyresults

Sonophoresis treatmentsusing a cosmetic ampoule are useful for people with a high level of sebum on the skin.

Interpretation

A series of cosmetic treatments using sonophoresis and green tea ampoules contributed to a reduc-

tion in sebum on the surface of the participant's skin. Other studies have also shown the effectiveness of this plant for reducing sebum on the surface of the epidermis. For example, Mahmood et al. conducted studies on men aged 22–28 years and showed that the external application of green tea extract and lotus contributed to a reduction in sebum [17]. Similarly, Lu et al. used green tea in the form of cellulose capsules in people with acne vulgaris and showed that it reduced skin eruptions [18]. The use of green tea lotions has also shown good results in a study by Elsaie et al. In this study, there was a significant improvement in acne-prone skin after 6 weeks of using the preparation [19]. In 2010, Mahmood et al. used a 3% green tea gel on men with excess sebum production over a period of 8 weeks. It was reported that there was a significant reduction in sebum on the epidermal surface, thus demonstrating that this plant has a sebostaticeffect [20].

There are a number of cosmetic treatments that can positively reduce sebum and the amount of eruptions on the surface of the skin. Maciuszek-Malinowska et al. used a microdermabrasion treatment combined with cosmetic acids to reduce skin eruptions and excess sebum on the epidermal surface. The number of skin eruptions on the GAGS (Global Acne Grading System) scale was reduced from 20 to 14. There was also reduction in the amount of sebum on the surface of the epidermis between the eyebrows from206 to 98 μg/cm^2, on the chin from 178 to 112 μg/cm^2, on the right nose petal from 128 to 244 μg/cm^2, on the left nose petal from 225 to 158 μg/cm^2, on the right cheek from 183 to 114 μg/cm^2, and on the leftcheek from 213 to 146 μg/cm^2 [21].

To our knowledge, no other studieshave examined the impact of sonophoresis on oily or acne-prone skin. However, sonophoresis itself has been used to move other active substances into the epidermis. For example, Zasada et al. showed the effect of a combination of 0.3% and 0.5% retinol in a liquid crystal formula on a group of 16 healthy women. The treatment contributed to a reduction in sebum of the epidermal surface, and a reduction of erythema and hyperpigmentation of the skin [22]. Park et al. also used a combination of sonophoresis treatment withiontophoresis to improve the permeability of drugs through the stratum corneum.In addition, the enhanced effect of sonophoresishas been evaluated for various cosmeceutical drugs using a Franz diffusion cell [23]. Jung et al. examined the effects of ultrasound and heat on the percutaneous absorption of l-ascorbic acid. The combination of ultrasound- and heatsignificantly enhanced LAA (l-ascorbic acid) transdermal penetration when the treatment duration was sufficient [24].

Generalizability

Generalizing the effects of sonophoresis with green extract is currently difficult, as this is the first time this treatment has been described in literature. We hope that, in the future, it will be possible to discuss this treatment with other researchers. As expected, the synergy between the two treatments reduced epidermal sebum.

Study limitations

Our research results are promising; however, it would be useful to verify the effectiveness of this treatment in a larger sample of participants, and to include the male sex. The effect of cosmetics with the green tea applied externally in the sonophoresis treatment, which introduces the cosmetic deep into the skin, could also be compared. We would then get an answer to the question of whether the preparations applied externally work in the same way as those introduced with the use of ultrasound.

Recommendations

We recommend this treatment for people who have issues with too high a level of sebum.

Conclusions

The sonophoresis treatment with the use of cosmetic ampoules containing plant extracts is an effective treatment for people with oily skin. This treatment reduces the amount of sebum on the surface of the epidermis.

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STRESS ASSOCIATED WITH SARS-COV-2 IN MIDWIVES

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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: At the end of 2019, news circulated the world that a new, highly contagious coronavirus had emerged in China that caused severe disease in the respiratory tract. Subsequently, SARS-CoV-2 spread rapidly around the world. Healthcare professionals, including midwives, have been on the front lines of the fight against this disease, and their working conditions changed overnight, causing tremendous stress.

Aim of the study: The purpose of this study was to analyze stress among midwives in relation to the SARS-CoV-2 pandemic.

Material and methods: This study was conducted in 2020/2021 among 500 midwives. The testing method used was a diagnostic survey consisting of a self-compiled questionnaire. 444 midwives properly completed the survey and their results were analyzed.

Results: The study confirmed that the work of a midwife is stressful. More than half of those surveyed changed their attitude towards work when SARS-CoV-2 emerged. Midwives were also more likely to experience stress before going to work. Only a small percentage of the respondents had the opportunity to receive psychological help in the workplace.

Conclusions: The stress caused by the SARS-CoV-2 pandemic in the midwifery profession has had a negative impact on the psychophysical health of this occupational group. Thus, there is a dire need for workplace interventions for midwives to minimize the accompanying stress.

KEYWORDS: SARS-CoV-2, COVID-19, pandemic, midwife, stress, professional work

Background

At the end of 2019, the novel SARS-CoV-2 coronavirus, which can cause severe disease in the respiratory tract, emerged in Wuhan (China) and spread rapidly around the world. Since this virus was first identified, it has mutated several times. Its effects, both on health and the economy, are unpredictable. The rapid increase in the number of cases and deaths due to SARS-CoV-2 became the reason for announcing the pandemic in 2020 [1]. This situation caused the outbreak of many negative emotions among humanity, including uncertainty, fear and even panic. During this difficult time, healthcare professionals who have direct contact with infected patients have become the most vulnerable occupational group. This group includes midwives who are constantly exposed to stress in their careers. The pandemic has brought about yet another stressor that they have to face and learn to work with. Despite the tremendous efforts of scientists and rapid medical advances, fear of this virus is remains. There is still no effective drug to combat COVID-19 and prevent the complications that it can cause. The main step that has been taken

to reduce the infection rate and prevent the uncontrolled spread of SARS-CoV-2 is immunization. In Poland, vaccines were introduced by the Regulation of the Minister of Health of December 31 2020 on the COVID-19 prevention method (OJ 2021.10 as amended). The order of vaccination is also regulated in Sections 27 and 28 of the Council of Ministers of May 6 2021 on introducing certain restrictions, requisitions and prohibitions in relation to the state of the pandemic (Dz.U. /Journal of Laws/ 2021.861 as amended.) [2,3]. The scientific community argues that vaccination is the only way to gain control over SARS-CoV-2 and gradually return to a pre-pandemic way of life. Nevertheless, the positive effects depend to a great extent on mass vaccination – achieving an appropriate level of immunization in the general population – and therefore on the common sense, knowledge and decisions of each individual. Many people are extremely skeptical or even hostile towards vaccinations, mainly due to the plethora of often contradictory or unreliable information appearing in the media [4,5]. The information about successive waves and increasing numbers of cases, new symptoms, and the growing number of complications for which there is no effective treatments, intensify this fear [6].

Aim of the study

The purpose of this study was to assess the stress midwives are exposed to due to the ongoing COVID-19 pandemic.

Material and methods

Study design

This study was conducted in 2020–2021 in Poland both online and in-person at the Regional Hospital in Tarnobrzeg and the County Hospital in Nowa Dęba. Management approval was obtained from these hospitals to conduct the study. An attempt was made to investigate whether the COVID-19 pandemic has an impact on the intensity of stress experienced by midwives and what methods this group of healthcare professionals use to minimize this stress.

Participants

The group of respondents consisted of 500 midwives. The inclusion criteria were being a midwive working in a hospital or in primary health care during the COVID-19 pandemic and correctly completing the questionnaire. Completing the questionnaire was equivalent to obtaining consent for participation in the research. The study excluded midwives who completed the questionnaire incompletely or incorrectly. In total, 444 midwives properly completed the survey and their data were analyzed.

Data sources/measurement

The applied method for data collection was a self-compiled survey questionnaire that included 26 targeted questions. A five-point Likert scale was used to measure stress levels, where 1 indicated the lowest stress level and 5 indicated the highest stress level.

Ethical considerations

The study does not have the characteristics of a medical experiment. On the basis of Polish law and Good Clinical Practice, studies without participation do not require approval by a Bioethics Committee. The study was anonymous and voluntary, and the midwives were informed about the purpose of the study.

Statistical analyses

Statistical analysis of the collected material was performed using Statistica v. 13.1 software (StatSoft, Hamburg, Germany). Tests from the non-parametric test group were used for analysis. Choosing them was conditioned by the failure to meet the basic assumptions of parametric tests. The Wilcoxon rank-sum test (Z), Spearman's rank correlation coefficients (r), and Pearson's chi-squared test (χ^2) were used. The assumed level of statistical significance was $p<0.05$.

Results

Characteristics of the study group

Analysis of the socio-demographic data showed that most midwives were in the age range of 22–30 years and lived in cities. With regard to education and professional activities, the highest number midwives had a master's degree and work experience of up to 5 years. The most common place of work was a hospital with a second level of reference (35.4%, n=157) and in the delivery room department (Table 1).

Main results

The great majority of respondents (99.1%, n=440) shared the view that the job of a midwife is stressful,

Table 1. Characteristics of the study group

Socio-demographic data			n	%
Age		22–30 years old	176	39.6
		31–40 years old	93	20.9
		41–50 years old	100	22.5
		Over 50 years old	75	16.9
Place of residence		Village	132	27.7
		City	321	72.3
Education		Master's degree	249	56.1
		Bachelor's degree	161	36.3
		Vocational	34	7.7
Seniority		1–5 years	155	34.9
		6–10 years	62	14.0
		11–15 years	46	10.4
		16–20 years	43	9.7
		21–25 years	46	10.4
		Over 25 years	92	20.7
Place of work	Hospital	Delivery room	138	31.1
		Obstetrics ward	124	27.9
		Gynae ward	108	24.3
	Primary Care Physicians (PCP)	K Clinic	39	8.8

with 65.3% (n=290) claiming that they had an average level of resilience to stress. When asked about satisfaction with their jobs, the vast majority of respondents gave a positive answer, while about 12% (n=52) stated that they had doubts about whether it was a good career choice.

For more than half of the respondents (64.2%, n=285), their attitudes toward work changed due to the SARS-CoV-2 outbreak. The number of instances where midwives experienced stress at work increased significantly during the COVID-19 pandemic (Table 2).

Table 2. Comparisons of the frequency of perceived stress at work in the period before the SARS-CoV-2 outbreak and during the pandemic

Perceived stress at work	Before the SARS-CoV-2 outbreak		During the SARS-CoV-2 pandemic	
	n	%	n	%
Yes, before each shift	18	4.1	93	21.0
Very often	47	10.6	104	23.4
Often	63	14.2	99	22.3
Sometimes	153	34.5	106	23.9
Rarely	84	18.9	23	5.2
Very rarely	47	10.6	14	3.2
Never	19	4.3	5	1.1
Total	444	100.0	444	100.0
p	Z=13.77, p<0.001			

Z – Wilcoxon rank-sum test value.

As a result of the coronavirus pandemic, 92.1% (n=409) of the respondents were most concerned about infecting loved ones. Other concerns of the midwives included infecting themselves (43.9%, n=195), asymptomatic infection, possibility of infecting patients (46.2%, n=205), and time spent in quarantine (29.3%, n=130).

In midwives, the SARS-CoV-2 pandemic has also increased the use of unscheduled leave and sick leave after a stressful work period. Before the SARS-CoV-2 outbreak, about 6.1% (n=27) of respondents had decided to take unscheduled vacation or sick leave every now and then after a stressful work period. During the pandemic, this situation occurred in twice as many respondents (13.3%, n=59), and the difference was statistically significant (p=0.001; Table 3).

Table 3. Instances of unplanned vacation or sick leave after a stressful work period in midwives before the SARS-CoV-2 outbreak and during the pandemic

Instances of unscheduled leaves or sick leaves after a stressful work period	Before the SARS-CoV-2 outbreak		During the SARS-CoV-2 pandemic	
	n	%	n	%
Yes	27	6.1	59	13.3
No	417	93.9	385	86.7
Total	444	100.0	444	100.0
p	Z=3.47, p=0.001			

Z – Wilcoxon rank-sum test value.

When asked about contact with a patient suspected of having COVID-19, 90.8% (n=403) of respondents confirmed that they had experienced this in their workplace.

Based on the scale used to measure the intensity of stress, the following activities were rated the most stressful for midwives during their work: delivery in a patient with suspected COVID-19 or with symptoms of COVID-19 (4.21) and responsibility for the health and life of the patient (4.14). We also confirmed the presence of several negative relationships between the severity of stress associated with the performance of medical activities and job seniority in the surveyed midwives. The lower the seniority the midwives had, the higher the level of stress they perceived in relation to the possibility of administering the wrong dose of a medication (p=0.004, r=-0.14) and delivering a baby (p<0.001, r=-0.22; Table 4). In addition, a percentage of the participants (2.7%, n=12) admitted that they had experienced situations in which feelings of intense stress from SARS-CoV-2 infection caused them to leave their jobs.

As a result of constant, stressful work, the participants experienced a range of psychosomatic symptoms at a rate of 59.7% (n=265). Among the most frequently mentioned were anxiety or restlessness (62.8%,

Table 4. The correlations between job seniority and the stress caused by various medical activities and clinical situations in midwifery work

Variables	r	p
Responsibility for the health and life of a patient and job seniority	0.02	0.660
Possibility of administering the wrong dose of a medication and job seniority	–0.14	0.004
Delivering a baby and job seniority	–0.22	<0.001
Delivering a patient with suspected COVID-19 or symptoms of COVID-19 and job seniority	–0.06	0.227
Assisting in obstetrics and gynecology procedures and job seniority	–0.05	0.287
Providing assistance with obstetric and gynecological procedures on a patient with suspected COVID-19 or with symptoms of COVID-19 and job seniority	0.06	0.192
Taking care of a healthy newborn and job seniority	–0.06	0.175
Providing care to a newborn born to a mother with COVID-19 or suspected COVID-19 and job seniority	0.05	0.263

r – Spearman's rank correlation coefficient.

n=166), fatigue or body fatigue (59.5%, n=157), headaches (59.0%, n=156), irritability (54.3%, n =143), and sleep disturbances (55.2%, n=146). Further stated examples were weight loss, nervousness, nausea, weakened immunity, diarrhea, heart palpitations, lack of desire to work, fatigue, irritability, family conflicts, abdominal pains, decreased concentration, lack of appetite, lack of patience, lack of motivation, tearfulness, desire to change jobs, peptic ulcer disease, increased blood pressure, limited social contacts, unwillingness to work without adequate protection, swearing, explosiveness, excessive hair loss, and irregular menstrual cycles. When asked about ways to cope with stress, the respondents most often indicated talking to a loved one (60.4%, n=268), limiting watching, listening, and reading about COVID-19 (48.0%, n =215), watching movies (40.5%, n=180), and listening to music (37.4%, n=166). It was observed that any form of coping with stress was more likely to be undertaken by younger respondents (Table 5).

Table 5. Age vs. ways of coping with the stress caused by the threat of SARS-CoV-2 infection

Stress coping strategies	Up to 30 years old		Over 30 years old		p
	n	%	n	%	
Sport	37	21.0	45	16.8	$\chi^2(1)=1.26$, p=0.261
Using stimulants	14	8.0	23	8.6	$\chi^2(1)=0.05$, p=0.814
Talking to a loved one	121	68.8	147	54.9	$\chi^2(1)=8.58$, p=0.003
Listening to music	77	43.8	89	33.2	$\chi^2(1)=5.04$, p=0.025
Watching movies	81	46.0	99	36.9	$\chi^2(1)=3.63$, p=0.056
Shopping	35	19.9	42	15.7	$\chi^2(1)=1.31$, p=0.251
Crying	42	23.9	42	15.7	$\chi^2(1)=4.64$, p=0.031
Taking sedative drugs	15	8.5	35	13.1	$\chi^2(1)=2.18$, p=0.139
Limiting viewing, listening and reading on the COVID-19	86	48.9	127	47.4	$\chi^2(1)=0.09$, p=0.760
Using a psychologist's help	6	3.4	5	1.9	$\chi^2(1)=1.05$, p=0.306
Using relaxation methods	30	17.1	41	15.3	$\chi^2(1)=0.24$, p=0.623
Not employing any strategy	7	4.0	21	7.8	$\chi^2(1)=2.67$, p=0.102

χ^2 – Pearson's chi-squared test value.

Only 6.5% (n=29) of the respondents reported that professional activities to reduce stress levels due to the threat of SARS-CoV-2 infection were in place at their workplace. These included securing staff with personal protective equipment, limiting the number of patients admitted, conducting webinars on new guidelines for the management of the SARS-CoV-2 infected patient, the introduction of taking staff swabs, and the opportunity to have a conversation with the ward manager. These activities were perceived as effective by 65.5% (n=19) of the respondents. Opportunities for psychological support for medical staff were available at their workplace for 21.4% (n=95). There was no confirmed association between the referral level of the hospital where the midwives worked and access to psychological support (p=0.131). Regardless of where the respondents worked, access to a psychologist occurred sporadically (22.5%, n=92) in these facilities (Table 6).

Table 6. Possibility of using psychological support in the workplace versus hospital referral level

Option of using psychological support	Single-name hospital		Referral level I		Referral level II		Referral level III		Total	
	n	%	n	%	n	%	n	%	n	%
No	13	56.5	53	55.8	79	50.3	60	44.8	205	50.1
Yes	2	8.7	16	16.8	33	21.0	41	30.6	92	22.5
Don't Know	8	34.8	26	27.4	45	28.7	33	24.6	112	27.4
Total	23	100.0	95	100.0	157	100.0	134	100.0	409	100.0
	$\chi^2(6)=9.84$, p=0.131									

χ^2 – Pearson's chi-squared test value.

Discussion

In the current research, 99.1% (n=440) of the midwives surveyed admitted that their work was stressful and the SARS-CoV-2 pandemic significantly increased emotional tension. The percentage of respondents who were likely to feel stressed before each shift during the coronavirus pandemic increased from 4.1% (n=18) to 21% (n=93). The number of midwives who said they were very stressed before going to work doubled.

Midwives experience a variety of emotional tensions in their careers that cause them to have both a greater desire to perform and a decreased interest in their professional duties, and sometimes even a reluctance to continue in the profession. The stress that they experience in their professional work can be exacerbated by many factors, including infectious diseases. Most of the concerns are caused by diseases that are not fully understood and have high death rates. The issue of stress related to the coronavirus in this medical group is still new, but the current results indicate that the SARS-CoV-2 pandemic significantly affected the quality of the professional and private lives of midwives.

The fact that midwifery is a stressful profession is reflected in the literature on the subject.

Results similar to the current research were presented by Przybek-Mita et al. in a study conducted in the Podkarpackie province. The authors showed that, for 90% of the nurses and midwives surveyed, stress was considered an integral part of their job and 76% experienced it on a continuous basis [7]. The experience of stress in midwives was also confirmed by Gruszyńska et al. [8]. The specific nature of the midwifery profession requires mental toughness and resilience to stress. In our study, the highest number of female respondents (65.3%, n=290) reported that they were moderately resilient to stress. About 12% (n=52) of the respondents had doubts about whether the profession they were pursuing was a good career choice. Przybek-Mita et al. showed that 29.7% of nursing staff often think about changing careers or leaving their jobs [7]. The current study also indicates that attitudes toward work changed with the emergence of the SARS-CoV-2 virus in more than half of the respondents. The pandemic has caused stress to become a common mental health problem, especially among healthcare workers. This statement is also supported by a study conducted in 2020 by Zhu et al. [9].

The present study also included a question regarding the most feared factor about coronavirus in their work environment. Most midwives were afraid of infecting loved ones and less than a half were afraid of infecting themselves. These data are consistent with the findings of Wierzbicki, who reported that a major stressor affecting many people during the pandemic is the fear of getting sick themselves and infecting their loved ones [10]. A study of midwives in two Spanish hospitals also confirmed that almost all study participants were most afraid of infecting their loved ones [11]. The danger of contracting the disease was also a key source of concern among healthcare workers in Taiwan [5].

Chronic stress caused by SARS-CoV-2 can lead to professional burnout. Makara-Studzińska et al. rank high aversion to going to work every day as the first symptom of burnout [12]. Respondents in the current study were asked "Before and during the pandemic, did you happen to take unscheduled vacation or sick leave?". Before the onset of the pandemic, 6.1% (n=27) of respondents answered affirmatively, and after the onset of the pandemic, the percentage was twice as high. Studies on other infectious diseases, including SARS and MERS, confirm increased burnout symptoms as a consequence of outbreaks [13, 14].

The current results show that as many as 90.8% (n=403) of the midwives surveyed had encountered a patient infected with SARS-CoV-2 or a patient suspected of being infected with SARS-CoV-2 in their workplace. The most stressful medical activity or clinical situation for respondents was delivering a baby of a parturient woman with symptoms of COVID-19 or suspected SARS-CoV-2 infection. The responsibility for the patient's health and life was the second most stressful situation. This was followed by providing assistance in obstetric and gynecological procedures on a patient with suspected infection or symp-

toms of coronavirus infection. A large proportion of the respondents felt that the possibility of giving the wrong dose of a medication was a stressful situation for them. A study conducted by Burba et al. indicated that the most stressful factor in the nursing profession is working under time pressure. They also placed responsibility for the health and life of the patient second [15]. No similar studies were found in the available literature indicating which activities related to midwifery practice were most stressful for these individuals during the SARS-CoV-2 pandemic. The topic of coronavirus stress in relation to this medical group is still new. On the other hand, there are studies that indicate that working in wards with infection risk is the main reason for poor mental health among medical staff, including nurses [16].

The COVID-19 pandemic increased the intensity of existing stress among midwives and caused many adverse symptoms, thus worsening the health status of this professional group. Among the reported symptoms that the respondents in our study experienced as a result of constant stress, anxiety and restlessness were the most common, followed by fatigue and weariness of the body, and headaches. In addition, more than half of the participants reported experiencing sleep disturbances and irritability, and 11.5% (n=30) reported nausea and vomiting. Similar psychophysical symptoms experienced due to accompanying stress have also been described by other researchers [6, 17]. In one Chinese study, as many as 34% of respondents complained of insomnia [6]. Wierzbicki also showed that the COVID-19 pandemic is a powerful psychosocial stressor that causes significant changes and disorders in the body. This latter study confirmed that sleep disturbances and the occurrence of anxiety and depressive disorders are most common results of stress [10]. Research conducted in April 2020 among healthcare professionals in Turkey also confirmed that they experienced serious psychological problems during the pandemic period, including anxiety, panic, depression, anger, restlessness, and sleep disturbances [18]. A significant mental deterioration among medics has also been reported by studies conducted in other countries [6, 19-21]. According to some studies, with increased exposure to COVID-19-related stress, feelings of anxiety are experienced by 90% of medics [22]. An anxiety reaction is the most typical manifestation of pandemic acute stress disorder [20]. On the other hand, in a study by Kang et al., 63% of healthcare workers reported mental disorders [23].

When examining the methods used to cope with the stress caused by SARS-CoV-2 at work, the surveyed midwives most often reported talking to a loved one, limiting access to information related to COVID-19, watching movies, and listening to music. Only 6.3% (n=28) of the respondents did nothing to reduce their stress levels. Only 6.5% (n=29) of the midwives reported that there were stress-related interventions available at their workplace, with most of them considered effective. Opportunities for psychological support for medical staff were available at the workplace for 21.4% (n=95) of respondents. There was no confirmed association between the referral level of the hospital in which the midwives worked and access to psychological support in the workplace (p=0.131). Regardless of where the respondents worked, access to a psychologist occurred only sporadically in these facilities (22.5%, n=92). A study conducted by Pietraszek et al. on nurses in the Lubelskie province in 2016 reported that 25.18% of the respondents had access to psychological counselling, and only 8 people decided to take advantage of it. The remaining 73.6% responded that they did not have such access. Therefore, the access to psychological help is more limited despite the ongoing pandemic [24]. Arden et al. recommend that individuals who are exposed to psychological distress during the SARS-COV-2 pandemic should have access to psychological support at their workplace [25].

Limitations of the study

This study was an attempt to assess stress levels among midwives during the COVID-19 pandemic. The results allowed us to confirm that the work of a midwife is stressful and that the pandemic is a contributing factor in causing this stress to increase. It was not possible in all cases to relate the results of the current research to those of other authors since the number of publications on this topic is still scarce. We feel that there is a deficiency in terms of showing the level of stress that midwives face at work due to the ongoing pandemic. This study was conducted in 2020/2021 when medical personnel became somewhat familiar with patients infected with SARS-CoV-2. Had the surveys been completed at the beginning of the pandemic, it is likely that the stress experienced by midwives would have been greater. Over time, more knowledge has been gained about COVID-19, and, with the availability of vaccines, it can be assumed that the level of stress experienced is less and there are fewer negative effects.

CONCLUSIONS

1. Stress is very much present in the midwifery profession and the COVID-19 pandemic has greatly exacerbated it. According to the respondents, the most stressful medical activity was delivering a child from a mother with symptoms of COVID-19 or suspected of having a SARS-CoV-2 infection.

2. The SARS-CoV-2 pandemic has had a significant impact on the quality of the professional and private lives of midwives.

3. More than half of the surveyed midwives reported negative effects resulting from work-related stress during the SARS-CoV-2 pandemic in terms of biopsychosocial functioning.

4. The SARS-CoV-2 pandemic is associated with more frequent unplanned leaves and sick leaves in midwives after stressful work periods.

5. The most common strategies employed to manage the stress caused by the threat of SARS-CoV-2 infection among midwives included talking to a loved one, limiting watching, listening, and reading information on COVID-19, watching movies, and listening to music. Only one-fifth of the surveyed midwives were offered psychological support in the workplace.

6. Ongoing efforts in workplaces to reduce the stress levels associated with SARS-CoV-2 infections among midwives are insufficient.

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ASSESSMENT OF SELECTED MUSCLES REACTIVITY IN THE LOWER SPINAL SEGMENT

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ABSTRACT

Background: Lumbar spine pain is now a common affliction. In 90% of cases, the pain is of ambiguous and multicausal etiology, described as non-specific lower back pain (NLBP). Various models of this dysfunction were examined. The most popular model presents the pain as a result of an insult and secondary to changes in tension and lumbar muscles degeneration. There is no unequivocal solution concerning the cause of lumbar spine pain in the literature.

Aim of the study: To examine the differences in muscles reactivity in the lumbar region in cases who suffer from lumbar spine pain in comparison to otherwise healthy controls.

Material and methods: In total, 50 participants (24 men and 26 women) aged 18–45, including 24 people with pain, and 26 without ailments were included in the study. The visual analogue scale was used to measure pain intensity. The participants were assessed to determine the reactivity of the soft tissues of the lumbar part of the body. Selected muscles of this area were examined using a myotonometer, which shows five parameters relevant to viscoelastic tissues.

Results: There were significant differences in the level of the pain ($p<0.001$), hypokinesia of the left abdominal rectus ($p<0.05$), asymmetry indicators for the creep parameter of the erector spinalis and abdominal external oblique muscle, and the stiffness of abdominal rectus ($p<0.05$). No significant differences for the remaining parameters were found.

Conclusions: Tissue reactivity of selected muscles of the lumbar spine shows slight differences because of pain afflictions occurring in this area.

KEYWORDS: Lower back pain, muscles, tissue reactivity, soft tissue

Background

Lumbo-sacral afflictions and pain syndromes such as lower back pain (LBP) resulting from them are among the most frequent musculoskeletal system healthcare complaints which affect society. Chronic lower back pain is problematic for patients because it limits their physical performance for the long-term. Due to the complex, multi-causal etiology of lower back pain, it is a diagnostic and therapeutic challenge for doctors [1]. In 90% of cases of LBP, an adjudication of an unequivocal cause of symptoms is impossible, and this state is determined as non-Specific lower back pain (NLBP) [2].

NLBP is defined as pain that cannot be related to a recognizable, known and specific pathology, and which has no clear causal relationship with symptoms, physical and graphic results [5, 6]. NLBP is usually regarded as pain, muscle tension, or stiffness located between the ribs and lower gluteal fold, occur-

ring with or without irradiation of pain downwards to the leg. Pain symptoms can affect various structures in and around this area, such as muscles, ligaments, dura mater, nerve roots, zygapophysial joints, vertebrae, and fascia [3,4]. The multi-dimensionality of NLBP is now heavily emphasized and indicated as a possible clarification of discrepancies in clinical examination findings [7]. Despite the high prevalence of LBP and the disability connected with it [8], little is known about its pathophysiology.

Global burden of disease research conducted in 188 countries found that lower back pain was the main cause of years lived with disability (YLDs). YLD is a benchmark that reflects a disease's impact on quality of life before a disease subsides or causes death. A meta-analysis of data from 165 studies conducted across 54 countries, found a high lifetime prevalence of lower back pain (40%), particularly among people aged 40–80 years [10]. The evidence arising from epidemiological research suggests that some specified structures of lumbar muscles relate to the development and progression of NLBP, but the hypothetical changes are still not fully known [7].

Most people with low back pain were found to have a traumatic cause. It was believed that this condition is a consequence of excessive physical effort, such as handling heavy objects, which can lead to degeneration or damage of vertebrae, intervertebral disc, and paraspinal muscles [10]. However, plenty of severe back pain episodes cannot be explained by this model. For example, in a study of 1,172 patients with severe back pain, one-third were not able to recall the pain episode [11]. The model based around a causative primary traumatic insult is too simplistic, because there is a small relationship between physical strain and degenerative changes arising from it, and the pathology of the spine in comparison to pathological changes observed in asymptomatic persons [12].

There are many risk factors that predispose a patient towards NLBP and its progression, and their interactions are complex. Among the individuals with NLBP who do not participate in sport, there may be changes in patterns of muscle activity, a reduction in muscle size and strength, and impaired neuromuscular control of spine stabilities. Research has shown that, compared to healthy patients, those with LBP had decreased motor control when performing repeated and dynamic trunk movements [13]. Patients with NLBP have changes in muscle activation, mechanical features of the trunk, and fear of pain [14]. Tardive activation of the transverse abdominus and multifidus muscles among people with recurrent LBP has also been reported [15].

While adaptations of motor control to pain occur over a wide spectrum, two broad phenotypes of NLBP patients have been established, which have been pre-defined at the ends of the spectrum, based on changes in trunk motor control observed in many studies. One phenotype shows tight control of trunk posture and movement due to increased excitability at the expense of increased tissue stress due to increased muscle contraction. The second group shows weak control due to decreased excitability, with the potential cost of increased tissue stress due to excessive spinal movement. Both groups were thus characterized by abnormal strain of tissues in the lower part of the back, but with different underlying mechanisms [15].

Mechanical features of muscles such as tension and stiffness are counted as fundamental to the proper functioning of muscles and to support energy-effective cramps [16]. Some clinical trials by manual or mechanical tools have shown that people with NLBP have more stiffness in the lumbar spine compared to otherwise healthy controls. Paraspinal muscle stiffness in some patients with NLBP decreased significantly during remission. Conversely, in other clinical trials, stiffness assessment showed no relationship between paraspinal muscle stiffness and NLBP. Although these discrepant results may be attributed to various methods of measuring muscle and back stiffness, it is probable that some patients with NLBP show pain trunk muscle hyperactivity and enhanced spinal stiffness. Shirley and Lee [17] found that some patients with NLBP showed higher levels of muscle stiffness and increased bilateral spinal extensor activity during a mechanical spine stiffness test.

Both changes in tension and lumbar muscles degeneration are common features of pain in the lumbar spine. Except for macroscopical changes, some microscopical changes also may occur in muscle tissue in patients with NLBP. For example, micro-traumas of deep muscle tissues can originate when a move of the vertebra extends its physiological range, and happens when a requisition of spinal muscles control is high [18]. These micro-traumas can constitute the source of pain in an acute episode of NLBP, or in the case of recurrent LBP. Shane et al. [19] showed that stiffness of the spinal extensors and multifidus muscle was higher in patients with NLBP compared to controls. Patients with severe and persistent NLBP have a greater proportion of II-B (glycolytic fast-contractile) fibers at the expense of type I (oxidative slow-contractile) fibers. Among healthy people, paraspinal muscles contain more type I fibers compared to other musculoskeletal fibers. Hence, as in the case of severe and persistent NLBP, changes in fiber types may lead to lower resilience to musculoskeletal fatigue, which equals higher susceptibility to spinal injury [18]. However, not all studies have shown differences in muscle fibers in patients with NLBP. Pain can affect muscle structures through impairment of their functions. Because of pain, a complex function

of muscles may in consequence lead to a change in muscle structure [20]. On the other hand, the inhibition and decline of muscles may be a direct consequence of pain, because pain-related nerve inhibition reduces muscle activity in the lumbar area to prevent tissue damage. Indeed, some studies have shown that structural changes in muscle tissue are strongly connected to NLBP, while others found no relationship between the occurrence of NLBP structural changes to the paraspinal muscles [18].

Aim of the study

For the above reasons, we examined the reactivity of selected muscles of the lumbar area in patients with NLBP and otherwise healthy controls.

Material and methods

Sample

This study was conducted between October 2021 and February 2022. In total, 50 patients took part in the study, including 26 women and 24 men aged 18–45 years (average age: 25.9 years). In total, 24 patients (including 11 men) reported lower back pain symptoms (Visual analogue score (VAS) >2), while the remaining 26 people (including 13 men) had a VAS <1 (i.e., lack of pain). Every patient with pain ailment was right-handed, whereas the control group included two left-handed persons. We excluded participants with tract diseases in the area of the viscus, those taking spasmolytics, those who had undergone a medical operation within 6 months before testing, and people who engaged in intense physical activity and sport.

Methods

Except for fundamental data such as age, height and weight, which were used to calculate body mass index, information about the prevalence of presumptive lumbar pain afflictions was collected. The visual analogue scale (VAS) was used to measure these afflictions. This analysis was performed last, and used for the characterization of a participant as a case or a control. Taking this measurement at the end ensured sample blinding. The MyotonPro diagnostic tool was used for the non-invasive measurement of muscle tension in the lumbar region. This tool causes mechanical deformation of soft tissue and records tissue reactivity parameters. During the measurement, parameters such as state of tension, tissue viscoelasticity and biomechanical properties are recorded [21]. The tool records five parameters: frequency (Hz), dynamic stiffness (N/m), elasticity, relaxation time (ms), and creep - the proportion of deformation to relaxation time (i.e., Deborah's number). The explorer applies mechanical pulses of 15 ms and a mechanical force of 0.40 N to register a tissue response. For analysis, a triple scan, which is an average of three impulses, was used [22]. This is considered a credible diagnostic tool [23].

The following tissues were examined: white line, abdominal rectus, abdominal internal and external oblique muscles, quadratus lumborum muscles, and erector muscles of the spine. The research was conducted in closed rooms at room temperature, with clinical assessment performed on the massage table. The participants were examined in the recumbent position. Every muscle was analyzed on both sides of the body and at the same points. The side of the body at which the test was started was selected arbitrarily. The abdominal rectus was examined at the umbilicus level; the abdominal internal oblique muscles were examined at the top of the XI rib level; and the white line was examined halfway between umbilicus and xiphoid cartilage. All measurements were performed in a supine position with hands positioned to the side of the body. The erector muscles of the spine were examined at the L1–L2 vertebrae level; the abdominal external oblique muscles were examined at the XII rib level; the quadratus lumborum muscle was examined at the L2–L3 vertebrae level. Measurements were performed in ventral decubitus with hands along the body.

Ethics

Informed, voluntary consent for research participation was obtained from all participants. The research was conducted in accordance with national rules, institutional policies, and the dogmas of the Declaration of Helsinki. The Ethical Commission of National Chamber of Physiotherapy approved this study (ref. 2/2022).

Statistical analysis

Statistical analysis was conducted using the Statistica 13 software. In addition to the descriptive statistics, muscle reactivity was compared between cases and controls using a Student's t-test. Measured points were also analyzed in terms of the asymmetry between the left and right sides of the body. This was calculated from the absolute value of the difference between several parameters of the muscle reactivity on the right and left sides of the body. A p-value <0.05 was considered as statistically significant.

Results

Descriptive data

There were no significant differences in terms of age, height, or weight between cases and controls. A summary of anthropometric data compared between these two groups is presented in Table 1.

Table 1. Anthropometric data compared between cases and controls

Groups	N	Age [years]			Height [cm]			Weight [kg]		
		$\bar{x}$	Min–Max	±SD	$\bar{x}$	Min–Max	±SD	$\bar{x}$	Min–Max	±SD
All	50	25.9	18–45	7.5	173.9	156–188	8.4	73.1	49–105	14.9
Cases	24	25.9	18–45	7.7	173.7	160–188	8.4	74.5	49–100	14.8
Controls	26	26.0	19–44	7.6	174.1	156–188	9.1	71.9	52–105	15.2

Main outcomes

The average VAS score was significantly higher in cases (4.5) than controls (0.2) ($p<0.0001$), respectively. In terms of tissue reactivity for selected muscles of the lumbar trunk, stiffness of the left rectus abdominis was significantly higher in cases (173.6 N/m) compared to controls (5 N/m). There were also significant differences in the crawling parameter for the erector spinae and abdominal external oblique muscles, and in the stiffness parameter for the rectus abdominis muscles (Table 2). No other significant between-group differences were found.

Table 2. The average parameter values of the significant statistical differences

Outcome	Controls	Cases	p
Asymmetry of abdominal rectus muscles	9.5	14.90	<0.05
Asymmetry of the external oblique muscles [Deborah's number]	0.1	0.15	<0.05
Asymmetry of the erector muscles of spine – crawling [Deborah's number]	0.13	0.08	<0.05

Discussion

The present research compared the reactivity of selected muscles in patients with NLBP compared to controls. Most previous studies which assessed changes in trunk muscle reactivity in patients with NLBP used tensomyography or sonoelastography [24, 25]. We examined five parameters concerning the characteristics of lumbo-sacral muscles, and compared them between the two research groups. There were multiple differences between patients with NLBP and controls.

The abdominal rectus and other muscles take part in central stabilization of the spine. This can be defined as the ability of the lumbar-sacral-iliac area to prevent the decline of stability and correct imbalance of the spine. The conceptions of stability state that functional co-action between stabilizing and motor muscles is important [26]. The results of this study may indicate that, in patients with NLBP, an imbalance in the tone of the rectus abdominis can be observed, which may be responsible for the lack of trunk stability. This is in keeping with recent evidence concerning asymmetry of muscle activity in patients with NLBP [27]. Yu et al. [28] claimed that patients with NLBP have altered strategy strengthening activation of surface trunk and back muscles in anticipation of posture correction to acquire stability in response to internal dysfunctions [28]. This may cause worsening of pain in patients with NLBP people due to inappropriate motor control.

It should be taken into consideration that alterations in muscles concerning the laterality of examined patients are physiological and observed also in otherwise healthy controls. The asymmetry of the trunk muscles and their inappropriate selection during activity is directly related to NLBP in the general population [29, 30, 34]. The greater the extent of asymmetry, the more pronounced the pain is anticipated to be [31]. In people living with chronic pain, an asymmetry of the external oblique muscle and erector muscle of the spine was observed. Sung et al. [27] showed that the non-dominant erector muscle of spine reaction was tardive in controls without NLBP ailments, and that abdominis rectus asymmetry was increased. This may be attributable to all participants in the experimental group having been right-handed [27], as in the case in our study. Altered activity of the external oblique muscle in patients with NLBP compared controls is also consistent with the findings of Yu et al., [28]. However, the literature does not agree and does not unanimously confirm these dependencies. It is quite surprising that the increased stiffness of the spinal extensor and quadratus lumborum was not evident in people with pain in the lumbar region. Altered reactivity of the lower back muscles, including the extensor muscle of the back, multifidus muscle, and quadratus lumborum muscle, has been described in patients with NLBP [26,32,33].

Limitations

This study had several limitations. The lack of significant differences in tissue reactivity may be caused by an insufficient sample size, or the specific VAS cut-off score used to include participants. In order to better examine the relationship between soft tissue reactivity and altered pain intensity in patients with NLBP, more studies should be conducted with larger sample sizes. Perhaps, it may be necessary to examine the relationship in other muscles responsible for the abdominal press, such as the diaphragm or pelvic floor muscles, the function of which are also altered in patients with NLBP.

Conclusions

In conclusion, we found that the occurrence of certain differences in muscle reactivity depends on the presence or absence of NLBP.

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SELECTED NEEDLING TECHNIQUES IN PAIN ASSOCIATED WITH MUSCULOSKELETAL DISORDERS: A NARRATIVE REVIEW

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ABSTRACT

Background: Therapies involving various needling techniques are becoming more common treatment methods for musculoskeletal disorders.

Aim of the study: To review the most commonly used needling techniques and their effect on the level of pain and functional status of patients with selected musculoskeletal disorders, i.e., lower back pain, upper trapezius muscle (UT) pain, cervicogenic headaches, myofascial pain syndrome (MPS), and chronic pain localized to the knee joint.

Material and methods: A review of the academic literature was conducted between December 2021 and January 2022. The needle therapy methods used in the treatment of pain ailments were selected based on publications available in recognized on-line medical databases (Web of Science, PubMed, Medline, PEDro) and are applied in everyday clinical practice. The following search terms were used: "needling"; "acupuncture"; "injections"; and "musculoskeletal disorders". The analysis focused on the characteristics of the materials and methods, results and conclusions sections of the publications.

Conclusions: This literature review demonstrated that the use of needle therapy is effective in selected musculoskeletal disorders. Various techniques of dry needling, acupuncture, and intra-lesional injections can effectively reduce pain and improve functional ability. This study can guide therapists in selecting the most suitable treatment for patients dealing with pain or limited physical functionality.

KEYWORDS: needling, acupuncture, injections, musculoskeletal disorders

Background

Therapies involving various needling techniques are increasingly common treatments for musculoskeletal conditions. There is a noticeable and growing interest among researchers in dry needling, acupuncture, and injections. This review examined therapies using techniques such as dry needling, silver needle therapy, acupuncture, electroacupuncture, and intra-lesional injections. A literature review showed that the selection of techniques used in selected diseases is sizable. This study can be used as a guideline for therapists on how to propose a therapy to a patient dealing with pain or reduced physical fitness, taking the type or stage of the disease into account, among other important factors.

Aim of the study

The aim of this study was to present examples of needling techniques and their effects on the level of pain and functional ability of patients with selected musculoskeletal disorders.

Material and methods

This review was conducted between December 2021 and January 2022. After an initial search of the literature, the following search terms were used:

Table. 1. Characteristics of included articles

Author	Publication year	Type of study	Groups	Methods of therapy	Number of patients (n)	Location of application	Number of treatments	Period of treatment (weeks)	Pain assessment methods	PEDro scale
Wang-Price et al.	2020	randomized, controlled, clinical study	treatment	DN needle manipulation	21	low back pain	1	—	NPRS skale	8
			teratment	DN without manipulation	21					
Téllez-García et al.	2015	randomized, controlled, clinical study	teratment	DN fast needle entry and exit	12	low back pain	3	3	NPRS skale	7
Sanchez-Infante et al.	2021	randomized, controlled, clinical study	teratment	DN fast needle entry and exit	27	latent trigger points (LTrP) of the upper trapezius	1	—	PPT (Pressure pain threshold)	—
			control	placebo	24					
Calvo-Lobo et al.	2018	randomized, controlled, clinical study	teratment	DN fast needle entry and exit (active TrP)	33	non-specific shoulder pain	1	—	NRS skale	7
			teratment	DN fast needle entry and exit (active and latent TrP)	33					
Núñez-Cortés et al.	2017	case series	—	DN fast needle entry and exit	14	chronic post-surgical pain following total knee arthroplasty	4	4	VAS	—
Sedighi et al.	2017	randomized, controlled, clinical study	teratment	DN superficial	15	cervicogenic headache	1	—	Headache index (HI)	5
			teratment	DN deep	15					
Taşoğlu et al.	2017	randomized, controlled, clinical study	teratment	DN deep	36	myofascial pain syndrome	3	3	VAS	—
				DN peppering	36					
Hu et al.	2021	randomized, controlled, clinical study	treatment	Silver needle therapy + physiotherapy	50	low back pain	1	—	NRS skale	7
			control	Physiotherapy (polarized light therapy and ultrasounds	50					
Yu et al.	2020	randomized, controlled, clinical study	treatment	Manual acupuncture	24	low back pain	6	4	VAS	5
			control	Placebo	26					
Comachio et al.	2020	randomized, controlled, clinical study	treatment	Manual acupuncture	33	low back pain	12	6	NRS skale	8
			treatment	Electroacupuncture	33					
Lv et al.	2019	randomized, controlled, clinical study	treatment	Electroacupuncture strong	145	knee osteoarthritis	10	2	VAS	—
			treatment	Electroacupuncture weak	72					
			control	Placebo	75					
Raeissadat et al.	2018	randomized, controlled, clinical study	treatment	Dry needling	20	myofascial pain syndrome	3	3	VAS	6
			treatment	Ozone injection	20					
			treatment	Lidocaine injection	20					

needling, acupuncture, injections, musculoskeletal disorders.

This paper presents selected methods of needle therapy used in pain ailments, based on publications available in recognized on-line medical databases (Web of Science, PubMed, Medline, PEDro) and applied in everyday clinical practice.

The articles were analyzed using the Physiotherapy Evidence Database (PEDro) Scale checklist for randomized clinical trials (Table 1). Our analysis focused on the characteristics of the materials and methods, results and conclusions sections of the articles.

Dry Needling Technique

One popular technique involving needling is the dry needling (DN) method, which involves inserting a thin needle into subcutaneous tissues and muscles in order to mechanically disrupt the tissue without the use of an anesthetic [1]. DN therapy is a popular treatment for musculoskeletal conditions, such as myofascial pain syndrome (MPS) of the cervical spine [2,3], lateral epicondylitis [4], patellofemoral pain syndrome [5,6] and pain in the bottom of the heel [7,8]. DN has also been used in patients with tension-type headaches (TTH) [9,10] and migraine headaches [11], as well as in the treatment of temporomandibular myofascial pain [12,13]. In addition, DN therapy has been used in fibromyalgia [14,15], hip osteoarthritis [16,17] and painful shoulder syndrome [18,19].

Dry needling technique with and without needle manipulation

The academic literature indicates various uses of DN. In their study, Wang-Price et al. [20] compared the effects of two deep DN techniques with (n=21) and without (n=21) manipulation in patients with lower back pain (LBP) on pressure pain thresholds (PPT) and electromyographic (EMG) amplitude of the lumbosacral multifidus (LM) segment. An 11-point Likert scale (NPRS) was used to assess pain intensity. Measurements were taken before therapy, immediately after therapy, and 1 week after a single DN application. In both techniques, two needles were inserted at or near the most tender point; another two needles were applied on the opposite side at the level of the most tender point. The needles were directed into the spinous process at an inferior-medial angle (approximately 20–30°). When performing the DN technique with manipulation, the needle was retracted after insertion into the tissue, and advanced at slight angles within the muscle for 10 seconds. The needle was then removed. During the DN technique without manipulation, the needle was left in the tissue for 10 minutes. There was a significantly greater increase in PPT in the DN group with manipulation immediately after therapy and 1 week after therapy, compared to the DN group without manipulation. There was no significant between-group differences in the EMG amplitude of the LM muscle. The NPRS evaluation showed no significant interaction between the groups. There was a significant reduction in pain, immediately after DN (p=0.001) and one week after DN (p=0.019). A single DN session with or without manipulation may thus have an equal effect on pain reduction [20].

Dry needling technique for rapid needle entry and exit

Trigger point puncture (TrP-DN) is a popular DN technique. In their study, Téllez-García et al. [21] used three sessions (TrP-DN) in one group to determine the short-term effects of dry trigger point puncture (TrP-DN) in LBP therapy, with additional neurological education (TrP-DN+EDU) in the second group. In both groups, needles were inserted during DN treatments into overactive TrPs located in the gluteus medius and quadratus using the rapid needle entry and exit technique until the first local oscillatory response was obtained. The needle was inserted using skin and muscle penetration to a depth of 20–25 mm into the TrP. Multiple local contraction responses should be made for effective treatment, with vertical movements without rotation (5–8 mm) for approximately – 30 seconds. Patients in both groups had similarly effective improvements in terms of pain and disability [21].

Sanchez-Infante et al. [22] presented the effectiveness of dry needling of latent trigger points (LTrP) of the upper trapezius (UT) on the mechanical and contractile properties of the muscle [22]. Subjects were randomized to a DN group (n=26) and a placebo group (n=24). In the DN group, a single session was performed in the middle part of the UT. After identifying trigger points, the needle was inserted at each LTrP using a fast needle entry and exit technique ten times to elicit oscillatory responses. DN therapy for LTrP may thus be an alternative treatment in clinical practice used to improve muscle stiffness and contraction time.

The effectiveness of DN using the rapid needle entry and exit technique was confirmed by Calvo-Lobo et al. [18], who evaluated the effect of a single application in patients with non-specific shoulder pain. The beneficial effects of this technique have also been described in patients with persistent pain after total knee alloplasty [23].

DN technique, deep and superficial needling

Sedighi et al. [24] compared the acute effects of superficial and deep dry needling. Study participants with cervicogenic headaches were randomized to one of two comparison groups based on either single superficial dry needling (SDN) or deep dry needling (DDN) was performed. In both groups, a single treatment session took 15 minutes; applications were made to the upper trigger points in the trapezius and suboccipital muscles. In the SDN group, needles were inserted into trigger points subcutaneously, while in the DDN group, they were inserted deeper, thus penetrating further structures. Headache index, trigger point tenderness and cervical spine range of motion (CROM) were assessed before, immediately after, and 1 week after treatment. DDN and SDN may therefore be effective in reducing headaches, improving trigger point tenderness and the range of motion index, as well as ensuring favorable functional outcomes. DDN treatment thus had a significant effect on CROM and functionality.

Dry needling technique, deep needling and peppering

Tasoglu et al. [25] compared two DN techniques for the treatment of MPS. Study participants were randomized into one of two comparison groups receiving DDN (n=36) or peppering (n=36). Three treatments were performed in both groups (once per week for three weeks). DDN involved inserting a sterile needle (44 mm long, 0.25 mm diameter) into the tissue in the tense bands over palpable trigger points, until a local contractile response was achieved. The needles were left in the tissue for 10 minutes, rotated clockwise, and left for another 10 minutes, for a total treatment time of 20 minutes. The peppering technique used sterile 32 mm long subcutaneous injection needles. Trigger points were needled by moving the needle 8–10 times back and forth at the same point by moving it clockwise and changing its angle. The presence of a localized oscillatory response was referred to as proper needle application. DDN and peppering are both effective in MPS, with favorable treatment effects lasting for up to 12 weeks. The authors of the study also evaluated the pain sensations experienced by patients during the first treatment session and found that the DDN technique was experienced as milder compared to peppering.

Dry needling technique according to the five regulatory systems concept

A different pain relief therapy method involving needles is offered by the dry needling technique according to the Five Regulatory Systems Concept (FRSC). This is an innovative Polish method, often used by practitioners, based on Radoslaw Składowski's development of the FRSC. In its assumptions, the activity includes five key mechanisms needed to maintain homeostasis [26]. The method draws attention to the tissues of the fascia, which have the ability to structurally adapt to external forces [27]. The punctured tissue undergoes relaxation, which occurs as a result of a response to numerous nerve endings, relaxing the point under pressure, along with the adjacent area. This process forms the basis of the first regulatory system [26]. The second regulatory system is associated with the phenomenon of stasis, or impaired flow of blood, lymph, and extracellular fluid in each compartment, with its aetiopathogenesis resembling that of compartment syndrome [28]. Applications targeting drainage and return of fluid from the affected area may result in pain reduction [26]. The third regulatory system refers to the influence of the autonomic nervous system on the organ of locomotion and the antagonism of the action of its two main branches, i.e., the sympathetic and parasympathetic branches. According to the FRSC principles, an increased sympathetic impulse can lead to significant or even complete reversal of pain, often combined with an increase in range of motion and return of previously impaired function [26]. The fourth regulatory system involves proprioception and the extrapyramidal control of voluntary movements. The focus of therapy in the FRSC guidelines is on restoring proper proprioceptive stimulation and, through targeted action, restoring proper muscle balance [26]. Thanks to the deep sensory receptors that are responsible for proprioception, it is possible to orient the body in space. Impaired local or systemic proprioception in the musculoskeletal system can affect movement pattern impairments [29,30]. The fifth regulatory system suggests the presence of skin reactive zones (SRZs) over the affected areas. SRZs are characterized by significant sensitivity to a superficial nociceptive stimulus. The application of the rhythmic tapping technique to this zone, when properly performed, can be critical in treating patients, taking note of the regenerative processes [26].

An example of needling treatment for lower back discomfort (Figure 1) according to the FRSC is the application to the "bumps" (dense connective tissue) in the sulcus between the spinous processes of the spine and the extensor muscle massif at L1-L5, on both sides. Another application targeting the "grips", which are connective tissue bands that are extensions of the bumps, are palpable as transverse bands on the dorsal extensor massif at L1-L5, on both sides. It is suggested to needle the so-called superior gluteal nerve neuro-compartment (Figure 2) by generating a local twitch response (LTR) within palpably tender

areas. This involves possible crossings of the superior gluteal nerve course (both upper and lower branches) with the gluteus maximus, gluteus medius, and tensor fasciae latae muscles. In addition, application is indicated for myogelosis of the piriformis muscle, which is identified as a painful, palpable thickening of the muscle fibers.

Figure 1. Dry needling application on the back according to FRSC

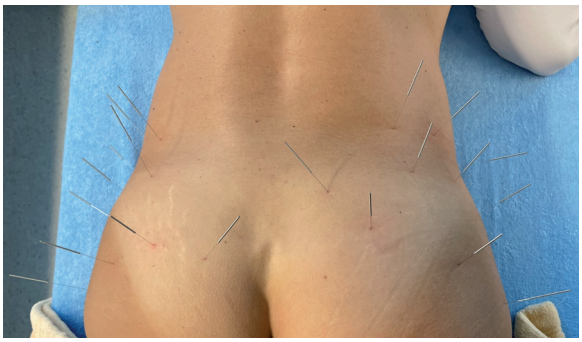

Figure 2. FRSC dry needling technique on gluteal nerve neurocompartment

Silver needle therapy

Silver needle treatment is a method designed to relieve soft tissue pain via heating with a special device.

Silver needle therapy was used in treat LBP in a study by Hu et al. [31]. In total, 100 patients were randomized to two comparison groups, wherein the study group (n=50) included patients receiving silver needle therapy and physiotherapy, and the control group (n=50) had patients receiving only physiotherapy. In the study group selected for silver needle application, the location of pain was determined by marking the sites at the point of muscle attachment, fascia, or tendon. Needle points were marked 1.5 cm apart, covering the entire pain-affected area. Silver needles (17 cm long, 1 mm in diameter) were inserted into the inter-spinous ligament and inter-vertebral space in the region of the pain and/or third transverse process of the lumbar spine. The needles were applied perpendicularly or obliquely to the target points. Next, the needles were connected to a heating device so that the temperature of the silver needle was about 42°C, with a treatment procedure time of 25 minutes. Silver needle therapy was found to reduce pain and improve quality of life and autonomic nerve activity in patients with sacral pain at both short-term and long-term follow-up.

The effectiveness of silver needle therapy has also been demonstrated in patients with sacral pain [32] and peri-artheritis of the shoulder joint capsule [33].

Acupuncture and electro-acupuncture

Scientific reports also point to the popular needling technique of acupuncture. The use of this method can promote pain relief by modulating brain areas and networks associated with pain perception and modulation [34,35]. Acupuncture is a component of traditional Chinese medicine by which inducing pain in a specific area of the body provides pain relief and improvement in symptoms in another area of the body [36].

Manual acupuncture

Yu et al. [37] showed pain reduction in patients with LBP after six manual acupuncture treatments. In total, 79 patients were enrolled and randomized to one of four groups: real acupuncture with “expanded context”, real acupuncture “with limited context”, sham acupuncture with “expanded context”, or sham acupuncture with “limited context”. Seven acupuncture points considered effective in LBP were used for acupuncture treatments: Yaoyangguan (GV3), bilateral Shenshu (BL23), bilateral Weizhong (BL40), bilateral Taixi (KI3), and 1–3 ashi points bilaterally on the lower back and lower extremities [38]. Each treatment procedure took approximately 25 minutes; additional needle manipulation was performed after 10 minutes at the end of the treatment to induce a tissue contractile response (*deqi*). Acupuncture treatments were beneficial in reducing pain, supporting its potential in treating LBP.

Manual acupuncture and electroacupuncture

An interesting study was conducted by researchers in Brazil, who sought to determine the effectiveness of manual acupuncture (MA) and electroacupuncture (EA) in treating pain and disability in patients with LBP [39]. MA is a technique in which the activation of endogenous pain control systems is achieved by puncturing specific points on the body [40]. In the EA technique, electric current is additionally applied to enhance these effects [41]. This randomized clinical trial included 66 patients, who were assigned to two comparison groups: the MA group (n=33) and the EA group (n=33). The 11-item NRS scale was used to assess pain, and the Roland Morris Disability Questionnaire (RMDQ) was used to assess disability (primary outcome measures). Measurements were assessed at baseline, 6 weeks after, and 3 months after the therapy. In both groups, participants received 12 acupuncture sessions (twice a week for 6 weeks). In the MA group, a single treatment included 23 needles inserted perpendicular to the skin surface, to a depth of approximately 0.5 cm for 40 minutes in different body parts. Patients in the EA group had the same acupuncture treatments for 30 minutes, plus 10 minutes of electrical stimulation with an EA Accurate Pulse 585, using electrodes connecting acupoint BL23 (1.5 in. toward the inferior border of the spinous process of the L2 vertebra, 2 cm laterally from the midline), BL30 (near the sacrum, 1.5 in. laterally from the median sacral crest, at the level of the fourth posterior sacral foramen), and connecting electrodes bilaterally at GV4 (dorsal midline in the hollow below the L2 spinous process). The parameters used for stimulation were: intermittent wave, 10 Hz frequency and 10 mA pulse width for 10 min. The intensity of stimulation was adjusted for individual patient comfort. The two methods had similar effectiveness in reducing pain and disability [41].

Lv et al. [42] evaluated the effect of electro-acupuncture intensity on chronic pain in patients with knee osteoarthritis. The study participants were randomized to one of three comparison groups: a strong EA group (>2 mA), a weak EA group (<0.5 mA), and a sham EA group. Ten treatments were performed in each group over 2 weeks. Outcome measures included pain intensity level using the visual analogue scale (VAS) and pain modulation value (CPM). Measurements were assessed before therapy and at 1 and 2 weeks post-therapy. In the strong EA and weak EA groups, applications were made at four acupuncture points: Neixiyan (EX-LE 5), Dubi (ST 35), Liangqiu (ST 34) and Xuehai (SP 10), unilaterally, according to the meridian theory of traditional Chinese medicine. Needles (0.32 mm in diameter and 40 mm long) were inserted vertically to a depth of 25–40 mm (lifting and pushing the needle, combined with rotation) to evoke the feeling of *deqi*. An EA device (Shanghai Medical Electronic Instrument) was used for electrical stimulation: one pair of electrodes was connected to points EX-LE 5 of ST 35, the other pair of electrodes was connected to points SP 10 of ST 34. The treatment was applied in the form of a direct current, continuous wave, 2 Hz frequency, 0.5 ms pulse width, 30 min treatment time. A maximum tolerable current of 2–5 mA was used in the strong EA group, whereas a current of 0–0.5 mA was used in the weak EA group. In the sham treatment group, acupuncture points and stimulation parameters were the same as in real treatment procedures. However, they involved short and thin needles (0.20 mm in diameter and 25 mm in length) that were inserted superficially to a depth of up to one mm at sites 2 cm laterally from each of the four acupuncture points, applying stimulation with a low current of up to 0.5 mA. In the strong EA group, a current intensity of 2–5 mA was more effective in relieving pain intensity and the development of chronic pain in patients with knee osteoarthritis, compared to poor EA group and sham EA treatments.

Topical injections

The academic literature includes case reports of local injections of analgesics or anesthetics being used, which is a separate therapeutic method involving needles.

Raeissadat et al. [43] conducted a randomized clinical trial involving patients with NPS and compared the efficacy of ozone injection (OI) versus lidocaine injection (LI) and DN. Study participants were randomized to the OI group (n=22), LI group (n=20), and DN group (n=20). Patients in all groups received three treatments in 1-week intervals. The primary outcome measures were the VAS for pain assessment, CROM, PPT, and neck disability index, which were assessed at baseline and 4 weeks after the applied therapies. Trigger points were determined by manual palpation, with the most painful one (MMPS) being selected. The same 22G, 1.25-inch needles were used for treatment in all groups. 8 cm^3 of gaseous oxygen/ozone at 15 μg/mL was injected during each treatment in the OI group, wherein the LI group received 2 cm^3 of 2% lidocaine, and in the DN group: the needle was applied in MMPS by pulling out and inserting it in different directions. All three methods were effective when treating MPS patients, in terms of pain assessment, pressure test and disability. There was no significant improvement observed in the range of motion measures. According to the authors' findings, the DN group showed less efficacy with respect to the OI and LI groups.

A metanalysis by researchers from Brazil [44] presented a comparison of the effects of corticos-

teroid injection (CSI) and dry needling (DN) on musculoskeletal conditions in short-, medium- and long-term follow-up. 6 articles were included in the analysis, representing a total of 364 participants. Two studies involved plantar fasciitis, two involved lateral epicondylitis, one study concerned Greater Trochanteric Pain Syndrome, and one focused on myofascial pain with headache. Sousa Filho et al. found that patients had a single dose of corticosteroids administered in all studies. One study included DN treatments performed at the therapist's discretion, with 3 to 7 sessions, two studies used 5 treatment sessions, one study involved 3 applications, and two studies had a single DN session. The presence of pain was assessed in each study, and three studies were concerned with assessing disability. At the conclusion of the analysis, researchers indicated that there was no significant difference between CSI and DN in pain and disability scores at short-, medium-, or long-term follow-up in patients with myofascial pain and Greater Trochanteric Pain Syndrome. For patients with plantar fasciitis and lateral epicondylitis, CSI treatment has a better outcome than DN in short-term evaluation, whereas DN is more beneficial than CSI in long-term follow-up. According to the authors, the quality of the scientific data was very low and further studies of higher methodological quality are indicated.

Conclusions

A review of the presented articles demonstrates that the use of needle therapy is effective in selected musculoskeletal dysfunctions. Various techniques of dry needling, acupuncture, as well as intralesional injections can effectively reduce pain and improve functional ability. The types of needle treatments outlined above show that there are methods to reduce pain and improve functional status, and can guide therapists in choosing the most effective treatment for a patient.

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