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**LADIES AND GENTLEMEN, FACULTY, GRADUATES
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AND ENTHUSIASTS OF *MEDICAL SCIENCE PULSE!***

We are delighted to introduce the third issue of the MSP quarterly - we are grateful for our effective cooperation, support and your kind reviews. We are proud to emphasise that the quarterly is a beneficiary of the Ministry of Science and Higher Education programme 'Support for scientific journals'. Authors receive 20 points for publications accepted by the journal, and the journal receives financial assistance for future scientific and editorial development. MSP is on the ministerial list of scientific journals and reviewed materials from international conferences together with the assigned number of 20 points under No. 27848.

We wish to thank all our authors, scientific, language and statistical editors as well as the reviewers for their creative contribution in the continuous improvement of the scientific quality of the quarterly.

We invite academic staff to join the MSP editorial team, and authors to publish in our quarterly (short publication times, preprints, free of charge), and readers to actively use these scientific resources in their research and educational activities.

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The scientific section of issue 3 opens with original papers on physical activity level and energy expenditure of clinical physiotherapists and physiotherapy educators in selected tertiary health and educational institutions in South-West Nigeria, physical activity, physical fitness and quality of life of the University of the Third Age students, the standard level of first aid knowledge of students and emergency medicine, the status of the Primary Health Care Plus project in Poland, and deep tissue massage and flexibility in the structural components of the superficial back line of professional vol-

leyball players. We recommend three case studies: the application of needle radiofrequency for the reduction of acne scars, the use of tensegrity massage in pregnant women, and intrauterine fetal demise and late motherhood. The issue ends with review papers on: virtual treatments in an integrated primary care-behavioral health practice: an overview of synchronous telehealth services to address rural-urban disparities in mental health care, interregional coordination for a fast and deep uptake of personalised health (Regions4Permed) – multidisciplinary consortium under H2020 project, corrective factors of intestinal microflora disorders in the perinatal period.

We warmly invite all our readers to the next, seventh edition of the International Medical Science Pulse Conference, which will take place on May 7-8, 2020 at Opole Medical School (Poland). The subject of the conference will concern promoting research visibility with an emphasis on the latest issues of sharing and data management in the open access model. The European Parliament has adopted new solutions in the field of open access to data which originates from research financed using public funds. The conference will include presentations by outstanding scientists from many research centres in Europe and the USA, individual meetings with researchers, a Master Class module for the presentation of research projects, a scientific debate and specialised workshops on research data management. Detailed information will be available soon at: https://expandio.pl/7th_MSP_Conference/

In the new academic year 2019/2020, we wish you continued scientific success and wellbeing.

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PHYSICAL ACTIVITY LEVEL AND ENERGY EXPENDITURE OF CLINICAL PHYSIOTHERAPISTS AND PHYSIOTHERAPY EDUCATORS IN SELECTED TERTIARY HEALTH AND EDUCATIONAL INSTITUTIONS IN SOUTH-WEST NIGERIA

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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: Physiotherapists are trained in the use of physical activity for health promotion, and therefore are expected to be physically active themselves.

Aim of the study: This study determined the physical activity level and energy expenditure of clinical physiotherapists and physiotherapy educators.

Material and methods: The research design is cross-sectional survey. Sixty participants were selected using the consecutive sampling technique. A pedometer (Omron) was used to measure the number of steps taken by the participants, the distance covered, and the overall energy expenditure. The number of steps was used to classify the participants' physical activity levels. The data obtained were analysed using descriptive statistics and frequency, percentages and chi-square inferential statistics, Pearson product-moment correlation, Spearman's rank correlation, independent t-tests and Mann-Whitney U tests. The alpha level was set at 0.05.

Results: The mean age and BMI of all participants were 36.81±7.86 years and 26.16±4.46kg/m² respectively. The average number of steps taken per day was 8002±3411 and the mean energy expenditure was 248.26±182.92kcal. This study revealed that 21.3% of the participants were sedentary, 27.7% were 'low active', 27.7% were moderately active, 10.6% were active and 12.8% were highly active. The Pearson product-moment correlation coefficient showed a significant negative relationship between the number of steps and age ($r = -0.292$ $p = 0.047$) and a significant positive relationship between the number of steps and energy expenditure ($r = 0.325$; $p = 0.026$), respectively. There was a significant inverse relationship between the number of steps, the energy expenditure and the age of the participants. There was no significant difference in the number of steps per day, PAL and energy expenditure between clinical physiotherapists and physiotherapy educators.

Conclusions: Physiotherapists should improve their physical activity levels, as most of them (76.7%) were classified in the low activity level category.

KEYWORDS: Physical activity, energy expenditure, number of steps, physiotherapists

BACKGROUND

Physical activity has been described as an important factor in the prevention of chronic diseases [1] and the fact that physical activity is critical to the enhancement of one's health has been well-documented [2,3].

Physical activity is defined as any bodily movement produced by the contraction of skeletal muscles that results in a significant increase in caloric requirements beyond the typical resting energy expenditure [4]. Physical activity may consist of sports, conditioning exer-

cises, household activities, and/or other activities. The benefits of physical activity span various aspects of life including emotional, physical and mental health. Specific benefits include improvements in body composition, lower blood pressure and resting heart rate and during sub-maximal exercise, reduction in blood fat and cholesterol levels, increased glycaemia control and better immune responses. These benefits make physical activity pivotal in the management and prevention of several chronic conditions [1].

On the other hand, physical inactivity is a leading public health problem associated with decreased longevity, as well as cardiovascular disease, cancer, obesity, diabetes, and other diseases [5]. Physical inactivity is associated with 21–25% of breast and colon cancer burdens, as well as 27% of the burdens of diabetes and about 30% of ischaemic heart disease burdens in 2004 [2,6]. In 2010, physical inactivity and low physical activity accounted for 3.2 million deaths and 2.8% of Disability-Adjusted Life Years (DALYs), globally [7]. Worldwide, 31% of adults are estimated to be physically inactive and this percentage is rising. With that rise come major public health implications [8]. The World Health Organization (WHO) in 2010 [5] recommended that adults aged 18–64 years should do at least 150 minutes of moderate intensity, 75 minutes of vigorous intensity, or an equivalent combination of moderate and vigorous intensity aerobic physical activity weekly, in order to improve cardiorespiratory and muscular fitness, bone health and reduce the risk of non-communicable diseases and depression. Several modes of physical activity such as walking, cycling, swimming, muscle strengthening exercises and many others are useful in enhancing health.

Walking has been reported as the most common form of physical activity in both developed [9,10] and developing countries [11–13]. This is, in part, due to the fact that walking is a natural, inexpensive and easily accessible activity for a large portion of the general population [9] and across age groups [10]. There are fewer physical, social and psychological barriers associated with walking when compared with other forms of exercise [14]. Walking can be safely prescribed for any category of patients, or for otherwise healthy individuals. However, in order to achieve an adequate level of physical activity through walking, it is important to consider the number of steps taken per day, the distance covered per day and stride length. Energy expenditure involved in any physical activity is defined as an index of the level of a given individual's physical activity [15].

Physiotherapists have the potential to make a substantial impact on individuals, communities and general public health through their professional expertise in the use of physical activity and exercise in the management and prevention of chronic conditions, such as obesity, cardiovascular disease, ischaemic heart disease and other diseases [16]. Exercise is a core subject in the study of physiotherapy, and physiotherapists have been effective in managing chronic and non-communicable diseases with exercise [17,18]. Physiotherapists are well-

positioned to assess patients with chronic conditions and tailor exercise programs to the specific needs of this complex patient population in order to help them make essential lifestyle changes. Moreover, they are the only clinicians who possess the core education and training to provide these types of assessments and exercise interventions for patient populations in acute care, rehabilitation, outpatient, complex continuing care and homecare settings [19]. It has been hypothesized that physiotherapists who themselves participate in physical activity will become more involved in prescribing physical activities as a form of intervention for their patients due to their own personal knowledge of and skills in using exercise treatments for different conditions [16]. Although physiotherapists are trained physical activity experts, there is a paucity of information on their knowledge and training being translated into effective uses for their own personal benefits.

AIM OF THE STUDY

The study assessed physical activity level, physical activity parameters and energy expenditure among physiotherapists (clinicians and lecturers) and compared the physical activity level and expenditure of both clinicians and lecturers in southwest Nigeria. The following hypotheses were postulated:

1. There will be no significant relationship between the number of steps taken per day, energy expenditure and the demographic characteristics of clinical physiotherapists and physiotherapy educators in the selected tertiary health and educational institutions in southwest Nigeria.
2. There will be no significant relationship between the physical activity level and the demographic characteristics of clinical physiotherapists and physiotherapy educators in the selected tertiary health and educational institutions in southwest Nigeria.
3. There will be no significant difference in the physical activity level, physical activity parameters and energy expenditure between clinical physiotherapists and physiotherapy educators in the selected tertiary educational and health institutions in southwest Nigeria.

MATERIAL AND METHODS

Study design

The design for this study is a cross-sectional survey.

Setting

The researchers sought and obtained ethical approval from the University of Ibadan/University College Hospital (UI/UCH) Health Research Committee with approval number UI/EC/15/0205 before the commencement of the study. The study was conducted between November 2015 and November 2016.

The consecutive sampling method was used to recruit 60 licensed physiotherapists in the selected tertiary health and educational institutions in southwest Nigeria [University College Hospital (UCH), University of Ibadan (UI), Obafemi Awolowo University Teaching Hospital (OAUTH), Obafemi Awolowo University (OAU), Lagos University Teaching Hospital (LUTH), University of Lagos (Unilag)]. Excluded from the study were physiotherapists who were pregnant, retired physiotherapists and physiotherapy clinicians who were also post-graduate students. An informed consent form stating the purpose of the study, as well as assuring participants of confidentiality and anonymity, was attached to the provided questionnaire. The questionnaire was self-administered by the participants. Researchers obtained relevant socio-demographic information including age, gender, years of qualification, weight, and height.

Participants

The participants were physiotherapists in tertiary health and educational institutions in southwest Nigeria, including University College Hospital, Ibadan (UCH), University of Ibadan (UI), Obafemi Awolowo University Teaching Hospital, Ile-Ife (OAUTH), Obafemi Awolowo University, Ile-Ife (OAU), Lagos University Teaching Hospital, Lagos (LUTH) and University of Lagos, Lagos (Unilag). Participants were licensed physiotherapists within the selected tertiary educational and health institutions. Sixty physiotherapists were recruited from the randomly selected tertiary institutions and allowed to participate in this study. Only 47 participants had results that were valid for analysis. Of the 47 participants, 33 (70.2%) were male, while 14 (29.8%) were female. Nine (27.27%) of the male participants were physiotherapy educators while the remaining 24 (72.73%) were clinicians. Five (35.71%) of the female participants were physiotherapy educators and nine (64.29%) were clinicians.

Variables

The variables measured in this study included age, height and weight. Body mass index (BMI) was computed for each participant based on their weight and height [W/H^2 (Kg/m^2)]. Physical activity level was estimated from the number of steps taken in a day. Energy expenditure was measured with the pedometer.

Data sources / Measurement

Age: Each participant's age was recorded to the nearest whole number.

Height: This was measured with the participant standing erect, barefoot, looking straight ahead with their feet together and their back against a graduated height meter. The height was recorded to the nearest 0.01 meter.

Weight: This was measured with the participant standing erect, facing straight ahead and with their hands by their side, in light clothing and barefoot on

the weighing scale. The weight was measured to the nearest kilogramme.

Body mass index: This was calculated for each participant from their measured height and weight using the formulae W/H^2 (Kg/m^2). BMI was classified into the following:

- Underweight: < 18.5
- Normal: 18.5–24.9
- Overweight: 25.0–29.9
- Obese Grade I: 30.0–34.9
- Obese Grade II: 35.0–39.9
- Obese Grade III: > 40

Physical activity level: This was assessed using the number of steps taken per day as measured by the pedometer according to Tudor-Locke, 2011 [20].

- Less than 5000 steps/day is classified as a "sedentary lifestyle index".
- 5,000-7,499 steps/day is classified as "low active".
- 7,500-9,999 steps/day likely is classified as "somewhat active".
- 10,000 steps/day indicates is classified as "active".
- More than 12, 500 steps/day is classified as "highly active".

Energy expenditure: This was calculated using the number of calories per day and number of steps per day, as obtained by the pedometer. This was then compared with the estimated total daily energy expenditure using an estimated Basal Metabolic Rate (BMR) and Activity Factor of each individual. BMR can be calculated using the Mifflin – St Jeor formula [21].

- Women = $(9.99 \times \text{weight in kg}) + (6.25 \times \text{height in cm}) - (5 \times \text{age in years}) - 161$
- Men = $(9.99 \times \text{weight in kg}) + (6.25 \times \text{height in cm}) - (5 \times \text{age in years}) - 5$

BMR is measured in calories/day.

Table 1. Activity Factor

Amount of Exercise Exercise/Activity	Description	TDEE/ Maintenance
Sedentary	Light or no Exercise/ Desk Job	TDEE= 1.2 x BMR
Lightly active	Light Exercise/Sports 1-3 days/week	TDEE= 1.375 x BMR
Moderately active	Moderate Exercise, Sports 3-5 days/week	TDEE= 1.55 x BMR
Very active	Heavy Exercise/ Sports 6-7 days/week	TDEE= 1.725 x BMR
Extremely active	Very heavy exercise/ physical job/ training twice/day	TDEE= 1.9 x BMR

Total Daily Energy Expenditure (TDEE) = BMR X Activity Factor

The estimated TDEE and the one obtained from the pedometer were compared to see if the individual was expending energy as expected for maintaining the normal body physiology.

Bias

All of the participants were licensed physiotherapists. Physiotherapists who were also post-graduate students or were pregnant were excluded because it was believed this could affect their physical activity level.

Study size

This is a population-based study where all available and willing physiotherapists in the selected tertiary health and educational institutions who met the inclusion criteria were allowed to participate in the study.

Statistical methods

Descriptive statistics was used to summarise age, height, weight, number of steps per day, distance covered per day and energy expenditure. Chi-square analysis was used to determine the association between the physical activity level of physiotherapists and demographic characteristics. The Pearson product-moment correlation coefficient was used to determine the relationship between demographic characteristics and the number of steps, and demographic characteristics and energy expenditure. Spearman's rank correlation was used to determine the relationship between PAL and demographic characteristics. Independent t-tests were used to compare the number of steps, energy expenditure, distance covered and calories per day between the two groups. Mann-Whitney U tests were used to compare PAL between the two groups. The level of significance was set at $\alpha = 0.05$.

RESULTS

The mean age was 36.81 ± 7.86 years and mean BMI was $26.16 \pm 4.46 \text{ kg/m}^2$ (Tab. 2). The average number of steps taken per day was $8,002 \pm 3,411$ steps, distance covered was $4.36 \pm 3.90 \text{ km}$ and mean energy expenditure was $248.26 \pm 182.92 \text{ kcal}$ (Tab. 2). Out of the 47 participants, only 40 (85.1%) of them responded positively to driving their cars as a means of transportation, while the remaining seven (14.9%) said they do not use their personal cars as a means of transportation (Tab. 3).

Table 2. Demographic Characteristics of the Participants

Variable	Minimum	Maximum	Mean	S.D
Age (in years)	24	60	36.81	7.86
Weight (in kg)	50.90	132.50	76.45	14.69
Height (in cm)	153.60	189.00	170.92	8.43
BMI (in kg/m^2)	19.67	38.71	26.16	4.46
Number of Steps taken per day	2,364	19,180	8,002	3,411
Distance Covered (in km)	1.21	26.33	4.36	3.90
Energy Expenditure (in kcal)	43.10	1103.33	248.26	182.92

Key: n= 47; BMI: Body Mass Index; S.D: Standard Deviation

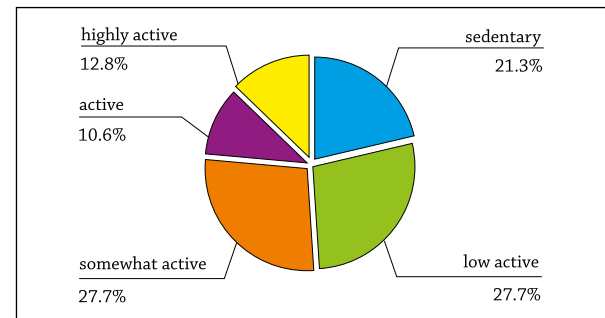


Figure 1. Physical Activity Level among physiotherapists in the selected tertiary institutions

Table 3. Frequencies and percentages of participant characteristics

	Frequency	Percentage (%)
Physiotherapist		
Clinician	33	70.2
Educator	14	29.8
Total	47	100.0
Gender		
Male	33	70.2
Female	14	29.8
Total	47	100.0
Use of private car as a means of transportation		
Yes	40	85.1
No	7	14.9
Total	47	100.0

Table 4. Association between PAL of physiotherapists and their demographic characteristics

		PAL					X ² - value	p-value	Comment
		Sedentary	Low Active	Somewhat Active	Active	Highly Active			
Gender	Male	60%	84.6%	69.2%	80.0%	50.0%	3.20	0.526	Not Significant
	Female	40%	15.4%	30.8%	20.0%	50.0%			
Use of private car as a means of transportation	Yes	100.0%	92.3%	69.2%	100.0%	6.7%	7.35	0.118	Not Significant
	No	-	7.7%	30.8%	-	33.3%			
BMI	Underweight	-	-	-	-	-	11.27	0.506	Not Significant
	Normal	20.0%	46.2%	38.5%	60.0%	50.0%			
	Overweight	70.0%	38.5%	53.8%	40.0%	16.7%			
	Obese Grade I	-	15.4%	-	-	16.7%			
	Obese Grade II	10.0%	-	7.7%	-	16.7%			

Key: PAL – Physical Activity Level; X² – Chi-square value; BMI: Body Mass Index

Table 5. Relationship between number of steps and demographic characteristics using the Pearson product-moment correlation coefficient

		No. of steps	Age	BMI	Energy expenditure
No. of steps	r	1	-0.292	0.058	0.325
	p	0.047	0.696	0.026	
Energy expenditure	r	0.325	-0.009	0.063	1
	p	0.026	0.954	0.676	
	n	47	47	47	47

Key: BMI – Body Mass Index; r = Pearson product-moment correlation coefficient; p = Calculated level of significance (2-tailed); n = Total number of participants

Table 6. Relationship between PAL and Demographic Characteristics using Spearman's rank correlation

		PAL	Use of car	Gender	BMI classification
PAL	r	1	0.263	0.044	-0.127
	p		0.074	0.769	0.395
	n		47	47	47

Key: PAL – Physical Activity Level; BMI – Body Mass Index, r = Spearman Rho correlation coefficient; p = Calculated level of significance (2-tailed); n = Total number of participants

Table 7. Comparison of number of steps and energy expenditure between clinical physiotherapists and physiotherapy educators using an independent 't' test

	Clinical physiotherapist	Physiotherapy educators	
	mean \pm sd n = 33	mean \pm sd n = 14	p value
Number of steps/day	8,212.64 \pm 3,372.64	7,504.07 \pm 3,576.72	0.52
Energy expenditure	234.86 \pm 136.76	281.78 \pm 266.94	0.43

Key: p = Calculated level of significance (2-tailed); n = Number of participants

Table 8. Comparison of PAL between clinical physiotherapists and physiotherapy educators using a Mann-Whitney U test

	Clinical physiotherapist		Physiotherapy educators		p value
	N = 33		N = 14		
	Mean rank	sum of ranks	Mean rank	Sum of ranks	
PAL	25.03	826	21.57	302	0.42

Key: p = Calculated level of significance (2-tailed); n = 47 (total number of participants)

DISCUSSION

A total of 47 out of 60 participants had results deemed valid for analysis. The remaining 13 were deemed invalid due to the inability of the participants to effectively use the pedometer, thereby resulting in errors with the data obtained from the device. Thirty-three (70.2%) participants were male while 14 (29.8%) were female. Fourteen (29.8%) participants were physiotherapy educators while 33 (70.2%) were clinical physiotherapists.

The mean age and BMI were 36.81 \pm 7.86 years and 26.16 \pm 4.46 kg/m² respectively. The average number of steps taken, distance covered and energy expenditure per day were 8,002 \pm 3,411 steps, 4.36 \pm 3.90 km and 248.26 \pm 182.92 kcal, respectively. This indicates that on average, physiotherapists in the selected tertiary institutions could be defined as moderately active. Previous studies [13,20,22] have shown that 8 km, along with an energy expenditure of about 300 to 400 kcal is equivalent to the required 10,000 steps per day. Considering the average energy expenditure of physiotherapists from the selected tertiary institutions, it can be concluded that physiotherapists were not expending enough energy necessary to ensure an optimal physical fitness level. This will affect energy balance and weight control, as the mean BMI indicated that most physiotherapists were overweight. Out of the 47 participants, only 40 (85.1%) responded positively to the question of whether or not they drive their cars as a means of transportation, while the remaining seven (14.9%) said they do not. According to Tudor-Locke and Myers' [23] classification of physical activity level using the number of steps taken per day, 21.3% of physiotherapists would be considered sedentary, 27.7% were low active, 27.7% were classified as somewhat active, 10.6% as active and 12.8% were highly active. These findings show that 76.7 percent of all participants in this study were below the 'active' level.

It was shown that there was no significant association between physiotherapists' gender, use of private car as a means of transportation, BMI and physical activity level. This is probably due to the fact that physiotherapists are trained physical activity experts and have significant knowledge about the use of physical activity. Therefore, their gender, use or lack of use of their private car or BMI would not have been a barrier to the level of their physical activity.

There was both a negative and significant relationship between the number of steps taken per day and age. However, it was a weak relationship. This implies that the number of steps reduces as age increases, and these findings agree with studies conducted by Grubbs and Carter [24] and Bray and Born [25]. Most people tend to do less physical activity as they grow older [24]. This less active behaviour can begin to arise during late adolescence and into early adulthood. A decline in physical activity during these early periods may lead to physical inactivity in later years [25].

There was a positive and significant relationship between the number of steps taken per day and energy expenditure. However, the relationship was also weak. This implies that as the number of steps increases, daily energy expenditure also increases. This may be due to the fact that physical activity is defined as any bodily movement produced by the skeletal muscles that results in energy expenditure [26]. For example, steps obtained through walking result in energy expenditure. A decrease or increase in the number of steps will likewise result in a decrease or increase in energy

expenditure, respectively. Also, walking involves the contraction of antigravity muscles and the contraction of muscles requires oxygen consumption, which translates into heat production and energy expenditure. Furthermore, as the frequency of muscle contraction increases, energy expenditure also increases [27]. This means that the more an individual walks, the greater the number of steps they will take, which leads to a greater frequency of muscle contraction, which ultimately results in higher energy expenditure.

This study also showed that there was a negative but non-significant relationship between daily energy expenditure and age. This may be because lifestyle-dependent physical activity has now reduced, irrespective of age. Research has clearly shown that an increase in sedentary lifestyles is associated with physical environments, infrastructure development, urbanization and a change in individual thinking about lifestyle and the social environment [28]. Therefore, daily energy expenditure, which comes as a result of physical activity, is influenced by many factors and not necessarily age or age alone.

The relationship between physical activity level, gender and the use of a private car as a means of transportation was positive and not significant. This may be because the same requirements are expected from both male and female physiotherapists. It is desirable for physiotherapists to have a good level of physical fitness in order to meet the demands of their job. The physiotherapy profession requires the practitioner to be very active (with good muscle strength, endurance and flexibility). Therefore, expectations of physical ability are not dependent on gender; it's expected that all practitioners are physically active in order to meet the demands of the job as a whole. It is therefore necessary and important that physiotherapists, male or female, using a private car as a means of transpor-

tation or not, should be able to be classified as either active or highly physically active in order to meet the physical demands of the job.

There were no significant differences in the number of steps, daily energy expenditure and physical activity level of clinical physiotherapists and physiotherapy educators when compared to one another. This is probably due to the fact that the demands on a physiotherapist are likely to be the same, irrespective of workplace. Since the measurement of the number of steps was not limited to workplace activities only, this result implies that the lifestyles of physiotherapists in the selected tertiary institutions were relatively the same, regardless of their various workplace demands.

Pedometers measure ambulatory physical activity. Therefore the result of this study is limited to participants performing activities more specific to ambulation, which did not include other activities such as swimming, cycling and weight training that they may have also or otherwise participated in.

CONCLUSIONS

There was no significant association between the physical activity level of physiotherapists and their demographic characteristics. There was no significant difference in the number of steps taken per day, physical activity level and energy expenditure between clinical physiotherapists and physiotherapy educators. Hence, it was concluded that physiotherapists in the selected tertiary institutions were predominantly sedentary as the physical activity levels for most of them fell into the categories below 'active'. There is great need for physiotherapists (whether they be clinical physiotherapists or physiotherapy educators) to improve their physical activity levels as most of those surveyed fell into the categories of low active and somewhat active.

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PHYSICAL ACTIVITY, PHYSICAL FITNESS AND QUALITY OF LIFE OF THE UNIVERSITY OF THE THIRD AGE STUDENTS

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ABSTRACT

Background: Physical activity (PA) has a positive effect on human health at all ages and it is especially important in older people. When insufficient, it may lead to the deterioration of a person's health status.

Aim of the study: The aim of the study was to assess the declared PA of the Universities of the Third Age (U3A) students and to examine the relationship between the level of PA, physical performance, and quality of life in this population.

Material and methods: The study included 99 subjects, aged ≥ 60 years, with a Mini Mental State Examination score ≥ 24 . Participants were examined using the International Physical Activity Questionnaire (IPAQ), the Short Form Health Survey (SF-36) questionnaire, the Short Physical Performance Battery (SPPB), the Activities of Daily Living scale (ADL), the Lawton Instrumental Activities of Daily Living scale (IADL), and the short form of the geriatric depression scale (GDS). Handgrip strength (HS) was measured using the baseline hydraulic dynamometer.

Results: Statistically significant differences in the results of women and men were demonstrated in 5 variables: the level of PA measured with the IPAQ, physical component summary of the SF-36 questionnaire, the total SPPB score, HS of the dominant hand and the non-dominant hand. In all examinations, men obtained higher scores than women. Positive correlations between PA and the result of the ADL, IADL, SPPB, HS and physical component summary of the SF-36 questionnaire were shown.

Conclusions: The study confirmed that the participants of the U3A classes mostly meet the recommendations regarding minimum PA and they willingly undertake regular PA. It translates into high functional and physical fitness, stronger muscles and a good QoL.

KEYWORDS: physical activity, University of the Third Age, quality of life, elderly people, physical fitness

BACKGROUND

Physical activity (PA) has a positive effect on human health at all ages [1,2], and it is especially important in older people. Regular PA improves quality of life (QoL) [3], helps maintain normal body weight, reduces the risk of cardiovascular diseases, type II diabetes [4], sarcopenia [5], protects against the onset of depression [6] and positively affects cognitive function [7]. It is also considered as a factor that reduces the risk of death in older people [8].

Nowadays, older people want to remain active after having retired. They wish to perform social functions, develop their interests and knowledge, and, above all, maintain their independence for as long as possible. Intellectual and physical activity, adapted to the current state of health, is crucial to achieve these goals. Thanks to Universities of the Third Age (U3A), such goals are possible to attain and people who have retired can further develop their passion, interests and meet new people. U3A offer classes that allow to shape intel-

lectual and motor skills. Participants can individually choose the class that interests them as the range of offered physical activities is wide and includes gymnastics, water exercises, pilates, yoga, dancing and nordic walking [9–11].

According to the World Health Organization (WHO) [12] people aged ≥ 65 years should undertake 75 minutes of vigorous-intensity aerobic PA throughout a week, or 150 minutes of moderate-intensity aerobic PA throughout a week, or an equivalent of a combination of both types of activities. The WHO also recommends muscle-strengthening activities twice a week and balance exercises at least 3 times a week for people with reduced mobility. If, however, a person's health poses some limitations, this physical activity should be adjusted individually but kept at the highest level possible for a given person.

According to a Eurobarometer survey published in 2018, more than 50% of Europeans aged ≥ 15 years do not undertake any vigorous-intensity PA, and 47% do not engage in any moderate-intensity PA. Only 30% of Europeans aged ≥ 55 years declare taking PA with a certain regularity, and as many as 61% do not engage in any form of PA [13]. In the surveys carried out in Poland by the Public Opinion Research Centre, CBOS, less than 50% of Polish residents aged ≥ 55 years declare doing some PA [14]. The 2017 Kantar Public survey shows that the percentage of Polish people who meet WHO standards regarding PA decreases with age and amounts to 8% for a group of 60–69 year olds [15].

AIM OF THE STUDY

Insufficient PA of older people may be a reason for deteriorating health status. The aim of the study was to assess the PA of older people attending classes at U3A and to examine the relationship between the level of PA, physical performance, and quality of life in this population.

MATERIAL AND METHODS

The study was carried out from December 2017 to December 2018 and included a total of 99 students of the U3A from Wielkopolska Region. The inclusion criteria were age ≥ 60 years (the retirement age for Polish women), functional capability of at least one hand and cessation of professional activity. The only exclu-

sion criteria was a score ≤ 23 in the Mini Mental State Examination (MMSE) adjusted for age and education. The study was carried out once for each subject by the same researcher. Written informed consent was obtained from all participants.

To assess the level of PA of respondents, a short Polish version of the International Physical Activity Questionnaire (IPAQ) was used [16]. The tool contains 7 questions regarding all types of PA lasting at least 10 minutes at a time and the time spent in a sitting position. The respondents say how many days during the last 7 days they did PA and how much time a day they spent on those activities. The PA in the questionnaire are divided into two types: moderate-intensity activities described as the ones causing slightly faster breathing and increased heart rate, vigorous-intensity activities (causing very fast breathing and a very fast heart rate), and activity related to walking. IPAQ scores are expressed in MET/minute/week (Metabolic Equivalent of Work). Different types of PA are assigned a different value of MET: for walking activity it is 3.3, for moderate effort 4 and for vigorous activity 8. When expressing a given activity in MET/minute/week, the value of the coefficient is multiplied by the number of days in which it is performed and by its average duration. The weekly score for a given patient is presented by summing the results of each type of activity. On this basis the respondents can be classified into three groups according to their level of PA, as shown in Table 1.

To assess the QoL, a Polish version of the SF-36 (Short Form Health Survey) questionnaire was used (license: QM039604). This tool assesses a person's health in a subjective way in a physical dimension (Physical Component Summary, PCS) and a mental one (Mental Component Summary, MCS) [17]. It contains 36 questions that evaluate 8 components: physical functioning, role physical, bodily pain, general health, vitality, social functioning, role emotional and mental health. Each answer provided by a patient is evaluated according to the key, and the results are interpreted as follows: the higher the total score, the higher the QoL assessment [18].

Physical performance of participants was assessed using the Short Physical Performance Battery (SPPB). The SPPB consists of three tasks: standing up from a chair five times consecutively, a hierarchical test of balance and a short walk at a normal pace. Each SPPB component test is scored from 0 to 4 with a score of 0 representing inability to perform the test and a score

Table 1. Classification physical activity intensity. Based on the weekly scores of the International Physical Activity Assessment Questionnaire expressed in MET/min/week

High	Moderate	Low
3 or more days of vigorous-intensity physical activity, 1500 MET / min / week or 7 days of physical activity, combining all types, with a value of over 3000 MET/ min/week	3 or more days of vigorous-intensity physical activity, minimum 20 min a day or 5 or more days of moderate-intensity physical activity or walking minimum 30 min a day or 5 or more days of any activities combined, exceeding 600MET / min / week	lack of any activity or failure to meet other criteria

Abbreviations: MET, Metabolic Equivalent of Work.

of 4 representing the highest category of performance. The maximum number of points is 12 and indicates the best body function [19].

The handgrip strength was tested using the Baseline hydraulic dynamometer. The results were collected in a digital form using Hercules software (CRI Jolanta) and they were expressed in kilograms. The measurement was performed in accordance with the recommendations of the American Society of Hand Therapists (ASHT) [20]. During the measurements, the subject was sitting in a chair without a back or armrests, with feet resting on the floor, parallel to each other, hip and knee joints set at right angles, arms adducted and touching the torso, elbow joint bent to 90°, forearm in a neutral position, and wrist straightened in the range of 0° to 30°. The subject performed their strongest handgrip and held it for 6 seconds. Each of the hands was tested three times, with a one-minute break between each measurement. The mean result from those three measurements was used for further analysis.

The Activities of Daily Living scale (ADL) was used to measure independence of activities of daily living such as bathing, dressing, toileting, transferring, continence, and feeding. Patients receive 1 or 0 points for independence in each function [21]. More complex skills were assessed using the Lawton Instrumental Activities of Daily Living scale (IADL), which consists of 8 domains. The subject receives 3 points when he performs the activity independently, 2 with a little help and 1 when he is unable to perform the given activity [22].

The short form of the geriatric depression scale (GDS) was used to identify the risk of depression. It consists of 15 questions and assesses the mood and motivation of the subject in relation to the last 2 weeks. A threshold score of 5 points indicates an increased risk for depression [23]. MMSE was used as the screening test for cognitive impairment [24].

The Body Mass Index (BMI) value was calculated based on the height and weight measurements. Interpretation of the index was made after taking into account the correction for age. For the subjects aged 55-65, a BMI of 23-28 was accepted as the norm, and for subjects 65 years old and more it was set at 24-29 [25].

Statistical analysis was performed using Statistica 12. The Shapiro-Wilk test was used to check the normality of the distribution. Quantitative variables are presented as mean (m) and standard deviation (SD). Due to the non-parametric distribution of some variables, median (M) and range of parameters have been taken into account. Mann-Whitney U test, Kruskal-Wallis test and Correlation of Spearman were used in the analysis. The p-value of <0.05 was considered statistically significant (ss).

ETHICAL APPROVAL

The study obtained the approval of the Bioethics Committee at the Poznan University of Medical Sciences, no: 389/16 and 390/16.

RESULTS

99 volunteers participated in the study: 88 women and 11 men, aged 60-90 years old. Statistically significant differences in the results of women and men were demonstrated in 5 variables: the level of PA measured with the IPAQ ($p=0.004$), PCS of the SF-36 test ($p=0.008$), the total SPPB score ($p=0.003$) and the grip strength of the dominant hand ($p=0.00007$) and the non-dominant hand ($p=0.0005$). In all examinations, men obtained higher scores than women. The characteristics of the studied group are presented in Table 2.

The average PA of the participants was 1751 (± 799) MET min/wk. In less than 79% of subjects PA was defined as moderate, in 13% as high, and in 8% low. Positive correlations between PA and the result of the ADL scale ($p = 0.022$, $r = 0.23$) and IADL ($p = 0.000059$, $r = 0.392$) were shown. Physical fitness measured by the SPPB also positively correlated with the results of the IPAQ ($p = 0.006$, $r = 0.276$). The same dependence was observed in relation to the grip strength of the dominant hand ($p = 0$, $r = 0.540$) and the non-dominant one ($p = 0$, $r = 0.535$). In the SF-36 questionnaire only the PCS positively correlated with PA ($p = 0.004$, $r = 0.288$).

People whose PA was below the norm obtained a lower number of points in the IADL scale, compared to people who were moderately and highly active ($p=0.006$, $p=0.015$). A similar dependence was found in the SF-36 PCS as people who were physically inactive assessed their QoL worse than those who were moderately and highly active ($p=0.001$, $p=0.0004$). The results of the SPPB were significantly lower in the low-activity group compared to the high-activity group ($p=0.034$). The grip strength of the non-dominant hand was higher in subjects who were moderately and highly physically active ($p=0.01$, $p=0.0004$). In the results of the dominant hand a statistically significant difference was found in the juxtaposition of low activity and high activity groups ($p = 0.012$). Detailed results are presented in Table 3.

DISCUSSION

A low level of PA in older people is a global problem. 45% of people who are over 60 years old do not meet the norms of PA [26]. In this study recommendations regarding PA were met by almost 92% of the participants. Such high PA may stem from the fact that the participants of the study were recruited among the students of the U3A where various physical activities are offered.

Sun et al. showed in a systematic review that the percentage of active older people ranged between 2.4-83% and that men were more active than women, which was also shown in our study [27]. A high percentage of people who meet WHO standards in our study may be caused by the use of a subjective questionnaire – IPAQ. In a review, Prince et al. [28] compare direct measures with self-reporting measures but they do not recommend any of them. Such questionnaires as IPAQ have

Table 2. Characteristics of the studied group

parameter	total n=99	women n=88	men n=11	p value
age (years) m ± SD	72 ± 7	72 ± 7	74 ± 7	0.343
BMI (kg/m ²) m ± SD	28.02 ± 4.4	27.9 ± 4.4	28.3 ± 4.5	0.528
underweight n (%)	18 (18.2)	16 (18.8)	2 (18.8)	
normal weight n (%)	40 (40.4)	35 (39.8)	5 (45.5)	
overweight n (%)	41 (41.4)	37 (42)	4 (36.4)	
diseases: n (%)				
– musculoskeletal	65 (65.7)	60 (68.2)	5 (45.5)	
– cardiovascular	60 (61.3)	54 (61.4)	6 (54.5)	
– diabetes	11 (11.1)	11 (12.5)	0 (0)	
– cancer	13 (13.1)	11 (12.5)	2 (18.2)	
– thyroid diseases	15 (15.2)	15 (17)	0 (0)	
– Parkinson's disease	1 (1)	1 (1.1)	0 (0)	
– COPD	5 (5.1)	4 (4.5)	1 (9.1)	
number of diseases M (range)	2 (0-4)	2 (0-4)	1 (0-2)	0.073
ADL (points) M (range)	6 (1-6)	6 (1-6)	6 (5-6)	0.973
IADL (points) M (range)	8 (0-8)	8 (0-8)	8 (0-8)	0.241
SPPB TOTAL (points) M (range)	7 (0-12)	7 (0-12)	12 (4-12)	0.003 ^{ss}
GDS (points) M (range)	3 (0-9)	3 (0-9)	1 (0-7)	0.052
0-5 n (%)	88 (88.9)	78 (88.6)	10 (90.9)	
>5	11 (11.1)	10 (11.4)	1 (10.1)	
SF-36 PCS (points) M (range)	39.6 (12.6-68.5)	38.1 (12.6-68.5)	48.7 (16.8-54.9)	0.008 ^{ss}
SF-36 MCS (points) M (range)	55.7(11-77.6)	54.3 (11-77.6)	58.4(42.5-77.6)	0.202
IPAQ (MET) m ± SD	1751 ± 799	1659,3 ± 753,8	2484.1 ± 804.2	0.004 ^{ss}
low n (%)	8 (8.08)	8 (9.09)	0 (0)	
moderate n (%)	78 (78.8)	71 (80.68)	7 (63.64)	
high n (%)	13 (13.1)	9 (10.23)	4 (36.36)	
HS dominant (kg) m ± SD	22.7 ± 5.8	21.7 ± 4.8	30.7 ± 7.1	0.00007 ^{ss}
HS non-dominant (kg) m ± SD	21.1 ± 6,1	20.2 ± 5.3	28.1 ± 7.8	0.0005 ^{ss}

Abbreviations: m, mean; SD, standard deviation; M, median, BMI, Body Mass Index; COPD, Chronic obstructive pulmonary disease; ADL, Activities of Daily Living; IADL, Instrumental Activities of Daily Living; SPPB; Short Physical Performance Battery; GDS, Geriatric Depression Scale; PCS, Physical Component Summary; MCS, Mental Component Summary; IPAQ, International Physical Activity Questionnaire; HS, handgrip strength; ss, statistically significant.

Table 3. Average test scores results obtained by volunteers with different levels of physical activity

parameter	low pa m ± SD	medium paa m ± SD	high pab m ± SD	p value
ADL points	5.6±0.5	5.8±0.7	6±0	a0.574 b0.503
IADL points	4.5±2.7	7.2±2	7.4±1.5	a0.006 ^{ss} b0.015 ^{ss}
SPPB points	4.5±3.4	7.4±3.8	8.9±3.5	a0.148 b0.034 ^{ss}
SF-36 PCS points	22.5±7.6	39.7±11.4	44±9.5	a0.001 ^{ss} b0.0004 ^{ss}
SF-36 MCS points	53.9±19	51.8±12.6	56.4±8.6	a1 b1
GDS points	3.7±2.6	2.8±2.2	1.5±1.7	a0.951 b0.108
HS dominant kg	18.7±5.3	22.5±5.2	26.7±7.6	a0.222 b0.012 ^{ss}
HS non-dominant kg	14.5±7.2	21±5	25.5±7.7	a0.01 ^{ss} b0.0004 ^{ss}

Notes: aa comparison of the moderate activity group with the low activity group, b b a comparison of the high activity group with the low activity group.

Abbreviations: PA, physical activity; m, mean; SD, standard deviation; ADL, Activities of Daily Living; IADL, Instrumental Activities of Daily Living; SPPB; Short Physical Performance Battery; GDS, Geriatric Depression Scale; PCS, Physical Component Summary; MCS, Mental Component Summary; HS, handgrip strength; ss, statistically significant.

advantages as they are easy, cheap and they are not problematic for the participants. Zając-Gawlak achieved high scores in the research on PA among U3A students [9]. The study checked the level of activity of 104 U3A students by counting the daily number of steps using an accelerometer. Most of them did more than 10,000

steps and thus met the standards of the American College of Sports Medicine for cardiorespiratory exercises.

The study showed a correlation between the functional fitness of older people and the level of their PA. The ADL and IADL tests positively correlated with the results of the IPAQ. Paterson and Warburton also

showed a positive effect of PA on the fitness and independence of older people. The aim of their study was to systematically review the relationship between PA of people aged 65 and older and their functional fitness, disability or loss of independence. They showed that even regular aerobic exercise and short-term exercise programs decrease the risk of functional limitations and disabilities in old age [29].

The relationship between the HS and PA was researched by, among others, Cooper et al. [30] on a group of 65,582 people aged 60 years or older, using the IPAQ and the Jamar hydraulic dynamometer. In their study people who declared undertaking more moderate-intensity PA achieved higher values of the HS.

The correlation between physical fitness of people aged 65 years and older and PA was also studied by Yasunaga et al. [31]. The authors assessed daily PA using the accelerometer and divided this activity into time spent in a sedentary position, light PA (LIPA) and moderate- to vigorous-intensity PA (MVPA). However, physical fitness was assessed based on a HS, maximal and normal gait, "Stand up and go" test and standing on one leg with eyes open. The results of the study confirmed the beneficial effects of PA on physical fitness of older people, except for the HS. Researchers suggest that replacing sedentary behaviour or light-intensity PA with moderate- to vigorous-intensity PA for 10 minutes a day can improve the fitness of older people. This is confirmed by our research in which the participants with a moderate and high level of PA demonstrated better physical fitness measured by the SPPB and the HS.

Mijnarends et al. present PA as a factor preventing sarcopenia [32]. For 5 years the authors examined 2309 people aged 66-93 years and showed that in peo-

ple declaring moderate and high level of PA the risk of sarcopenia was lower than in people with a low level of PA (OR = 0.64, 95% CI 0.45- 0.91). The group with an initial higher level of PA had stronger HS, greater muscle mass and faster gait. The meta-analysis conducted by Steffi et al. confirms an important role of PA in older people [5]. According to its authors regular PA (work-related, aerobic and muscle-strengthening activity) is crucial for healthy aging and decreases the risk of sarcopenia. Our research demonstrates a positive correlation between PA and the HS of the dominant and non-dominant hand.

Apart from showing a relationship between PA and physical fitness our research demonstrates a correlation between PA and QoL. Valadares et al. [33] examined 271 women aged 60 years and older using a longer version of the IPAQ to assess PA, and World Health Organization Quality of Life Questionnaire (WHO QOL-OLD) to assess QoL. A positive correlation of QoL was demonstrated only with PA related to transport. Our research showed a positive correlation between PA and the PCS of the SF-36 questionnaire.

CONCLUSIONS

Physically active people have a better QoL and are more physically fit than those who are not very active. At the same time they cope better with basic and complex activities of everyday life. The study confirmed that older people participating in the U3A classes mostly meet the recommendations regarding minimum PA and they willingly undertake regular physical exercise, which translates into high functional and physical fitness and a good assessment of QoL.

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STUDENTS AND EMERGENCY MEDICINE: WHAT IS THE STANDARD LEVEL OF FIRST AID KNOWLEDGE?

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ABSTRACT

Background: First aid is a critical skill, and knowing how to perform it may ultimately save a person's life.

Aim of the study: The aim of the study was to assess the level of first aid knowledge among students from three backgrounds: medicine, science, and the humanities.

Material and methods: The authors surveyed a group of 180 fifth-year physiotherapy, geoinformatics, and psychology students, of which there were 60 from each discipline. The authors used an anonymous survey of their own design, composed of open- and closed-ended questions, which included 15 questions about first aid rules. The research was conducted in Wrocław, Poland.

Results: Only 60 students (30.33%) had previously had the opportunity to receive first aid training during the course of their studies. An additional 100 students (55.56%) claimed they were familiar with first aid rules. Of the physiotherapy students, 32 (53.3%) declared they would remain calm and composed in an emergency situation, with men claiming they would remain more composed than women. The difference in behaviour turned out to be statistically significant; the value of the chi-square test was 13.74. Students who had had prior first aid training at university were the most familiar with life-saving techniques and claimed they would remain the most composed in an emergency situation (32 students from physiotherapy; 53.3%). Prior to taking the first aid exam, the majority of students (100 respondents; 55.6% of the total) were confident that they would obtain the maximum number of points possible on the test. However, upon completion, they were found to have a medium level of knowledge at 889 points out of 1,500, or 59%.

Conclusions: The level of first aid knowledge among university students should be dramatically improved, so they are able to perform first aid with some level of expertise, should the need ever arise. To facilitate this, every university should include first aid classes in their curriculum. First aid techniques should be revised and refreshed every six months.

KEYWORDS: first aid, education, emergency medicine, universities, students

BACKGROUND

The practice of first aid has existed since prehistoric times. Ancient hunters sometimes got hurt and to survive, needed to understand basic emergency techniques. Great advances in the science of first aid began about

120 years ago, based on the knowledge of military surgeons [1–3]. Today, intentional failure to provide first aid to someone in need constitutes a criminal offence in some countries, including Poland. The Code of Criminal Procedure lays down regulations regarding the pro-

vision of first aid. It states that if a person refuses to help a victim whose life or health is threatened, they could face potential imprisonment of up to 3 years, but only if they would have been able to provide such help without risking their own life or health. Other legal regulations regarding first aid are described in the Road Traffic Law; a driver is obliged to provide any necessary assistance to a victim of an accident, and must call the paramedics and police [1]. The principles of first aid education are based on the guidelines of the European Research Council (ERC). The use of these principles is not imposed in any way by the Council in the training programmes of private companies, nor is it mandated for university syllabuses. The studies described below show that universities often do not take them into account when constructing their syllabuses as many institutions do not teach first aid as a subject at all. In a survey conducted among 152 medical students in the South Indian city of Mangalore, Joseph et.al indicate that a high level of knowledge about first aid was observed in 13.8% of students, moderate knowledge in 68.4%, and poor knowledge in 17.8% [4]. According to the Alhejaili and Alsubhi study of health science students at Saudi Arabia's Taibah University in Al-Medina, 98.2% had information about first aid, however 79.1% thought their information was not sufficient and 83.7% thought they did not have the ability to perform first aid in emergency cases [5].

AIM OF THE STUDY

The aim of the study was to assess the level of expertise in first aid among fifth-year students from three universities in Wrocław, Poland: the University School of Physical Education in Wrocław (UPE), the University of Science and Technology (UST), and the University of Wrocław (UW). The purpose of choosing three different universities was to ensure the diverse backgrounds of study participants. Participants have educational backgrounds in medicine, science, and the humanities.

MATERIAL AND METHODS

The study was conducted at three universities and lasted for 3 months, from January to March 2016. The study included 180 second-year master's degree students. The participants were students from three faculties (60 each): physiotherapy (UPE), representing medicine; psychology (UW), representing the humanities; and geoinformatics (UST), representing the non-medical sciences. Among the chosen disciplines, the selection of these groups of students was random. Overall, 107 women and 73 men, aged 23 to 28 years, were surveyed. The study was conducted using an anonymous survey, which was designed by the authors of the study based on their professional experience as paramedics. The purpose of the study was to establish the participants' level of expertise in first aid techniques.

The questionnaire had 25 closed- and open-ended questions, including 15 questions related to knowledge of premedical first aid (PFA). The analysis of the survey results was carried out in two stages: the analysis of the remaining questions and the analysis of the theoretical part pertaining to PFA. The remaining questions referred to age, sex, education, prior first aid training, the need for first aid training, and behaviour during emergency situations. In the education section, additional questions covered topics such as the participant's current and previous course of study, any prior training in first aid techniques within the university setting, their total number of hours of first aid training, and by whom and in what form the PFA training was given. One question was about any prior PFA training that took place outside the university setting. For the study we asked the respondents the following questions: Do students remain calm in an emergency situation? Are men or women more composed? Does the inclusion of first aid training in the curriculum affect readiness to help a victim? Does confidence in one's own lifesaving skills translate to the results of the test contained in the survey?

The analysis of the theoretical part of the survey involved 100 students who declared that they knew the rules of first aid. Each student had the opportunity to earn a maximum of 15 points on the test. The number of points possible for any given group to earn corresponded adequately with its number: UPE, 48 students; UST, 21 students; and UW, 31 students.

The following statistical indicators and tools were used: minimum, maximum, standard deviation, mean, and chi-square test. Participants were ranked on the level of knowledge assessment based on the number of points they earned on the test. The high level included 100–66.67% of points, the medium level included 66.60–33.33% of points, and the low level included 33.26–0% of points. Differences between the groups of students were examined using the chi-square test. The null hypothesis at the critical level of significance $\alpha = 0.05$ was verified. Significance was found when the test probability was $p < 0.05$. The results were calculated using Excel. The study was approved by the bioethics committee of the Opole Medical School.

RESULTS

Among the study group, only 60 respondents had PFA training during their studies. Physiotherapy students were the only ones with prior training because, out of the three universities, the University School of Physical Education was the only institution to provide it. More than 25% (49 students) participated in a PFA training outside the university setting. A total of 25 students had PFA training organised by an external company (about 8 hours, practise plus theory). The rest of the group (24 students) received training as part of their driver's licence course (about 1.5 hours, practise plus theory).

More than 50% (99) of respondents claimed they knew how to help a victim. Less than 10% (13) of students admitted they did not know any rules of PFA (Figure 1).

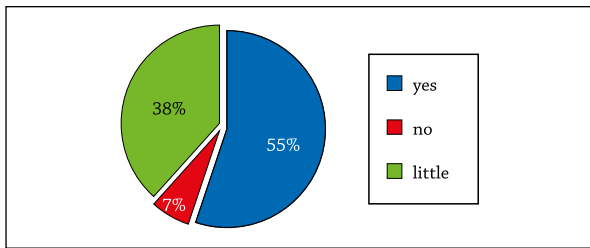


Figure 1. Self-identified familiarity with the basic principles of first aid.

The level of confidence regarding first aid rules was the highest amongst psychology students, followed by physiotherapy students, while the least amount confidence was expressed by geoinformatics students (Figure 2).

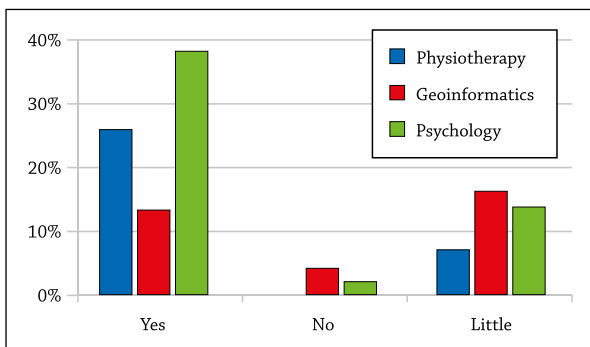


Figure 2. Declaration of first aid knowledge (acc. to the field of study)

In an emergency situation, 68 (37.8%) of respondents claimed they would remain composed. The largest group of people who thought they would remain composed were physiotherapy students (53.3%; 32 students). However, the majority of students (45%; 81 students) said they would probably feel uncertain. The largest group of people in this category were geoinformatics students (63.3%; 38 students) (Figure 3).

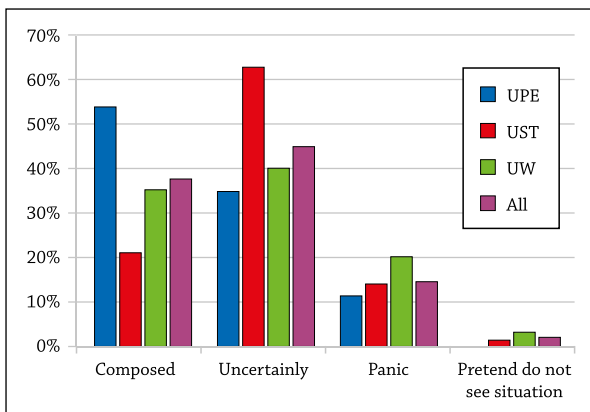


Figure 3. Statement of probable behaviour in an emergency situation among students from the three universities (UPE – The University School of Physical Education in Wrocław, UST – University of Science and Technology, UW – The University of Wrocław, All – all students).

Of the total number of respondents, 27 (15%)—who had been in life-threatening situations themselves—provided help to a person in danger. Physiotherapy students had previously provided first aid to people in life-threatening situations significantly more often than students of other faculties ($\chi^2 = 12.81$, $df=2$, $p < 0.005$).

Men claimed that, compared to women, they were more likely to remain calm. There are statistical differences between the sexes and their behaviour in emergency situations ($\chi^2 = 13.74$, $df=3$, $p < 0.05$) (Table 1).

Table 1. Behaviour in an emergency situation depending on gender.

Behaviour	Gender			
	Women		Man	
	[N]	%	[N]	%
Composed	35	32.71	32	43.84
Uncertain	60	56.07	22	30.14
Would panic	11	10.28	16	21.92
Pretend not to see the situation	1	0.93	3	4.11

Table 2 is a summary of the test part of the survey and includes only the scores of students whose answer to the question, “Do you think you are familiar with the basic principles of first aid?”, was “yes” (N=100). Physiotherapy students obtained the highest score. Of 100 students who were confident about their skills, they gained 889 points out of 1500 (15 points for each student). These results show the students have achieved a medium level of knowledge (59%; 889 points) (Table 2).

Table 2. Distribution of parameters for results of the first aid test.

University	[N]	Measure of variability and appointed				Total score	
		Mean	Standard deviation	Minimum	Maximum	Amount	[%]
Geoinformatics	21	7.71	1.52	5	10	162/315	51.43
Psychology	31	9.17	2.10	6	14	275/465	59.14
All	100	8.98	1.95	4	14	889/1500	59.93

Among the 100 students (55.6% of respondents) who were confident about their skills, 74 (41.1%) students answered the question about the appropriate depth of chest compression incorrectly, 45 (25%) respondents gave an incorrect answer to the question about the number of chest compressions used for children, and 120 (66.7%) respondents stated that cooling a burnt area of the body is enough to manage a burn, which is not true. Only 13 (7.2%) respondents answered the question about choking correctly.

DISCUSSION

In the last 10 years, many studies have shown that expertise in PFA is rapidly decreasing. In a randomized controlled trial, Chamberlain et al. [6] evaluated a person's level of expertise before a basic life support course and then 6–9 months after the course. The study enrolled 262 randomly selected volunteers. The study found that after 6–9 months, 68% of the respondents carried out effective breathing control, but only 33% remembered to provide a patent airway. However, 54% of the respondents properly performed chest compressions. Smith et al. [7] conducted a study among 133 nurses, which showed that it took less than 6–9 months to forget the skills acquired during the PFA training. The results indicated that the nurses retained their theoretical knowledge, but their practical skills significantly diminished. They found that the ability to perform advanced resuscitation procedures, or ALS (Advanced Life Support), degraded faster than the skill of providing basic life support (BLS). After 3 months of training, 63% of the respondents could pass the basic course exam, but after 6 months, this percentage dropped to 58%. After 12 months, the level of expertise of the study subjects was once again tested, and it turned out that only 14% could once again pass the exam. The above data suggests that the PFA training should be repeated twice a year.

Among the surveyed physiotherapy, geoinformatics, and psychology students, two-fifths agreed that PFA training should be repeated once a year, and about 25% of the students said PFA training should be refreshed every two years.

A study conducted in Poland in 2012 among 228 drivers showed that PFA training helped reduce the number of road accidents. The authors of the study found that PFA training significantly expanded and consolidated the knowledge [8].

People adapt to difficult situations in different ways. Some find it hard, others find it easier. There are people who always try to avoid difficult situations, while others are more willing and prepared to handle them [9]. For example, the behaviour of physiotherapy students might be tied to their individual ability to control stress. Obligatory first aid training was provided to these students only at the University School of Physical Education in Wrocław. Behaviour analysis showed that men (44%) were more controlled than women in emergency situations (33%), with more than 50% of women admitting to feeling insecure in an emergency situation [10].

A total of 15 questions were asked to establish the level of expertise in first aid techniques among students from three different faculties. The analysis of the results showed that only 50% of the respondents had expertise in first aid. This is an alarming result, and it might suggest that in many cases, victims will receive inadequate help. More than 50% of the students declared they were quite confident about their level of skills; however, this did not correlate with the results they

obtained. On average, the number of correct answers was 8.9 (SD = 1.95) to 15. Physiotherapy students gave the most correct answers (63%), and geoinformatics students gave the fewest (51%). These are the results of the group of respondents who initially claimed they knew the rules of providing first aid, which should be synonymous with obtaining the maximum number of points. However, that was not the case. Seemingly, the most difficult question on the test was the one about the depth of chest compressions during cardiopulmonary resuscitation (CPR). In total, 25% of the respondents incorrectly marked 1–3 cm, which is not enough. High-quality and correctly performed CPR is essential to increase the likelihood of a victim's survival. According to one study, out of four recently performed by the European Resuscitation Council in 2015, the depth of chest compressions should be from 4.5–5.5 cm in adults. This depth increases the overall effectiveness of resuscitation and is more effective compared to shallower compressions during manual CPR [11]. In one of these studies, the authors found that a compression depth of 46 mm was linked to the highest survival rates. Therefore, the ERC recommends a chest compression depth of about 5 cm, but no more than 6 cm [12].

For non-healthcare professionals, the recommended chest compression-ventilation ratio in children is 30:2. The results of our survey showed that 74% of respondents answered this question incorrectly. In 2010, ERC introduced changes in how CPR should be conducted by non-healthcare professionals [13]. Many children do not receive resuscitation because potential first aid providers are afraid to harm the child. This fear to act may be due to a lack of ability to perform the procedure correctly.

In 2016, a study was conducted in German PFA training schools to evaluate the reduction of fear while performing first aid to victims by rescuers who had had prior training. It is better to for a lay person to learn how to perform first aid and be able to use BLS sequences for adult victims than to stand idly by and do nothing [14,15].

Those who are professionally responsible for children, for example teachers or school nurses, can learn a modified BLS. The modified sequence can be safely applied to children in the following way: give the first five rescue breaths before starting chest compressions, and then perform the BLS sequence for 1 minute before calling for help if no one else is around. Chest compressions should be at least one third of the depth. In children under 1 year of age, the chest is compressed with 2 fingers, and in children over 1 year of age, 1 or 2 hands should be used to achieve the appropriate depth [16–19].

In case of thermal burns, after the affected area has been cooled, it is important to cover it using a sterile dressing to avoid hypothermia. Currently, a wide range of wet and dry dressings are available that effectively protect burned skin. Plastic dressings are also available. Food film has the advantage of being widely available,

non-toxic, non-adherent, impermeable and transparent, which allows observation of the wound without the need to remove the dressing. There is no scientific evidence showing which types of dressings are the most effective [20–24]. Our analysis of the results showed that 70% of the surveyed students believed that cooling the affected area under running water was enough. The students did not know that after having cooled the burn, they should cover the damaged area using a sterile dressing in order to avoid hypothermia [25].

Studies conducted in San Diego (2007) of choking incidents among conscious adults and children over one year of age demonstrated that the most effective methods of first aid were blows to the back between the shoulder blades and abdominal thrusts. However, the studies were related to the treatment of acute obstruction [26]. A foreign body in the airway is a rare but possible cause of death. Often, an early and appropriately applied intervention can save a person's life [27].

One of the survey questions was about choking with an effective cough; an effective cough accompanies a light airway obstruction as a result of which the person can inhale before coughing, and can speak or breathe. Only 7% of students answered this question correctly. Back blows and epigastric abdominal compressions are performed when the injured person cannot breathe, cannot speak, silently attempts to cough, or has a whistling breath [28–30]. It is very important for bystanders to know how to perform first aid in these types of situations [31].

LIMITATIONS

The survey should be standardized. Because of the style and grammatical form, the questions could be considered leading; however, they do reflect the nature

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of the information the authors were seeking to collect, and clearly indicate the need to introduce first aid training in each university.

CONCLUSIONS

To conclude, the students who participated should ask themselves whether or not they rightly claimed that they knew the rules of PFA. Our research has shown that these students obtained test results with no more than 63% of correct answers, which indicates a medium level of first aid knowledge. That is why we believe mandatory PFA training should be introduced into all universities to improve this level.

Typically, men and women behave differently. The ability of men to remain calm may result from their psychology and ability to keep emotions at bay, so they are able to take action in a more controlled fashion, as compared to women. This is not a hard and fast rule, but it may be the case that the ability to correctly provide first aid is gender-related. Nevertheless, we believe that after a training session, even women who were not sure of their possible reactions or emotions beforehand, would then be able to control their behaviour. Based on our research, we believe that similar surveys evaluating students' expertise in PFA should be carried out in all universities across the country to help raise awareness among students regarding their desired behaviour in emergency situations and to help students acquire relevant skills that can save lives.

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THE STATUS OF THE PRIMARY HEALTH CARE PLUS PILOT PROJECT IN POLAND

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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 National Health Fund (NHF) is the public payer solely accountable for securing and organizing access to health care services in Poland. The NHF is responsible for implementing a project entitled “Primary Health Care PLUS” which aims to introduce a primary care centered model, based on coordinated, proactive and preventive methods relevant to patients’ needs and furthermore, works to keep patients well-informed and active participants in health care decision-making. The implementation period of the project is July 1, 2018 through Dec. 31, 2021.

Aim of the study: The purpose of this study is to outline patient demographics and staff structures of providers that took part in the PHC PLUS pilot program, as well as the status of the program throughout the first year of its implementation.

Material and methods: Following an open and transparent recruitment process, 42 urban and rural primary health care providers were selected. The purpose of the providers’ geographic spread was to ensure the model was tested in all representative regions of the country.

Results: 42 PHC PLUS providers attending to 288,392 patients are participating in the project. Approximately 1,100 medical staff members are involved in the project. PHC PLUS medical teams consist of specialists including physicians, coordinators, nurses, dietitians, psychologists, physiotherapists and health educators. Out of 41,022 health risk assessments declared to be conducted during the project, 18,058 (43.1%) were performed from July 1, 2018 to April 30, 2019, including 4,537 basic and 13,521 extended assessments. Furthermore, 15,020 patients in total, participated in the disease management programs, which are also paid from the project.

Conclusions: A Polish health care pilot project that centers primary care can help shift the focus toward preventive interventions, rather than the current system, which often focuses on providing medical care to patients who have already been diagnosed with diseases, often in their more advanced stages.

KEYWORDS: Primary Health Care Plus project; health checkups, disease management programs

BACKGROUND

Many countries that have worked towards providing universal health care for their citizens have experienced significant economic challenges, deriving from a number of sources. For example, greater patient longevity means health care providers are now treating more chronic diseases as patients have increased long-term health care needs [1]. The related expenses exceed economic growth even in the most developed countries. These challenges put pressure on providers to find ways of improving health outcomes for patients without incurring additional costs. Therefore, many countries are looking for more effective ways of deliv-

ering high-quality health care services. The coordination of health care systems and better distribution of tasks between medical and non-medical personnel are expected to lead to both financial savings and improved quality of services [2].

The National Health Fund (NHF; Polish: Narodowy Fundusz Zdrowia - NFZ) is the sole public payer responsible for securing access to health care services throughout Poland for all eligible people. Entitlement to inpatient and outpatient services is generally dependent on the payment of a monthly health care fee [3]. The Polish health care system is currently predominantly focused on specialized and inpatient care, based on

providing reactive medical services which are targeted toward poorly informed patients, who may be passive or uncooperative and highly dependent on the system [3,4]. Patients' medical care is driven by and dependent on the efforts of individual physicians, who are therefore regarded by patients as their only partners in the care process.

Based on the agreement with the Ministry of Health (MoH) dated November 28, 2017, the NHF currently facilitates a project entitled "Preparation, testing and implementation of Coordinated Care in the health care system. Stage 2, a pilot phase - Primary Health Care (PHC) PLUS model" [5].

Originally, the project was divided into 3 phases:

1. Creation of concept - developing 3 models
2. Implementation of the model chosen for the pilot program
3. Implementation of the final chosen measures throughout the entire health care system

As previously mentioned, the Primary Health Care PLUS model was chosen and is currently being implemented. The project is financed through European funds and NHF's own resources. The World Bank, which is a neutral partner with no political links to the project, is also involved [3,5].

Primary Health Care PLUS (PHC PLUS), is composed of both regular primary health care services and additional proactive and preventive activities based on plans provided by the PHC teams. It is focused more on preventive tools than on providing medical services after the fact. Objectives of the PHC PLUS include improving the quality of medical services at the primary care health level, increasing the amount of medical services delivered at the primary care health level instead of specialist and inpatient care, focusing on prevention rather than reaction, and coordination of medical services at the primary care health level [3,5]. All members of health professional teams should be regarded as patients' partners, rather than just physicians. The level of supporting technology should be adequate to facilitate the overarching goals [6].

AIM OF THE STUDY

The purpose of this study is to outline patient demographics and staff structures of providers that took part in the PHC PLUS pilot program, as well as the status of the program throughout the first year of its implementation.

MATERIAL AND METHODS

Participants and setting

Following an open and transparent recruitment process, 42 urban and rural primary health care providers were selected. The purpose of the providers' geographic spread was to ensure the model was tested in all representative regions of the country. The entities were

required to adjust their organizational structure and internal IT systems for the purpose of the project. The adjustment process was financed through the project.

Design

The implementation period of phase II of the project is July 1, 2018 through Dec. 31, 2021. The implementation of the pilot program was divided into stages:

- Stage 1: Selection of project participants (PHC units)
- Stage 2: Adjustment of the PHC units' organizational structure and IT systems to meet the project requirements
- Stage 3: Creation and implementation of an IT platform for cooperation between the NFZ and PHC units for processing generated data, coordinating the project, giving recommendations based on continuous monitoring of the processes, exchanging information between participants, and providing patients with educational information
- Stage 4: Providing health services and monitoring the quality of care

Health services financed by European funds under the PHC PLUS project include:

- performing health risk assessments for adults and conducting extensive educational activities in the field of preventive health
- care management and coordination. (For example, a new position of health care coordinator was introduced to the PHC, remunerated through projects funds.)

Services financed by Regional Branch Offices of the NHF included conducting disease management programs for 11 chronic diseases. The programs were developed by the Medical University of Lodz upon request by the NHF.

An E-learning platform developed as part of project includes:

- educational applications (apps), including mobile versions
- educational materials dedicated to health promotion and disease prevention
- educational films for PHC teams dedicated to organizational aspects of health care providers and management of information in health care organizations

Data sources

The Polish public payer database was used to extract data concerning Primary Health Care PLUS project participants as well as data reported by health service providers during the project. The database of the NHF contains data on all health services provided to Polish patients financed through public sources.

Statistical analyses

Microsoft Excel 2013 was used to prepare the results of the statistical analyses.

RESULTS

Patients

42 PHC units providing health care services to 288,392 patients are participating in the project. Of the patients in these PHC units, 155,768 (54.01%) are women and 109,623 (38%) are <19 or >66 years old (Tab. 1, Fig. 1–2). More than half of the PHC units (23) are medium-sized care providers which cover anywhere from 5,000 to 10,000 patients in need of primary care services, 13 are small care providers, meaning they serve fewer than 5,000 patients, and 6 are large, serving more than 10,000 beneficiaries.

Table 1. Demographics of the patients in PHC providers involved in the project

Age [years]	Female	Male	Total
0-19	30,149	30,798	60,947
20-24	10,738	8,847	19,585
25-29	12,227	10,721	22,948
30-34	11,456	11,051	22,507
35-39	11,611	10,678	22,289
40-44	11,039	10,007	21,046
45-49	9,121	8,003	17,124
50-54	7,892	6,980	14,872
55-59	8,703	7,029	15,732
60-65	12,719	9,947	22,666
66+	30,113	18,563	48,676
Total	155,768	132,624	288,392

Medical Staff

Approximately 1,100 medical staff are involved in the project. PHC medical teams consist of specialists including physicians, coordinators, nurses, dietitians, psychologists, physiotherapists and health educators. Often, one person performs several different functions. For example, a primary care doctor is also a specialist and a nurse is also a dietitian or coordinator and health educator (Tab. 2).

Table 2. Medical staff involved in the PHC PLUS project

Medical staff involved in the PHC PLUS project	Total
Primary care physicians	256
Primary care physicians(specialists)	40
Specialists (external and internal)	345
Coordinators	103
Nurses	191
Psychologists	57
Physiotherapists	112
Health educators	90
Dietitians	52
Total	1,246

Status of project implementation

Health risk assessment

Of the patients in the PHC providers, 178,769 patients (62%) were eligible for a health risk assessment based on falling within the required age range of 20-65

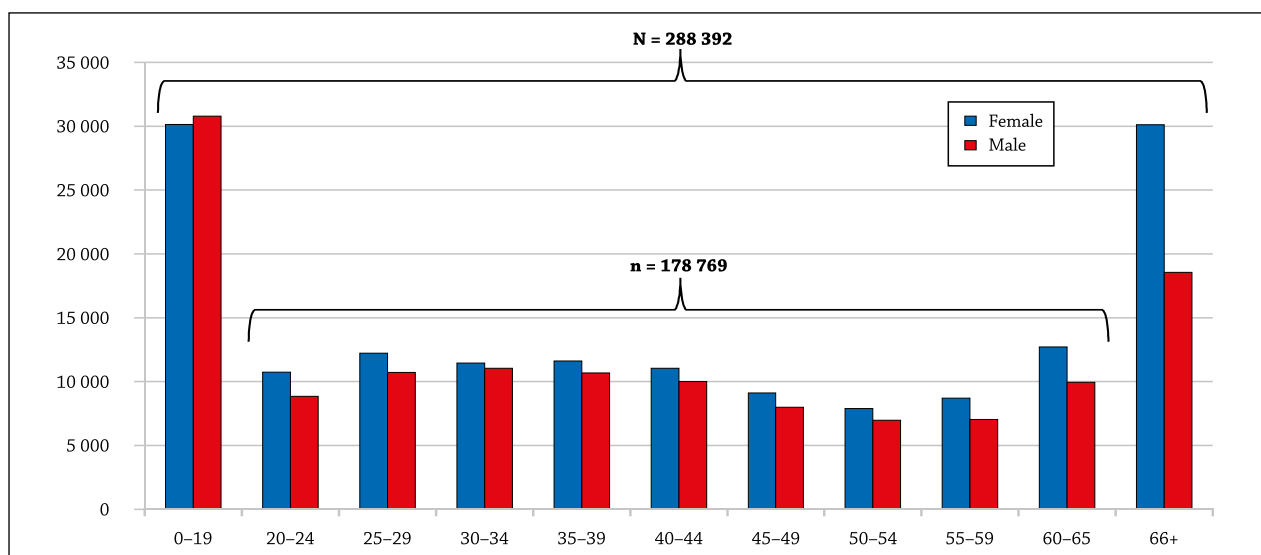


Figure 1. Demographics of the patients in PHC providers involved in the project.

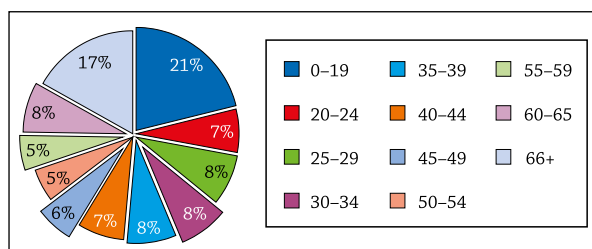


Figure 2. Demographics of the patients in PHC providers involved in the project.

years. To be eligible, patients were also required to have no history of receiving health care services within the prior 12 months. Out of the 41,022 health risk assessments which were to be performed during the course of the project, 18,058 (43.1%) were performed between July 1, 2018 and April 30, 2019, including 4,537 basic and 13,521 extended health risk assessments. Basic health risk assessments include a medical interview, an assessment of basic vital and anthropometric param-

ters, the performance of diagnostic tests, and an overall view of the patient's current health status. Extended health risk assessments should be performed in cases where patients are determined to have health risk factors. Extended assessments include additional diagnostic tests and a discussion of an individual treatment plan based on the aforementioned test results.

Disease management programs

The disease management programs began on July 1, 2018 and cover 11 chronic diseases found in adults, including Type II diabetes, spontaneous hypertension, chronic coronary heart disease, chronic heart failure, persistent atrial fibrillation, bronchial asthma, COPD, hypothyroidism, parenchymal or nodular goiter, osteoarthritis of the peripheral joints, and spinal pain syndrome. Eligibility for participation in the disease management programs was based on either a suspicion or diagnosis of a chronic disease. Additionally, the stage of disease should be treatable under primary care. In total, 233,856 patients in the PHC providers were eligible as they were 18 years of age or older. Of these patients, 15,020 (6.4%) participated in the disease management programs through April 30, 2019. The largest group of patients in these programs was

that comprised of people over the age of 60 (6,779 patients or 46%) (Tab. 3, Fig. 3–5). The majority of patients, 11,112 (74%), participated in rheumatology and/or neurology programs, 4,802 (21%) were in cardiology programs, 3,126 (14%) were in pulmonology pro-

Table 3. Potential and actual beneficiaries of disease management programs

Age [years]	Potential beneficiaries of disease management programs	Actual beneficiaries of disease management programs
18-19	6,411	55
20-24	19,585	290
25-29	22,948	437
30-34	22,507	611
35-39	22,289	926
40-44	21,046	1,170
45-49	17,124	1,419
50-54	14,872	1,559
55-59	15,732	1,774
60-65	22,666	2,781
66+	48,676	3,998
Total	233,856	15,020

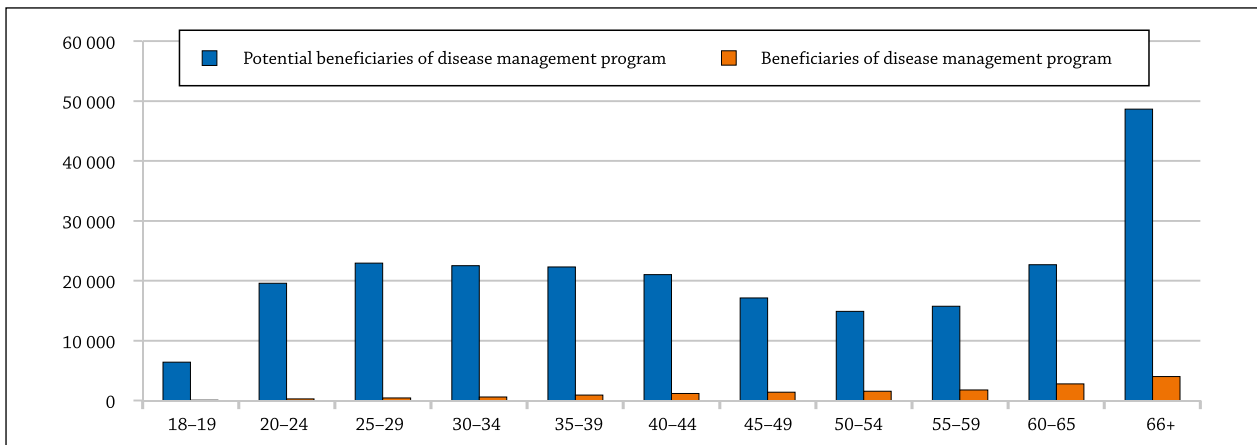


Figure 3. Potential and actual beneficiaries of disease management programs

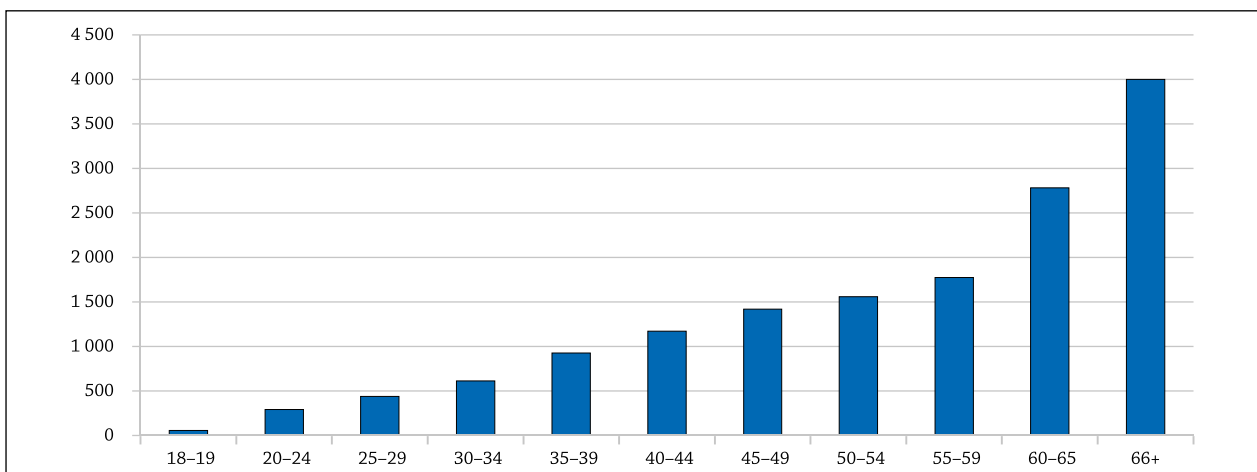


Figure 4. Beneficiaries of disease management programs according to age groups.

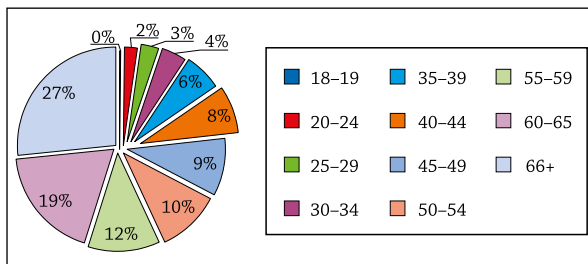


Figure 5. Beneficiaries of disease management programs according to age groups

Table 4. Participation in disease management programs as of April 30, 2019

	Beneficiaries of disease management program
Diabetology	1,001
Pulmonology	3,126
Cardiology	4,802
Rheumatology/neurology	11,112
Endocrinology	3,001
Total	23,042

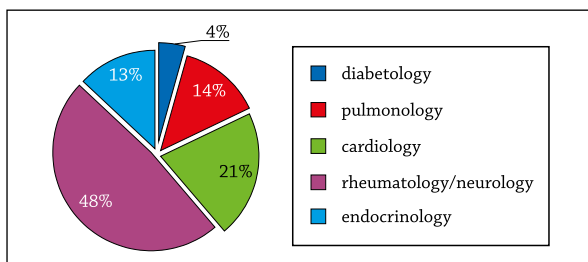


Figure 6. Participation in disease management programs

grams, 3,001 (13%) were in endocrinology programs, and 1001 (4%) were in diabetology programs (Tab. 4, Fig. 6). There were also many patients still within the process of classification, and the number of participants is still growing.

DISCUSSION

An element that is gaining more and more recognition within the realm of coordinated medical care is health checkups [7–10], the goal of which is population stratification, i.e. identification of healthy and sick patients in order to predict the number and types of services needed for a given group of patients, and to plan and implement interventions potentially changing population health indicators [7,11].

The key issue is the medical value of health checkups, in particular when they are not part of a more complex intervention. Although it is generally considered beneficial to detect the disease earlier, the benefit is only present if the detection is followed by a targeted intervention, e.g. treating the disease, instead of doing nothing. A simple example could be cervical dysplasia.

Its detection can prevent the development of cancer only if it is followed by further, preferably pre-planned therapeutic management.

Among others, the possible benefits of health checkups are:

1. Reducing morbidity and extending life by detecting risk factors for diseases
2. Enabling or accelerating the implementation of preventive treatment, including non-pharmacological interventions aimed at implementing health-promoting behaviors
3. Determining the at-risk groups for the development of chronic non-communicable diseases (NCDs), which are a current challenge for all health care systems. Early implementation of pro-health interventions for these at-risk groups is a chance to stop the early occurrence of NCDs (including complications). It is expected that the implementation of interventions in NCDs at-risk groups will significantly affect the population burden of chronic diseases and change the structure of demand for the medical services of proactive health care systems.

In literature originating predominantly in Great Britain, there are examples of health checkups conducted mainly as national programs for insured people. The lack of benefits highlighted there seems to result mainly from the lack of appropriate interventions implemented after the completion of diagnostic procedures [12,13].

With relatively low outlays on health care, which is the case in Poland, achieving goals for NCDs is difficult. Therefore, one idea is to start health checkups at the age of 20, and combine that with health promotion and targeted educational intervention (behavioral and social) [14]. NCDs in Poland cause about 90% of all deaths [15–16]. The probability of death between the ages of 30 and 70 due to one of the 4 main NCDs (cardiovascular diseases, cancer, chronic lung diseases, and diabetes account for 80% of the NCDs) is about 20%. To the question, “Do evidence-based national guidelines/protocols/standards for the management of major NCDs through a primary care approach exist?”, Poland should replace the current answer of “unknown” with “yes” [15–17].

The main purpose of integrated care interventions consists of reducing fragmentation of service delivery [18,19]. To address this, many approaches have been developed over time. The most well-known are the Chronic Care Model (CCM) [20] and its variation, the Innovative Care for Chronic Conditions model (ICCC), the latter of which was developed by the WHO as part of a ‘road map’ for health systems to deal with the rising burden of chronic illness, placing a premium on prevention, and treating patients and their families as partners [21].

Implications for research and/or practice

Future reform targets the entire population of Poland, with around 38 million people. People-cen-

tered coordinated care is expected to help care systems achieve the following objectives (Triple Aim goals):

- improving population health
- increasing quality of care for the individual
- lowering per capita costs

This patient-oriented strategy seems to be better adapted to the current health care environment and demographic trends as, by the year 2060, the number of seniors in Poland is expected to double from 5.5 to 11 million. Further analyses to confirm the expected benefits are necessary.

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CONCLUSIONS

A coordinated care model in primary health care in Poland can help train the focus on preventive interventions instead of on providing medical services to patients already diagnosed with diseases, many of which are already in more advanced stages. The results of the study indicate that the primary health care population will be the main beneficiary of similar future programs. Other beneficiaries include the medical staff necessary for the proper implementation of integrated care models in health care systems similar to the one that exists in Poland.

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DEEP TISSUE MASSAGE AND FLEXIBILITY IN THE STRUCTURAL COMPONENTS OF THE SUPERFICIAL BACK LINE OF PROFESSIONAL VOLLEYBALL PLAYERS: A PILOT STUDY

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ABSTRACT

Background: Massage is a common treatment in physiotherapy, often used as a prophylaxis or during recovery following a musculoskeletal contusion. One form of therapeutic massage is deep tissue massage (DTM), which has become more popular in recent years as a way of performing targeted work with the myofascial system.

Aim of the study: The aim of the study was to examine the effectiveness of deep tissue massage on superficial back line flexibility (hip flexion and knee extension range of motion - ROM).

Material and methods: Elite volleyball players (n=15), age: 22.8 ± 4.41 years; mass: 82.67 ± 6.99 kg; height: 1.96 ± 0.08 m) were recruited for this study. Deep tissue massage of the myofascial superficial back line was performed from the plantar fascia through the gastrocnemius and soleus muscles, the hamstrings to the ischial tuberosity (based on Myers, 2014). Hip flexion and knee extension ROM were measured at rest both before and after DTM. The Wilcoxon signed-rank test was used to compare pre and post values during the intervention.

Results: Following deep tissue massage, there was significant improvement in superficial back line flexibility, demonstrated by an increase in hip flexion angle compared to pre-DTM values in both lower limbs. Right lower limb pre-DTM 1.86±0.66; post 2.79±0.43 (p<0.005), left lower limb pre-DTM 2.36±0.74; post 2.79±0.43 (p<0.028). There was also significant improvement in superficial back line flexibility demonstrated by an increase in knee extension angle post-DTM in both lower limbs. Right lower limb pre-DTM 69.79°±10.8; post 81.43°±6.06, left lower limb pre-DTM 73.07°±11.45, post 82.50°±8.39).

Conclusions: Deep tissue massage increases the flexibility of the superficial back line and can be used as a form of increasing range of motion in the hips and knees.

KEYWORDS: deep tissue massage, superficial back line, volleyball players

BACKGROUND

Massage is a common treatment in physiotherapy. It can be used as a form of prophylaxis or during recovery following a musculoskeletal contusion [1]. One form of therapeutic massage is deep tissue mas-

sage (DTM), which has become more popular in recent years as a way of working with the myofascial system [2]. In deep tissue massage, techniques include myofascial release, trigger point pressure release and elements of structural bodywork such as structural integration/

Rolfing®. The essence of this therapy is to restore balance and proper function in the musculoskeletal system as a whole [3]. Physiotherapists work with soft tissue using their forearms, elbows, the palms of their hands or their knuckles without the addition of any oil or lotion. These are gentle techniques which must be used thoughtfully following an initial functional assessment of the patient [4,5]. For this reason, the term DTM is utilized here to describe a specific method of massage therapy, used specifically for the elimination of persistent abnormal tension and restrictions within the myofascial system by relaxing, lengthening, and releasing holding patterns [2,6]. Common indications for the use of DTM are locomotor and postural disorders accompanied by functional changes in the myofascial system. For example, this can include reduction of tissue flexibility (range of motion), myofascial trigger points (MTrPS), post-traumatic and post-surgical soft tissue dysfunction and any other disorders which stem from overstraining or compression [4,6]. DTM is commonly employed by sports medicine physiotherapists to improve athletes' physical capabilities and movement efficiency through an increased range of motion and muscular function [7].

The myofascial system is a network of interconnecting tissues that, when functioning correctly, work together effectively to allow for efficient movement. When muscles and fascia are subjected to some kind of strain or compression, fascial restrictions may alter normal muscular function through the development of myofascial trigger points and increased soft tissue stiffness. As a result, the range of motion in a person's joints may similarly decrease, and may be accompanied by altered neuromuscular properties and decreased muscle strength [7–9]. Current research suggests that the skeletal muscles of the human body are directly linked by fascia through myofascial chains. Because the fascia run in different directions, they are able to move and change form in concert with their surrounding tissues. For this reason, the myofascial system is believed to be one continuous piece of tissue working via connected “chains” as a tensegrity structure. Due to the increasing popularity of myofascial techniques, examining the functional relevance of these chains is critical in contemporary research. Further research into the transmission of strain along myofascial chains could provide a new way of understanding pain, along with a basis for developing holistic and evidence-based treatment strategies. Based on his anatomical dissection studies, Tom Myers proposed 6 myofascial meridians, of which one is the superficial back line [10–13].

AIM OF THE STUDY

The aim of the study was to examine the effectiveness of deep tissue massage on superficial back line flexibility (hip flexion and knee extension range of motion).

MATERIAL AND METHODS

Study design

Goniometric measurements were carried out twice on the volleyball players, both before and after deep tissue massage. Then, the results were compared.

Setting

Studies were conducted from November 2017 to March 2018.

Participants

Study participants included elite national level volleyball players (n=15). The criteria for inclusion were that the players were injury-free at the time of the study, 18 years of age or older, members of an elite volleyball team, and actively playing volleyball (training and/or matches). Players were excluded if they were found to have suffered a lower extremity injury or lumbar pathology, including back injury, in the previous six weeks. Information regarding age, body height and body weight was collected. Height was measured to the nearest 0.1 cm with the use of an anthropometer and body mass was measured to the nearest 0.1 kg with a calibrated digital scale. The general characteristics of the participants are as follows in Tab. 1.

Table 1. General characteristics of the participants, n=15

Descriptive statistics	Age [years]	Body height [cm]	Body mass [kg]
Mean	22,80	195,53	82,67
SD	4,41	8,07	6,99
median	22,00	194,00	84,00
max	33,00	210,00	98,00
min	18,00	187,00	73,00

The participants were given an explanation of the study's purpose and methods, and were required to provide informed consent. They were then instructed on how to perform the test movements with precision. Prior to conducting the study, the researchers obtained approval from the Bioethical Commission at the Opole Medical School (Nr KB/56/FI/2017).

Variables

Goniometric measurements were taken with a short arm goniometer for both the Active Straight Leg Raise test (ASLR) and the Active Knee Extension test (AKE). The measurements were carried out twice, both before and after deep tissue massage was performed with the participants lying in a supine position. The results were then compared.

Data sources/measurement

Active Straight Leg Raise test (ASLR)

Participants lay supine with the lower limb that was to be tested actively flexed and the knee fully extended.

During the movement, the contralateral limb was stabilized and fully extended on the ground. The movement stopped when the participant felt strong resistance or when researchers observed any pelvic movement. Then, the physiotherapist identified the midpoint between the anterior superior iliac spine and the patella of the other leg, and placed a dowel at this position, perpendicular to the ground. The participant received a score of 3 when the vertical line of the medial malleolus of the tested lower limb stood between the mid-thigh and the ASIS. The participant scored a 2 when the vertical line of the medial malleolus of the tested lower limb stood between the mid-thigh and the knee joint. The participant scored a 1 when the vertical line of the medial malleolus of the tested lower limb stood below the knee joint. The other lower limb remained fully extended on the ground [14].

Active Knee Extension Test (AKE)

The participant was asked to perform an active extension movement at the knee joint (with the hip flexed at 90°), and was instructed to stop when they felt strong resistance to the movement. The tested limb was flexed at the hip until the thigh stood at a 90° angle with the table. The contralateral limb was fully extended and stabilized in neutral rotation. With the knee flexed at 90°, a goniometer was placed over the lateral femoral condyle, with 1 arm aligned with the thigh and the other arm aligned with the calf. From this position, the participant was instructed to extend the knee until they felt a strong resistance, and hold this final position for 2 to 3 seconds to allow the goniometric reading to be taken. The result was recorded in degrees of the knee-extension movement, starting from the initial test position (knee flexed at 90°). After the goniometric reading, the tested leg resumed the resting position, after which the same procedure was done with the second leg. Between the AKE and the ASLR measurements, subjects rested for 5 minutes.

Superficial back line deep tissue massage

Each participant received deep tissue massage from a certified physiotherapist for 30 minutes on both lower limbs in the prone position. The intervention was performed according to the following sequence: from the plantar fascia through the gastrocnemius and soleus muscles, the hamstrings (the semimembranosus, the semitendinosus, the biceps femoris long head and the biceps femoris short head) to the ischial tuberosity. The speed and depth of the DTM, along with a number of muscle repetitions, was selected individually for each player to maximize the therapeutic effect of the massage.

Bias

All procedures concerning data collection, measurements and deep tissue massage for a single player were executed in the same day and were done by the same physiotherapist.

Statistical methods

The arithmetic mean, standard deviation, median, minimum and maximum were calculated for the measurable variables. A non-parametric Wilcoxon signed-rank test was performed to compare the results between the values obtained before and after the intervention. The level of $\alpha=0.05$ was assumed, and the obtained p values were rounded to three decimal places. Statistical analysis was performed using Statistica 12 under the license of Opole Medical School.

RESULTS

The mean, standard deviation and p value for the ASLR and AKE in Table 2 and 3 were presented. An analysis of the data indicated that there were significant differences between the pre- and post-DTM measurements.

Tab. 2 shows significant immediate improvement in superficial back line flexibility which was demonstrated by an increase in the hip flexion angle from pre-DTM in both lower limbs. The right lower limb pre-DTM 1.86 mean score ± 0.66 ; post 2.79 mean score ± 0.43 ($p < 0.005$), left lower limb pre-DTM 2.36 ± 0.74 ; post 2.79 ± 0.43 ($p < 0.028$).

Table 2. Active Straight Leg Raise test (ASLR) pre- and post-deep tissue massage (DTM) [Mean \pm SD]

ASLR	DTM	Mean (\pm SD)	p-value
Right lower limb	Pre	1.86 \pm 0.66	0.005
	Post	2.79 \pm 0.43	
Left lower limb	Pre	2.36 \pm 0.74	0.028
	Post	2.79 \pm 0.43	

Legend: ASLR – Active Straight Leg Raise, DTM – deep tissue massage, SD – standard deviation

Tab. 3 shows significant immediate improvement in superficial back line flexibility which was demonstrated by an increase in knee extension angle post-DTM in both lower limbs. Right lower limb pre-DTM 69,79 \pm 10,8; post 81,43 \pm 6,06, left lower limb pre-DTM 73,07 \pm 11,45, post 82,50 \pm 8,39).

Table 3. Active Knee Extension test (AKE) pre- and post-deep tissue massage (DTM) [Mean \pm SD]

AKE	DTM	Mean (\pm SD)	p-value
Right lower limb	Pre	70 \pm 11	0.001
	Post	81 \pm 60	
Left lower limb	Pre	73 \pm 11	0.001
	Post	83 \pm 80	

Legend: AKE – Active knee extension, DTM – deep tissue massage, SD – standard deviation

Tab. 4 shows the percentage of the active straight leg raise test with a 1, 2, and 3 point scoring system for the professional volleyball players before and after the DTM intervention. Before the intervention, more than

50% athletes achieved a score less than 3 for both the right and left lower limbs.

Table 4. The percent of active straight leg raise test with 1, 2, 3 point score in the professional volleyball players pre and post the DTM intervention.

n=15	% pre DTM		% post DTM	
	Right lower limb	Left lower limb	Right lower limb	Left lower limb
3	20	47	80	80
2	53	40	20	20
1	27	13	0	0

DISCUSSION

Key results

This study investigated aspects of the effects of deep tissue massage on the flexibility of the superficial back line through an Active Straight Leg Raise test (ASLR) and Active Knee Extension test (AKE). The ASLR test assesses the ability to disassociate the lower extremity from the trunk while maintaining stability in the torso, as well as tests superficial back line flexibility while maintaining a stable pelvis and trunk [14]. When a patient achieves a score less than 3, the limiting factor must be identified by the physiotherapist. Clinical documentation of limitations can be obtained by using other tests such as the Thomas test or a sit and reach test. When a patient achieves a score of 2, there is a possibility of asymmetric hip mobility limitations, unilateral muscle tightness or stability dysfunction of the non-moving limb and trunk. When an athlete scores a 1 or less, hip mobility limitations are common [14]. In this study, before the intervention, more than 50% of the athletes achieved a score less than 3 for the right and left lower limbs (Tab. 4). Poor performance during ASLR tests can be the result of many factors. First, and most importantly in this study, the athlete may lack a functional hamstring muscle group or functional gastrocnemius in terms of fascial flexibility. Moreover, the athlete may have inadequate mobility in the opposite hip, which may be associated with psoas major muscle inflexibility and an anteriorly tilted pelvis [14]. Immediately after the intervention, 80% of the athletes achieve a score of 3 for both lower limbs (Table 4). According to our data (Tab. 2), a significant increase in hip angle, which correlates with a 3 point score in the ASLR, suggests that deep tissue massage induces greater range of motion and flexibility of the superficial back line, possibly through an increased stretch tolerance or an increased compliance of the superficial back line muscle group. Other researchers have reached similar conclusions [15,16].

Interpretation

The Active Knee Extension test is one of the most commonly used measures for the assessment of flexibility and hamstring length changes [17–20]. The result

of this study showed that DTM increases immediate post intervention knee range of motion. It is worth noting that knee range of motion (ROM) is necessary for both sports and daily activities, and loss of full ROM can have detrimental effects on the function of the entirety of the lower limbs. For example, decreased extension ROM can cause an altered gait pattern, which can affect the ankle and hip and cause difficulty with running or jumping. Moreover, the loss of knee extension can result in anterior cruciate ligament reconstructions, total knee arthroplasties and other musculoskeletal injuries involving the knee joint [21]. Deep tissue massage is the commonly used treatment for improving ROM in physiotherapy, though little is known about its efficacy, especially in lower limb flexibility. Eriksson Crommert et al. described the effects after a seven-minute medial gastrocnemius massage in which researchers observed a decrease in muscle stiffness, measured via elastography, immediately post intervention. It is interesting that this effect was short and returned to baseline values quickly after cessation of the massage [22]. Recent research about injury prevention in athletes suggests that increased flexibility in the hamstring muscle group is one of the modifiable risk factors for the most common musculoskeletal injuries in the lower limbs [23–25]. Literature suggests that DTM, and a related reduction of restriction or fibrous adhesion between layers of myofascial tissue, can contribute to muscle strain and other pathological processes such as TrPs [26,27]. These facts are clinically important to physiotherapists who specialize in sports medicine and musculoskeletal conditions, especially when evidence-based treatment strategies are required.

Generalizability

Flexibility is an important physical parameter often related to both muscle injury and athletic opportunities. Therefore, poor flexibility of the myofascial chains, especially affecting the hamstring muscle group, has been considered as a contributor not only to muscle strains but also to other conditions such as patella tendinopathy or back pain [17,23,28]. Clinicians routinely assess superficial back line muscle group length in patients with injuries to their musculoskeletal system, as well as in athletes when judging readiness to return to sports following an injury. They conduct this assessment using methods including the Straight Leg Raise test (SLR), the Passive Knee Extension test (PKE) or the Active Knee Extension test (AKE) [18]. Recent research suggests massage may have a positive effect and be a way of improving the recovery process after physical exercise, both in sports and in rehabilitation contexts [29]. Massage as a recovery technique may increase muscular blood flow and reduce muscle edema in delayed onset muscle soreness, reduce perceived fatigue and concentrations of cytokines in the blood after exercise, aid normalization of the autonomic nervous system, increase the secretion of certain hormones and lower blood pressure [1,15,30–32].

Massage is also utilized to improve flexibility or reduce stiffness in myofascial tissue through the stimulation of mechanoreceptors [33]. However, there is a lack of supporting evidence that such mechanical effects occur and future research is still needed [34].

Limitations

Further studies on the effectiveness of deep tissue massage should be conducted with a larger number of

participants, randomized control, objective measurements and a follow-up study.

CONCLUSIONS

Deep tissue massage increases flexibility of the superficial back line and can be used as a form of increasing hip and knee range of motion. However, this study design limits the interpretation of these findings.

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INTRAUTERINE FETAL DEMISE AND LATE MOTHERHOOD – A CASE REPORT

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ABSTRACT

Background: Intrauterine fetal death is a potential risk in each stage of pregnancy, regardless of the mother's age. In Poland in 2015, new standards of care were introduced for women with obstetric failure.

Aim of the study: This study aimed to analyze intrauterine fetal demise in the context of late motherhood.

Material and methods: Medical documentation and a semi-structured interview were used.

Case report: A 41-year old primipara in 37 weeks of pregnancy, who had not felt fetal movements for 2 days, was diagnosed with intrauterine fetal demise. The pregnancy was uneventful before, but the patient suffered from hypertension and severe obesity. As a result of induced labor, a male neonate weighing 2260 g, 49 cm long, with no signs of vital functions, was born. After the birth, it was established that the child died due to an umbilical cord accident. The mother was given the appropriate time to see the child for the last time. During delivery and hospitalization, the patient's privacy was ensured, she was isolated from other women in labor and new mothers and was assisted by her family. During the hospital stay, the patient was under the care of the obstetrician, midwife and clinical psychologist. She was discharged from the hospital after 6 days.

Conclusions: The loss of a child is one of the most traumatic experiences for a mother, particularly in the case of older mothers. A woman's fertility declines with age, so getting pregnant again might prove extremely difficult for older women.

KEYWORDS: fetal death, late motherhood, obstetric failure

BACKGROUND

Intrauterine fetal demise (IUFD) is one of the complications that can occur at any stage of pregnancy, regardless of the mother's age. Stillbirth is defined as the birth of a child without signs of life after 24 weeks of pregnancy or in Poland, after 22 weeks of pregnancy [1].

There are three groups of factors that affect IUFD: maternal, fetal and placental. The most common maternal factors include hypertension during pregnancy, pre-eclampsia, heart diseases, mental health problems, diabetes, obesity, high multiparity or primiparity and smoking during pregnancy, including passive smoking. Fetal factors include the sex, isoimmunization of Rh, 37 weeks of gestation, lethal malformations and chromosomal defects, fetal growth restriction such as a birth weight below the 10th percentile, and intrauterine infections. IUFD factors related to the placenta and umbilical

cord, in addition to premature detachment and placenta praevia, include umbilical cord prolapse, neck wrapping (usually multiple) and true umbilical knot [2,3].

Since disseminated intravascular coagulopathy (DIC) and puerperium sepsis are the most common complications of IUFD, vaginal delivery is recommended for a woman's safety. Waiting for spontaneous labour to begin significantly increases the risk of complications, so the standard procedure is to induce labor [1].

After a stillbirth, mothers are more likely to experience symptoms of post-traumatic stress, depression and sadness, as well as an unwillingness to become pregnant again [3–6].

The rate of late motherhood is increasing worldwide. It could be attributed to various causes, including infertility and socio-economic reasons in developed countries, but also, for example, the governmental

demographic policy, as in the case of the “one-child policy” in China [7–9]. Additionally, late motherhood may result from the difficulty in choosing the right partners for developing a satisfying relationship, waiting to achieve financial stability or a greater focus on women’s careers [8]. The risk of pregnancy complications grows with the age of the woman. Age-related conditions, such as hypertension, diabetes and previous surgery of the reproductive organs, can lead to complications during pregnancy, childbirth and puerperium [10].

The main complications during pregnancy, childbirth and puerperium are pregnancy-induced hypertension, gestational diabetes, anaemia and infections of the respiratory and urinary tract. The mother’s health problems may be the cause of fetal intrauterine growth restriction and IUFD, preterm birth or the need for different medical and surgical interventions. Due to the increased risk of chromosomal defects, women over 35 years of age may opt for free of charge, non-invasive and invasive prenatal tests in Poland. Researchers have indicated an increased risk of complications growing with the age of the mother [10].

In 2015, the Regulation of the Polish Ministry of Health defined the standards of perinatal care in case of complications and high-risk pregnancy. This was the first legal regulation concerning the treatment of obstetric failures in Poland. In addition to medical standards, it focused on proper communication with the patient in a traumatic situation caused by the loss of a child [11].

In 2016, based on the Regulation, recommendations concerning the care of women in case of obstetric failures were made locally for the Mazovian Province. The guidelines were developed by a team of regional consultants in the field of perinatology, obstetrics and gynecology, public health, a psychologist and a priest. The publication is divided into two parts, and it is intended for medical staff and accompanying persons. The guidelines discuss the stages of mourning in an accessible way, which is important not only for the mother and her relatives, but also for the medical personnel. The mother should be informed about her state of health and her rights so that she can make conscious decisions and give consent to carry out the necessary medical procedures. The woman should be isolated from other mothers in the delivery room during labor and in the maternity ward after the childbirth. Psychological support is needed not only for patients, but also for medical staff. All procedures should be carried out with respect for the mother’s privacy and to engender a sense of intimacy. It is also important to provide opportunities for family and relatives to say goodbye and receive mementos from the child. Finally, there are current legal acts relating to burial and assistance for the mother [12].

AIM OF THE STUDY

This study aims to draw attention to the problem of stillbirth in the context of late motherhood.

MATERIAL AND METHODS

A semi-structured interview was conducted and medical records were analyzed. The interview lasted approximately 2 hours and a standardized examination of health behaviour was performed using the inventory of health behaviour (IZZ) during the patient’s hospital stay.

The study has the consent of the bioethical committee no. AKBE/214/2017. The patient’s consent to publication was obtained.

CASE REPORT

The 41-year-old primipara in 37+6 week of her second pregnancy came to the Clinic of Obstetrics and Perinatology in Warsaw in November 2017 due to not feeling fetal movements for 2 days. Ultrasound examination revealed no heartbeat and fetal hypotrophy. On admission, the patient’s vital signs were BP 160/120, HR 120/min, Group B Strep (GBS) (+).

The reason for late motherhood was the difficulty in finding a proper partner, without history of infertility. She was unmarried, had a high socio-economic status and a university degree and lived in the city. She miscarried her first pregnancy at week 12 one year before.

During her current pregnancy, she regularly attended medical appointments. The combined test was performed at 13+2 weeks of pregnancy: the ultrasound examination showed no abnormalities, beta-hCG=1.107 MoM, PAPP-A=0.193 MoM (MoM - multiple of median, multiple of median for a given gestational age). An increased risk of trisomy 21 (1:15), 18 (1:57) and 13 (1:125) was found, but the patient did not decide on amniocentesis and karyotyping. A free fetal DNA test was performed, which did not indicate an increased risk of trisomy. The patient had arterial hypertension treated before pregnancy and obesity; her BMI before pregnancy was 35 (II degree obesity). During pregnancy, her body weight increased by 19 kg, reaching 119 kg. Due to the very low level of PAPP-A protein corresponding to 0.193 MoM, the patient was on prophylactic doses of 75 mg of acetylsalicylic acid per day, from the end of the first trimester to the end of the 36th week. Standardized examination of health behaviour revealed a high degree of healthy behaviour, including normal eating habits, preventive behaviour, positive mental attitude and health practices. She was a passive smoker and her partner smoked 10-20 cigarettes a day.

After admission to the Department, cephalic position of the fetus was confirmed and pre-induction was initiated with Misoprostol. Then, due to the lack of reaction to prostaglandins, Foley’s catheter was inserted into the cervix. The next day, the induction was performed with an oxytocin infusion. During labor, the patient was given epidural anesthesia.

After 3 hours of the first period and 30 minutes of the second period of childbirth, she delivered a male neonate weighing 2260 g, 49 cm long (1st percentile) with no signs of vital functions. After childbirth, the

umbilical cord conflict was considered as a probable cause of death; the umbilical cord was twisted twice around the child's neck and once around the child's torso.

As requested, the mother and her loved ones were given about 2 hours - according to current regulations - to see the child for the last time, to say goodbye and to be given a footprint of the child as a memento.

Subsequently, an autopsy was performed, in which the cause of death indicated asphyxia on the ground of the umbilical cord entanglement. No developmental abnormalities were found. In order to exclude genetic disorders, an array Comparative Genomic Hybridization (aCGH) test was performed, which did not reveal any abnormalities.

The neonatal weight was in the 1st percentile and, as previously mentioned, at end of the first trimester, very low level of PAPP-A = 0.193 MoM was noted. This demonstrates that there was evidence of intrauterine growth restriction (IUGR) most likely due to placental insufficiency that had developed despite acetylsalicylic acid prophylaxis. In IUGR, the umbilical cord is often abnormally thin due to the paucity of Wharton's jelly and is hence prone to fatal cord entanglement.

Due to the increase in acute phase protein CRP and leucocytosis indicating the development of inflammation, the patient received first intravenous and then oral antibiotic therapy.

The mother, with the help of her family, decided to bury the child. After the birth, the woman was both sad and calm. She was aware that with age it would

become more difficult for her to get pregnant, especially with existing health problems. Traumatic experiences with the birth of a dead baby and an earlier miscarriage directly impacted the woman's decision to refrain from getting pregnant again.

During the hospital stay, the patient's privacy was ensured, and she was deliberately isolated from other mothers and their children. The childbirth took place in a separate delivery room. During the entire hospitalisation, the patient was in a single room, under the care of obstetricians, midwives and a clinical psychologist. The family had the opportunity to contact her without time limits.

The patient was fully informed about her state of health and her rights, which helped her to make conscious decisions and consent to medical procedures. She was given the opportunity and enough time to discuss her decisions with her partner. A questionnaire and information for patients and accompanying persons was according to Recommendation for the Mazovian Province for medical personnel. She was discharged from the hospital after 6 days.

CONCLUSIONS

Losing a baby is one of the most traumatic experiences, especially for older women, where getting pregnant again can be difficult because fertility decreases with age. In addition to proper medical treatment, it is extremely important to provide psychological support and to respect the privacy of the patient and her family.

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THE USE OF TENSEGRITY MASSAGE IN PREGNANT WOMEN: A CASE REPORT

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ABSTRACT

Background: In pregnant women, changes in body posture and higher pelvic anteversion and increase lumbar lordosis are observed. Changes in the arrangement of bony elements result in an alteration in the pelvic floor soft tissue tension, increased resting muscles and ligaments tone in the lumbosacral region and sacral bone. The negative consequences of posture changes in pregnant women is lower back pain. The literature describing a lot of physiotherapeutic procedures and various of type massage which can use in pregnant women. In this study, we present applications of tensegrity massage combined with point manipulation of selected muscle attachments.

Aim of the study: The aim of the study was to determine the effectiveness of tensegrity massage combined with point manipulation of selected muscle attachments in pregnant women.

Material and methods: Two 30-year-old pregnant women received tensegrity massage were qualified for the study. The patients were subjected to a series of nine massage sessions of 45 minutes each, performed three times a week. Pain levels were assessed in both patients using the VAS.

Results: The procedure involved normalization of the tone of the system of ligaments, fascia, and muscles in the lumbar spine region, the pelvic girdle, and the lower limbs. The therapy brought pain relief and reduced muscle tone in the lumbosacral region of the spine, as well as in the pelvic girdle and the lower limbs.

Conclusions: Tensegrity massage combined with point massage is an effective therapy for pain problems and incorrect resting muscle tone caused by pregnancy-related posture changes within the pelvis and spine.

KEYWORDS: tensegrity massage, pain, pregnancy

BACKGROUND

In pregnant women, changes in body posture and higher pelvic anteversion are observed, as well as increased lumbar lordosis, weight gain, and a shift forward in the center of gravity. Anteversion of the sacral bone in pregnancy directly disturbs the spinal–pelvic balance and reduces the mobility of sacroiliac joints, leading to compensatory changes in other bone structures, such as the hip joints and lower limbs. Changes in the arrangement of bony elements result in an alter-

ation in the pelvic floor soft tissue tension. To maintain the static balance of the posture, the trunk leans backwards [1,2]. Dysfunction of intervertebral joints, together with lumbar hyperlordosis, leads to stiffness in the lumbar region, and excessive tension of the spinal erectors. One result of these pregnancy-related posture changes is a long-lasting aggravation of the ligaments stabilizing the sacral bone (the iliolumbar and sacrotuberous ligaments) and the sacroiliac joints. Moreover, increased lumbar lordosis tightens supraspinous

and interspinous ligaments [2,3]. The increased resting tone is observed in the iliolumbar muscle, and is accompanied by a weakening of the abdominal muscles and the gluteus maximus muscle, which is a typical symptom of lower cross syndrome [4]. Increased muscle tone and overload of tissues leads to the development of active trigger points of the pelvic girdle muscles (gluteus minimus muscle, iliolumbar muscle, longissimus dorsi muscle) [5]. Also characteristic is abnormal activity and the activation of selected pelvic girdle muscles during walking and, consequently, overload and increased tone of the muscular–fascial structures [2]. These symptoms—active trigger points, increased resting muscle tone, and tissue overload—give rise to lumbar spine pain, radiating to the pelvic girdle area and lower limbs. Such pain experienced by pregnant women is usually caused by the disturbed resting tone of the muscles—namely of the gluteus maximus and medius, piriformis, quadratus lumborum and lumbo-costal muscles, as well as the posterior thigh muscles and soleus muscle [5,6]. The tendency of the sacral bone to adopt a horizontal position increases the tension on the spinal erector, increases the disturbed activity of the iliac and lumbar muscles, and causes irritation and stretching of the piriformis muscle. The consequence of these changes is improper gait in which the pelvis does not swing; this establishes negative patterns and leads to overloading of the joints. Modifications in the arrangement of the bony elements impose compensatory changes on the system of muscles, ligaments, and tendons, which may produce so-called piriformis syndrome [2,6,7]. A permanent abnormal resting tone of the piriformis muscle can bring about pressure on the upper and lower gluteal arteries, as well as on the branches of the ischiadic nerve, leading to disturbances in the blood supply to the gluteal area and to persistent pain and paresthesia in the areas of the lumbar spine, buttocks, thigh, kneepit, shin, and even foot [8]. In pregnant women, weakness in the gluteus medius is sometimes observed, potentially producing pain in the lower back [2]. Alterations in the function of the pelvic girdle, sacral, and pelvic ligaments can result from prolonged dysfunction and muscular imbalance. Persistently irritated iliolumbar and sacrotuberous ligaments, as well as sacroiliac joints, prevents stabilization of the pelvis. Dysfunction is also observed in the interspinous and supraspinous ligaments, as a reaction to increased lumbar lordosis [2,6,9]. Inappropriate tension in those causes lumbar, sacral, inguinal, and gluteal pain, which can radiate to the thigh and shin, and even to the foot area. The negative consequences of posture changes in pregnant women include pain complaints of varying severity and location [2,6].

Treatment methods for such pain during pregnancy include pharmacotherapy with paracetamol, which has analgesic and febrifugal effects [6,10]. We can also use physiotherapeutic procedures, such as transcutaneous electrical nerve stimulation (TENS), hydrotherapy, and kinesiotherapy (full-body prenatal exercises, functional

and relaxation exercises, and water exercises) [10–13]. Additionally, to alleviate lower back pain (LBP) in pregnant women, autogenic respiratory training, postisometric muscle relaxation (PIR), fascia release techniques, segmental stabilization exercises, manual therapy techniques, craniosacral therapy (CST), and aromatherapy can all be used [6,9,14–20]. Various types of massage are useful, including relaxation, classic and therapeutic massage, lymphatic drainage, acupuncture and yoga [6,9,11,17,21–24]. There are numerous indications for massage in pregnant women, such as swelling or pain in the lower limbs and coexisting pain in areas of the body other than the lumbar region (for example, shoulder and neck pain). The most common of these is lumbar–sacral pain. The question in such cases is whether this spine region should be manipulated locally, or whether touch stimulation of the back abdominal wall should be avoided in favor of stimulating the lower part of the pelvis by manipulating the lumbosacral region spinal segment and sacral bone. The methodology should be tailored to the woman's current needs and abilities, and should be modified during the therapy, depending on changing symptoms. Additionally, the massage methodology should be considered by the patient's doctor [11]. There are also contraindications for massage in pregnant women that must be observed. These include an abnormal course of pregnancy associated with disturbed fetal development and dysfunction of the urogenital system; nephropathies: nephrocystitis, nephrolithiasis, renal failure; thyroid diseases: hyperthyroidism and hypothyroidism, as well as endocrine hyperfunction and hypofunction; pancreatopathies (pancreatitis, gestational diabetes mellitus); diabetic nephropathy; cardiovascular diseases and ninth month of pregnancy [11–13].

Objectives

In this study, we present applications of tensegrity massage combined with point manipulation of selected muscle attachments. Point manipulation has direct effects on the tendon part of muscle attachments and does not overload tissues. The advantage of tensegrity massage over other types of massage is that tissues located in distal parts and which are in indirect contact with the most painful locations are manipulated first; this allows for gradual normalization of tissue tone and allows the possibility of manipulating the most painful area in the final stage of the procedure. In this study, we present the cases of two patients who share many similarities, being of the same age (30 years old), pregnant for the first time, and with the same job (professional musicians). The differences lie mainly in their body builds and the pathomechanism of pain, as well as their mental and emotional states. Despite the differences we made an attempt to use tensegrity massage combined with point manipulation of selected tissues and we managed to alleviate pain in both women. Both women had increased resting tone, though in different tissues, which directed the choice of two separate massage methodologies.

MATERIAL AND METHODS

Participants

The first woman was 164cm/5.4ft tall and with a body mass of 50kg/110.2lbs, very slim, petite build, with a small pregnancy belly. She was in the second month of pregnancy, professionally active, working as a violin teacher in a music school, playing the violin professionally. She was on a healthy diet but not involved in any regular physical activity, other than occasional skiing in the season. She felt very well, was generally content, and was committed and eager to doing everything necessary to delivering a healthy baby. The violinist sought massage therapy for a strong, nagging, radiating, pain that had persisted for three weeks in the lumbar spine region, the gluteal area, and in the left lower limb. This was most probably caused by a fall from a ladder that had occurred while cleaning windows: a sudden jump from the second rung of the ladder, landing on the left lower extremity, might have been the cause of the pain, which tended to increase after work and after a long time sitting. It extended downwards along the back part of the thigh towards the knee, following the ischiadic nerve. As indicated by the patient, the pain was most intense in the gluteal area. A pain avoidance gait helped lighten the load on the affected (left) lower extremity: this involved bending slightly at the knee and iliac joints, with the buttocks moved backward. The woman complained of a pulling sensation on the back part of the thigh and a squeezing sensation in the buttock. She avoided lying on her back, because the pain was increased in this position. Today, she has visible adhesion and stretch marks in the gluteal and iliac areas. The patient had not yet made use of pharmacotherapy or physiotherapy.

The second woman was 185cm/6.1ft tall, had a body mass of 78kg/172lbs, and had a pregnancy belly proportional to the other parts of her body. She was in the third month of pregnancy and active as a professional harpist and harp teacher in the music conservatory. She regularly cycled, went to the swimming pool, and frequently visited health and beauty spas. However, the nature of her job (frequent trips, concerts) made it impossible to have regular meals and to obtain sufficient amount of good-quality sleep. The harpist suffered from an acute stabbing pain in the lumbar spine region and the pelvic girdle area. She also complained of a burning, excruciating, enduring pain between the shoulder blades, accompanied by the sensation of swollen and heavy lower limbs. She additionally felt tension in the area of the neck, shoulder girdle, and upper limbs. Visual assessment revealed protraction of the shoulders, rounded back in the thoracic spine region, a pulling sensation from the greater pectoral muscle, lumbering gait, and inability to relax the trunk. The patient felt generally unwell, and complained of fatigue and lack of sleep.

INTERVENTION

Therapeutic process

The patients were referred to a physiomassage therapist by the primary care physician after having consulted the gynecologist-obstetrician in charge of the pregnancy. Since both pregnancies had a normal physiological course and there were no medical contraindications, this type of massage could be applied. Prior to each session, we performed a palpation evaluation of the structures belonging to particular systems, according to a chart of the patient's condition for massage purposes. On the basis of the results, which indicated abnormal resting tone of the muscular-fascial structures, we selected the massage methodology, each time taking into account the individual current state of the patient (Table 1).

The palpation evaluation was supplemented with a visual assessment of body posture and with information from the interview concerning the movements performed when playing the instrument, the pain location, and the type of joint mobility disorders. Prior to the therapy, as well as immediately and two months after its completion, we used the Visual Analogue Scale (VAS) to assess the severity of pain. Next, we performed the final palpation assessment of tissues to be manipulated during the procedure, in order to demonstrate the effects of the massage. The patients were subjected to nine tensegrity massage sessions (45 minutes each) at three-day intervals. The entire course of therapy lasted 21 days (Figure 1).

Before, immediately after, and two months after the end of the therapy, the patients were screened for psychological distress using a 28-item version of the General Health Questionnaire (GHQ-28) [25,26], in its Polish version by Makowska and Merez (2001), (59% sensitivity, 75% specificity) [27]. The GHQ-28 allows the general health status to be assessed. It consists of 28 items divided into four seven-item scales measuring four health dimensions—namely, somatic symptoms, anxiety and insomnia, social dysfunction, and severe depression. Each item is accompanied by four possible responses scored from 0 to 3 with a total possible score ranging from 0 to 84, which is considered to be more sensitive in the measurement of psychological distress. A total score of 23/24 is the threshold for the presence of distress. Higher scores indicate a greater probability of mental trouble [28]. The patients' answers on the GHQ-28 were analyzed by a psychologist.

Massage methodology

Nine massage sessions of 45 minutes each were performed three times a week. Each session consisted of initial, main, and final stages. The first stages was to correctly position the patient lying on the side, to ensure safety, comfort, and support of the upper and lower limb joints and tissues, as well as the smooth flow of venous blood and lymph [29,30] (Figure 2).



Figure 2. Patient’s positioning

layer of the gluteus maximus muscle) as well as tissues indirectly connected to it, such as the posterior shin muscles [30]. At this stage, the methodology of the procedure (the sequence and number of tissues to manipulate) was different for each patient, due to the differing results from palpation assessment (Table 2). Manipulation of the selected tissues in the correct order allows muscle tone to be regulated more accurately and effectively. It also helps to avoid direct manipulation of tissues located in the most painful area. Additionally, we performed point manipulation of selected tissues in the lumbar–sacral region. This means that tissues were manipulated only at the muscle attachments and not along the muscle course, which is an advantage for

pregnant women, since it strengthens their conviction that massage is safe for their babies. Point manipulation involves pressing the tendinous part of the muscle and local rubbing. The pressure should not be very strong, but may evoke slight pain, which abates as the manipulation proceeds. In the final stage of the procedure, stroking of the manipulated area of the body was performed. The massage therapist manipulated both the left and right side of the body, starting from the more painful side [29–31].

During the therapy and immediately after its end, the massage therapist told the patients about the localization and number of manipulated tissues, demonstrating the inappropriate resting tone. She explained the

Table 2. Methodology of tensegrity massage (connective tissue and techniques)

Violinist		Harpist	
Connective tissue	Techniques	Connective tissue	Techniques
System 1		System 1	
Superior fibular retinaculum	Deep stroking, spiral friction	Superior fibular retinaculum	Deep stroking, spiral friction
Posterior crural intermuscular septum	Deep stroking, spiral friction	Posterior crural intermuscular septum	Deep stroking, spiral friction
Iliotibial tract, posterior part	Deep stroking, spiral friction	Iliotibial tract, posterior part	Deep stroking, spiral friction
Gluteus maximus superficial layer	Transversal kneading	Gluteus maximus superficial layer	Transversal kneading
Medial intermuscular septum of arm	Deep stroking, spiral friction	Hypothenar eminence, thenar eminence, and palmar aponeurosis	Stroking, friction, transversal kneading
Latissimus dorsi muscle	Stroking, rolling, friction, transversal kneading in upper part of the muscle	Anterior muscle group of the forearm	Stroking, friction, transversal kneading
		Medial intermuscular septum of arm	Deep stroking, spiral friction
		Latissimus dorsi muscle	Stroking, rolling, friction, transversal kneading

Table 2. cont.

Violinist		Harpist	
Connective tissue	Techniques	Connective tissue	Techniques
System 2		System 2	
Anterior intermuscular septum of leg	Deep stroking, spiral friction	Trapezius, ascending part	Transversal kneading
Lateral muscle group: peroneus longus and peroneus brevis	Stroking, friction, transversal kneading	Deltoid, spinal part	Stroking, rolling, friction, transversal kneading
Iliotibial tract, anterior part	Deep stroking, spiral friction	Trapezius, transverse part	Stroking, rolling, friction, transversal kneading
Sartorius muscle	Stroking, friction, transversal kneading	Deltoid, clavicular part	Stroking, rolling, friction, transversal kneading
Tensor fasciae latae	Transversal kneading	Trapezius, descending part	Transversal kneading
Ligament inguinal	Friction in a single point of insertion	Pectoral fascia	Skin mobilization
		Pectoralis major	Transversal kneading
System 3		System 3	
Biceps brachii Coracobrachialis Pectoralis minor	Stroking, rolling, friction, transversal kneading Skin mobilization	Biceps brachii Coracobrachialis Pectoralis minor	Stroking, rolling, friction, transversal kneading Skin mobilization
Serratus anterior Rhomboid minor Supraspinatus Levator scapulae	Skin mobilization Kneading	Serratus anterior Rhomboid minor Supraspinatus Levator scapulae	Skin mobilization Kneading
Lateral and posterior muscle groups of the forearm Lateral intermuscular septum of arm	Stroking, rolling, friction, transversal kneading Spiral friction	Lateral and posterior muscle groups of the forearm Lateral intermuscular septum of arm	Stroking, rolling, friction, transversal kneading Spiral friction
Medial deltoid Supraspinatus	Stroking, rolling, friction, transversal kneading Kneading	Medial deltoid Supraspinatus	Stroking, rolling, friction, transversal kneading Kneading
Serratus anterior Rhomboid major Infraspinatus Teres minor Supraspinatus	Skin mobilization Friction Kneading	Serratus anterior Rhomboid major Infraspinatus Teres minor Supraspinatus	Skin mobilization Friction Kneading
Gluteus medius Iliacus Quadratus lumborum Piriformis superior and inferior glutea	Transversal kneading Pressure and friction in a single point of insertion, locally on insertion Pressure and friction at a single point of insertion, half way along the upper and lower edge of piriformis muscle	Gluteus medius Iliacus Quadratus lumborum Piriformis superior and inferior glutea	Transversal kneading Pressure and friction in a single point of insertion, locally on insertion Pressure and friction at a single point of insertion, half way along the upper and lower edge piriformis muscle
System 4		System 4	
Deep layer of the gluteus maximus	Transversal kneading	Deep layer of the gluteus maximus	Transversal kneading
Posterior muscle group of the femoris (hamstring group)	Stroking, rolling, friction, transversal kneading	Posterior muscle group of the femoris (hamstring group)	Stroking, rolling, friction, transversal kneading
Adductor major muscles	Longitudinal kneading	Adductor major muscles	Longitudinal kneading
Popliteus	Skin mobilization	Popliteus	Skin mobilization
Surae posterior muscles	Stroking, rolling, friction, transversal kneading	Surae posterior muscles	Stroking, rolling, friction, transversal kneading
Erector spinae muscles	Friction in a single point of insertion, locally on insertion	Erector spinae muscles	Friction in a single point of insertion, locally on insertion
Sacroteruberculus ligament	Friction in a single point of insertion, locally on insertion	Sacroteruberculus ligament	Friction in a single point of insertion, locally on insertion

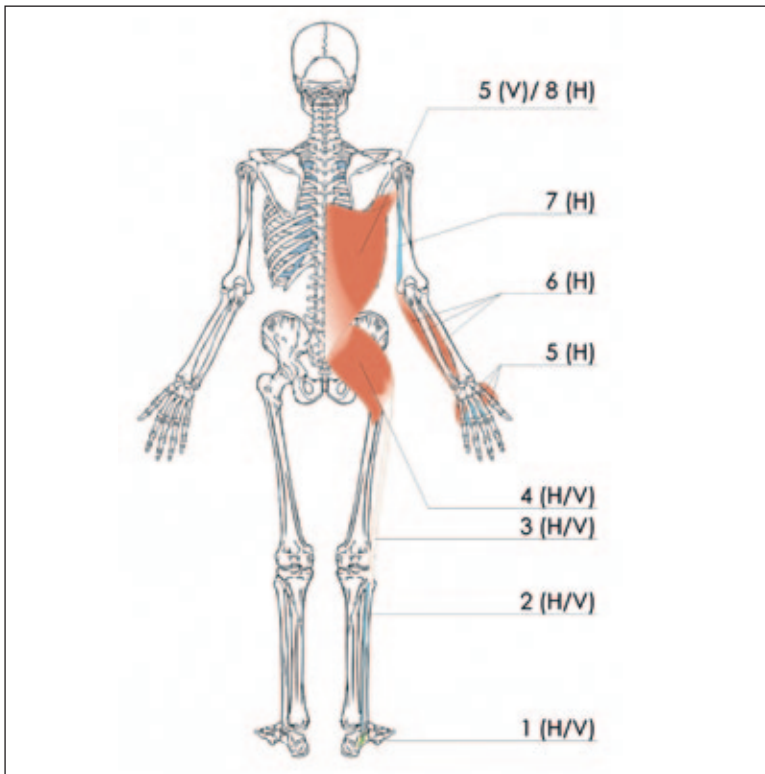


Figure 3. System I

Harpist: 1. Superior fibular retinaculum. 2. Posterior crural intermuscular septum. 3. Iliotibial tract, posterior part. 4. Gluteus maximus superficial layer. 5. Hypothenar eminence, thenar eminence, and palmar aponeurosis. 6. Anterior muscle group of the forearm. 7. Medial intermuscular septum of arm. 8. Latissimus dorsi muscle. Violinist: 1. Superior fibular retinaculum. 2. Posterior crural intermuscular septum. 3. Iliotibial tract, posterior part. 4. Gluteus maximus superficial layer. 5. Latissimus dorsi muscle.

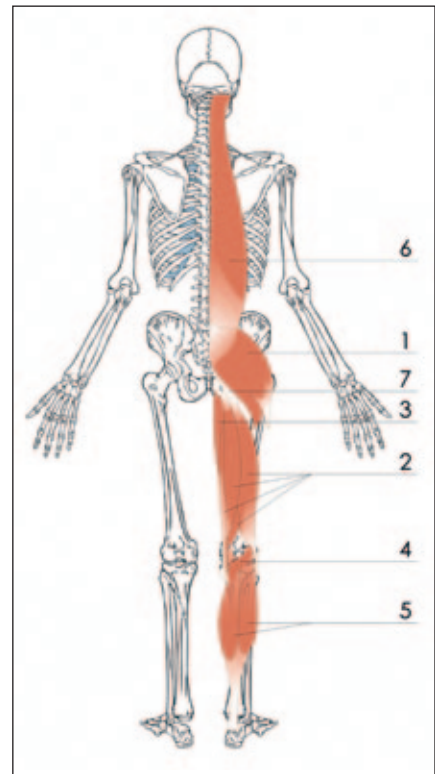


Figure 4. System IV

1. Deep layer of the gluteus maximus. 2. Posterior muscle group of the femoris (hamstring group). 3. Adductor major muscles. 4. Popliteus. 5. Surae posterior muscles. 6. Erector spinae muscles. 7. Sacrotuberulus ligament.

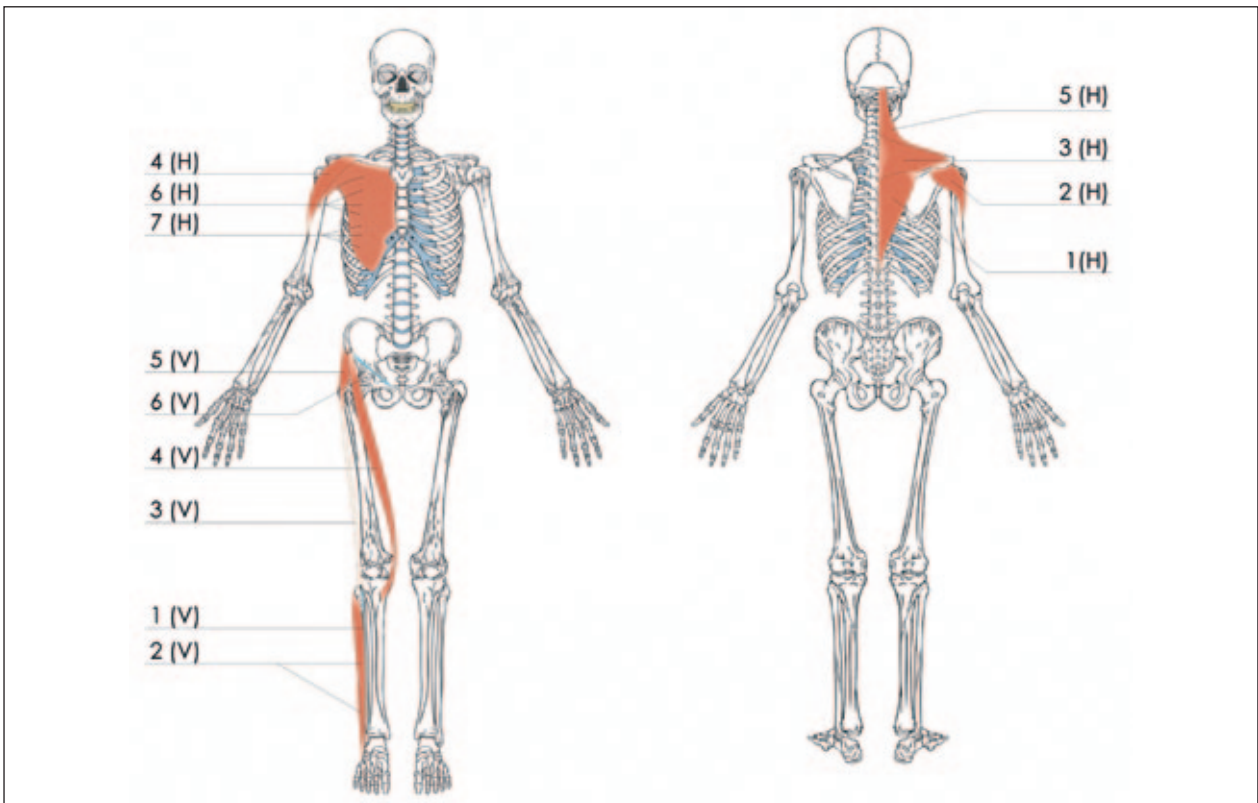


Figure 5. System II

Harpist only top: 1. Trapezius, ascending part. 2. Deltoid, spinal part. 3. Trapezius, transverse part. 4. Deltoid, clavicular part. 5. Trapezius, descending part. 6. Pectoral fascia. 7. Pectoralis major. Violinist only down: 1. Anterior intermuscular septum of leg. 2. Lateral muscle group: peroneus longus and brevis. 3. Iliotibial tract, anterior part. 4. Sartorius muscle. 5. Tensor fasciae latae. 6. Ligament inguinal.

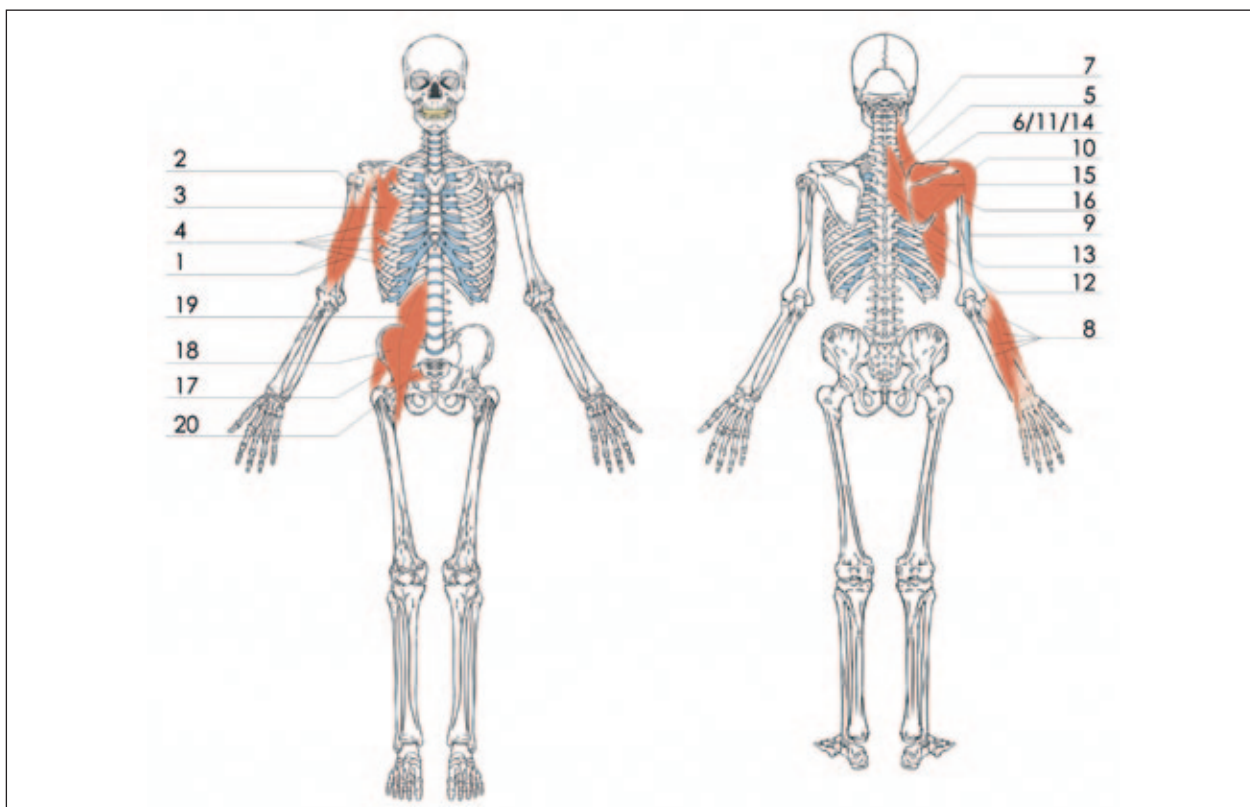


Figure 6. System III.

1. Biceps brachii. 2. Coracobrachialis. 3. Pectoralis minor. 4. Serratus anterior. 5. Rhomboideus minor. 6. Supraspinatus. 7. Levator scapulae. 8. Lateral and posterior muscle groups of the forearm. 9. Lateral intermuscular septum of arm. 10. Medial deltoid. 11. Supraspinatus. 12. Serratus anterior. 13. Rhomboid major. 14. Supraspinatus. 15. Infraspinatus. 16. Teres minor. 17. Gluteus medius. 18. Iliacus. 19. Quadratus lumborum. 20. Piriformis.

need for gradual and selective manipulation of the tissues, informed the patients about the need for correct positioning to support the lower limbs and spine, and explained how to get out of bed correctly and how to safely perform other everyday activities, such as bending down and lifting things.

RESULTS

Case 1

The results for the first patient (the violinist) are as follows: prior to the therapy, her VAS score was 6 (T_0); immediately after the therapy, the VAS score was 1 (T_1); and two months after the therapy, the pain had subsided and the VAS score was 0 (T_2). In the middle of the therapy, the pain reduced, as was confirmed by the lower number of tissues showing increased tone. This enabled the patient to make attempts to maintain the correct posture and to walk with an appropriate even load on the lower limbs. Bending and extending the lumbar region no longer caused pain, and bending was not accompanied by the pulling sensation along the whole back part of the lower limb. Neither did pain radiate to the knee pit. The patient was educated on the following aspects: resting in the back-lying position but with properly arranged and raised lower limbs, getting out of bed from the side and with bent lower limbs, relaxing the buttocks, making attempts to correctly load the left

lower limb in the standing position and during walking, and maintaining the correct extensor posture. Analysis of this patient's responses to the questionnaire showed that her mental state before the therapy was good: her total score ($x = 26$) was lower than the average scores obtained in the female population ($x = 27.35$). Analysis of specific factors indicated that the patient was not depressed; she scored highly on the Somatic symptoms and Social functioning disorders scales. Her state noticeably improved immediately after the therapy ($x = 12$). All subscale scores were below the cutoffs. The greatest improvement was achieved in Social functioning disorders and Somatic symptoms. An examination performed two months after the therapy demonstrated that all symptoms have minimized. A very low total score ($x = 2$) indicated good mental health status. Immediately after therapy, two months after the end of therapeutic sessions, and at the end of pregnancy, the violinist was not suffering from the pain syndrome.

Case 2

The results for the second patient (harpist) are as follows: prior to treatment, her VAS score was 8 (T_0). Immediately after the therapy, her VAS score was 2 (T_1). Two months following the end of the therapy, the VAS score was 1 (T_2). The therapy included selected techniques for lower limb lymphatic drainage since, after an active day, the patient noted slight swelling in the area of the tarsal joints and feet. The education

of the patient involved demonstrating the supportive back-lying position and putting wedges under the body when lying on the side lying, as well as explaining the important points of the correct lying position. Analysis of the GHQ responses showed that the total score ($x = 30$) obtained by the second patient (harpist) prior to therapy exceeded the threshold and was significantly higher than the average score obtained by healthy individuals ($x = 27.35$). Analysis of the subscales revealed that the patient did not suffer from depression, and that the total score resulted from the high scores on Anxiety, Somatic symptoms, and Social dysfunction. The patient's state improved considerably immediately after the therapy ($x = 8$). All subscale scores were below the thresholds. The greatest improvement was observed for Somatic symptoms and Anxiety, confirming the effectiveness of the massage. The examination conducted two months after the end of the therapy demonstrated that all symptoms were minimized. The total score ($x = 1$) was very low, indicating good mental health. Immediately after therapy and two months after the end of therapy, the harpist was no longer suffering from the pain syndrome in the lumbar region. In the ninth month of pregnancy, she felt a pain in the neck and shoulder girdle. We applied classical massage and manipulated the soft tissue neck: (muscles: trapezius: descending, transverse, ascending; deltoid; rhomboid: minor and major, supraspinatus and infraspinatus; levator scapulae). We educated the patient about the need to rest in the correct position—lying back with lower limb high.

DISCUSSION

Considering the significant limitations found in pregnant women suffering from pain syndrome, finding pain treatment methods that are both effective and safe for both the future mother and her baby is a priority for physicians and physiotherapists. Posture changes in pregnancy are inevitable, and the risk of pain problems is high. The most desired solutions are those that are the most effective and the least invasive. The education of the future mothers to maintain the therapeutic effects and to prevent pain problems is also of equal importance.

In pregnant women, we can use various types of physiotherapeutic procedures and kinesiotherapeutic methods, as well as many types of massage (relaxation, aromatherapeutic, classic, therapeutic, lymphatic drainage), massage during pregnancy and labor, massage after delivery can also be mentioned here [6,9,17,23,32,33]. The main objectives of massage are to alleviate pain, to

reduce stress and fatigue, to relax and regenerate, and to maintain wellbeing [17,21,33]. However, in advanced and difficult cases of bothersome and persistent pain—such as sciatica and piriformis syndrome—we should apply therapeutic massage based on carefully adapted and well-described methodologies [7].

As we can see from the example of the patients described in this article, the massage methodology should always be tailored to the patient on the basis of her main symptoms, current physical and mental state, and the changes that occur during therapy with respect to coexisting symptoms. Our study demonstrates the possibility of using the same type of massage, despite the different pain pathomechanisms. This case reports it shows that very important for physical therapists it is accurately performed diagnosis tissue tension before massage [31]. Nevertheless, it is necessary to monitor the positive effects obtained at each stage in order to modify, if necessary, the planned manipulations so as to react appropriately to changes occurring in the tissues and to predict the direction of further changes. Tensegrity and point massage require knowledge of anatomy, manual experience, interpersonal skills, and the ability to gain the patient's trust and give her a feeling of safety. The examples presented in our study encourage future research concerning the use of this type of massage in most pregnant women. As we can see from the example of the patients described in this article, the massage methodology should always be tailored to the patient on the basis of her main symptoms, current physical and mental state, and the changes that occur during therapy with respect to coexisting symptoms.

In our further research, we would like to apply the type of massage described here to a greater number of patients. Moreover, we plan to use a quality of life questionnaire to demonstrate the influence of pain syndrome on the functioning of pregnant women in everyday life, as such pain—together with the hormonal changes occurring in pregnant women—substantially reduces their quality of life, leads to sleep problems, fatigue, and feeling of discomfort, and can cause pregnant women to cease certain everyday activities and to limit their social life [8,20–22].

CONCLUSIONS

Tensegrity massage can serve as an element of therapies to relieve pain in pregnant women. It is an effective form of the counteracting pain caused by posture changes, and by increased or abnormal resting tone of the system of ligaments, fascia, and muscles.

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THE APPLICATION OF NEEDLE RADIOFREQUENCY FOR THE REDUCTION OF ACNE SCARS: A CASE REPORT

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ABSTRACT

Background: Acne fulminans can leave unsightly scars that can have a detrimental effect on a person's ability to function in society, resulting in a deterioration in the overall quality of life of these patients. Scientific research shows that problems with self-esteem may lower a person's quality of life, making them reluctant to interact with other people. This, in turn, may lead to depression and, in extreme cases, to suicide. For people who suffer from acne fulminans, this is an extremely serious problem. This is compounded by the fact that even if they spend much of their life fighting acne, ultimately successfully, they still may be left with the visual effects of the disease, like scars.

Aim of the study: The aim of the paper is to investigate how a series of six needle radiofrequency treatments will affect, and potentially shallow, the acne scars.

Material and methods: The analysis was conducted on the basis of an interview, photographic documentation of the patient and skin diagnosis using the NatiAnalyzer device. The case report was based on the medical history, photographic documentation and skin diagnosis (using the Nati Skin Analyzer), of a 28-year-old female patient who had suffered from acne fulminans during her adolescence. The effectiveness of the needle radiofrequency treatment was then analyzed.

Case report: A 28-year-old female patient who had struggled with skin eruptions caused by acne fulminans since the age of 15 underwent an examination. The lesions were located on her entire face which resulted in deep scars. The patient used a series of six needle radiofrequency treatments along with ampoules containing active ingredients. Treatments were performed once a month.

Conclusions: As evaluated using Goodman and Baron's scar scale, the scars appear to have shallowed. Additionally, the patient's self-esteem increased.

KEYWORDS: acne fulminans, scars, needle radiofrequency

BACKGROUND

Acne vulgaris is a problem that often affects young people. It appears in the form of not only blackheads, but also purulent eruptions, which in most cases develop on the face and back [1,2]. There are many potential causes. These include drugs, hormones, improper diet, improper skin care and genetic determinants [3].

In the beginning, an efflorescence called a blackhead often appears. The blackhead may change color and form, and turn into a purulent eruption. Acne fulminans usually affects men. However, regardless of gender, it appears with widespread purulent lesions, cysts, and redness of the skin [4].

Patients who experience discomfort due to the skin changes often start treatment on their own, at times

using methods they have seen on television, for example. However, while such methods may help for a short while, they can often cause additional harm, leading, ultimately, to an intensification of the problem. Therefore, it is extremely important to visit a dermatologist who can prescribe appropriately selected drugs (often is isotretinoin) [5–7].

Unfortunately, acne is not always cured without scars. The scars are often cylindrical and resemble deep valleys [8]. The skin has reduced elasticity in these places, as the defects have replaced the connective tissue [9].

Long-term treatment and a lack of improvement may cause patients to have a decreased quality of life. Studies by Chilicka et al. show that the quality of life

improves when skin efflorescence disappears and it gives a patient both greater confidence and a willingness to live [10].

THE AIM OF THE STUDY

The aim of the paper is to show how a series of needle radiofrequency treatments with the introduction of active substances helps to shallow acne scars.

MATERIAL AND METHODS

The patient underwent six treatments with ampoules containing sodium chloride, glucosamine sulphate (strengthening and firming), tocopherol, and ethylhexylglycerin (skin conditioning agent). After the treatment, the patient applied a mask on the skin to soothe the irritation. The mask contained glycerin, aloe and allantoin. Any contraindications, such as pregnancy, lactation, metal implants, presence of a cardiac pacemaker, epilepsy, diabetes, and cancer were excluded, to minimize the risk of complications.

The authors obtained written consent for performing the treatment and collecting photographic documentation, and also obtained consent from the Bioethical Commission at the Public Higher Medical Professional School in Opole (consent No. 6 / KO / 2017).

CASE REPORT

The patient underwent acne treatment at the age of 15. At the time, her condition was deemed to have



Figure 1. The front of the face before the series of treatments.

had a hormonal basis. She used zinc ointment, complexion tonics and gels, and tetracycline, which helped mitigate the effects. After a short period of time, the acne returned and there were twice as many spots as before the initial treatment. In 2013, the patient was treated successfully with isotretinoin. The acne never returned, however, deep scars remained in the skin. Cosmetic treatments including chemical peels, were not effective and did not alter the depths of the scarring (Fig. 1). The patient gave the authors of this paper permission to use her photos. The patient's recent treatment involved a series of puncture treatments and the application of active ingredients.

RESULTS

Goodman and Baron's scar scale was used to assess the depth of the scars. The patient's skin condition was assessed at level 4, where the skin changes did not flatten even when manually stretched (Tab. 1). Before the treatment series, the patient reported problems with her quality of life. She claimed to see other people looking at her face with contempt. She felt rejected by society, and despite wearing make-up, she was unable to feel comfortable in her own skin.

Table 1. Assessment of atrophic scars according to Goodman and Baron's scale.

Grade of scars	Appearance of skin
Grade 1	Macular, edema or discoloration
Grade 2	Mild atrophy is not visible at distances > 50 cm, easy to cover with makeup or a beard
Grade 3	Moderate atrophy visible at distances > 50 cm; not easy to cover with makeup or a beard, changes flatten when manually stretched
Grade 4	Severe atrophy, changes do not flatten when manually stretched

A total of six treatments were performed in the series, with a monthly break to regenerate damaged and punctured skin. During the first three treatments, there was more puncturing due to the thickness and unsightly appearance of the skin. Near the end of the series, the skin became thinner and thinner. Therefore, the procedure had to be more delicate. As a result, the 1.5 mm needles were replaced with 0.5 mm needles. During the procedure, there was also localized bleeding, which had a positive impact on the remodeling of the skin and led to greater overall improvement. After the treatment, ecchymosis was visible in some places. It predominantly appeared on the forehead, where the skin is very thin. Redness lasted for a few days.

After the series of treatments, the patient's scars were evaluated once again. According to Goodman and Baron's scale, there was shallow scarring to grade 2, which indicated the needle radiofrequency treatments had given very good results (Fig. 2). The patient noticed a visible change in the quality of her skin; it had become more radiant and unblemished. She was no longer con-



Figure 2. The front of the face after the series of treatments.

cerned about interacting with other people anymore. On the contrary, she received positive feedback from others that her skin looked much better than before the treatments. She was able to feel comfortable.

DISCUSSION

Needle radiofrequency treatments are eagerly performed by cosmetologists in the fight against post-acne scars. However, it is also worth searching for alternatives and finding ways to combine methods, which can also produce spectacular effects. For example, a good combination method involves using acids that cause controlled inflammation and fractional mesotherapy.

The effectiveness of these two methods was confirmed in studies carried out before Chilicka et al. where

exfoliation using 20% glycolic acid with fractional mesotherapy led to a reduction in scarring from grade 3 to 2, according to Goodman and Baron's scale, in case of scars covering the face. The series included eight treatments performed with the aforementioned methods alternating every second week. The study showed good results from the combination treatment, which also made the scars flatter and improved the overall structure of the skin [11].

At the time, there were 30 women and 19 men, all between the ages of 18 and 29, who were examined. In 2014, the BMC & Research Institute Karnataka carried out micropuncture research on 30 people. Four treatments were performed with a month-long interval between treatments on either side of the face. Vitamin C was introduced to the punctures on the right half of the face, while platelet-rich plasma was introduced to the left side. The piercing was done with 1.5 mm needles in three directions and repeated 4-5 times. After the treatment, the patient was given a skin preparation and the punctures were repeated. Platelet-rich plasma gave amazing results in 19% of the patients, while vitamin C gave good results in 7% of subjects [12].

After their research, Moetaz et al. also found that microcutting had a beneficial effect on improving the condition of the skin and making the post-acne scars more shallow [13].

According to a study by Elawar and Dahan conducted on a group of 19 patients with acne scars, fractional microneedle radiofrequency caused skin texture improvement (shallower scars), and pore size reduction [14].

CONCLUSIONS

The application of needle radiofrequency, together with the application of active substances, achieved very good results for the shallowing of post-acne scars. This therapy changed both the structure and visual appearance of the skin, and made the acne-based changes more shallow, as analyzed using Goodman and Baron's scale.

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VIRTUAL TREATMENTS IN AN INTEGRATED PRIMARY CARE-BEHAVIORAL HEALTH PRACTICE: AN OVERVIEW OF SYNCHRONOUS TELEHEALTH SERVICES TO ADDRESS RURAL-URBAN DISPARITIES IN MENTAL HEALTH CARE

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ABSTRACT

A quiet revolution underway is leading to changes in healthcare for many countries of the world. The sentinels of health have always been physicians; the medical model, representing the research, education, and experience of medical doctors, has worked well for treating acute conditions of injury and physical illness and been very successful in reducing disease-producing morbidity and mortality. But pressing contemporary issues, such as spiraling healthcare costs, population aging and the need to manage chronic conditions, and recognition that mental health care is necessary for societies to be physically healthy, are forcing a reevaluation of existing conceptualizations of care. In response, physicians are increasingly working in integrated practices with other specialists to broaden care coverage to include social and behavioral conditions empirically demonstrated to influence medical care outcomes. Aiding the development of these new, more inclusive models of healthcare are advances in communication technologies. Practitioners are now using synchronous and asynchronous forms of communication to deliver physical and mental health services beyond the boundaries of traditional brick-and-mortar practices, into communities where clients live and work. This brief review of the potential of telehealth to address disparities in healthcare has two purposes: 1) examine an innovative model of comprehensive, integrated biopsychosocial services useful in single- and multiple-location practices; and, 2) identify challenges of using synchronous, virtual technologies for client-centered, mental health care service provision in rural, underserved areas.

KEYWORDS: integrated care, behavioral health, rural mental health, telehealth, virtual technology, synchronous

BACKGROUND

Healthcare has become central to policy discussions, with consumers in many countries identifying overall service access, the need to balance costs with service provision [1], and mental health care as primary concerns [2,3]. Growing challenges of population aging [4] and research demonstrating links between behavioral issues and medical outcomes [5–7] are prompting healthcare providers to look for new approaches to effectively provide coverage for a broad range of medical, psychological, and social issues [8].

Chronic healthcare needs are highlighted through an increasing number and larger percentage of older adults for all countries of the world [4] and by the global short-

ages of specialists to manage unique, aging-related needs of all adults [9,10]. This includes addressing the rapidly growing need for informal caregivers for home-based care [11,12, pp. 325–327] and professionals to manage expected global surges in dementia conditions [13]. Chronic care needs have also been identified for conditions that afflict all age groups, such as obesity, arthritis, diabetes, anxiety disorders, and depression; impact workforce participation; create dependence; and, predict disability [14–16]. It is clear that care management is moving beyond traditional models of care [17]; the shift in focus from treating acute care needs, still a central concern of primary care practices, increasingly includes the management of long term, chronic care conditions.

PRIMARY CARE-BEHAVIORAL HEALTH INTEGRATED PRACTICE

One innovative approach to more comprehensive care includes the integration of primary care with behavioral health (PCBH). Behavioral health is a relatively new specialization that "...encompasses prevention, intervention, and recovery from mental health and substance use conditions" [18, p. 5]. The concept is similar to mental health, but the focus of behavioral health also includes the promotion of health and wellness behaviors. Behavioral health is becoming the preferred term in clinical applications: it avoids the stigma of mental health labels; and, by recognizing that behavior is a critical component of mental health conditions, includes the possibility of behavior change [19,20].

The PCBH model employs a biopsychosocial perspective [21] to provide medical, psychological, and social care in one practice, albeit sometimes in multiple locations at distance from one another. The providers in a PCBH practice work together as an interdisciplinary team: under the direction of the physician(s), additional team members, consisting of nurses and nurse practitioners, social workers, mental health providers, community health workers, and other specialists, as needed, engage in task sharing (i.e., task shifting) [22] to provide medical, psychological, and social care. Utilizing complementary skill sets, team members provide professional assessment of the full range of client behavior [19]. A physician can begin a medical examination with behavioral health information prepared ahead of time or note issues during an examination and request further assessment(s). Patient information, shared through a common record keeping system, is made available to and updated by all providers. A substantial body of research has demonstrated the efficiency of the PCBH approach; among reported benefits are better cost control, improved treatment outcomes, increased satisfaction for providers and clients, and better coordination of services promoting client independence within communities [23,24,19].

MENTAL HEALTH CARE

An advantage of the PCBH approach is the ability to assess and treat behavioral health – i.e., mental health care – needs of clients [18]. It makes sense that primary care is the first point of access for people with medical issues; indeed, people think of physicians when a physical health problem arises. As a result of this behavioral conditioning, however, persons with mental health needs also look first to medical professionals for answers [3]. The increasing prevalence of mental health problems [21] has become a major challenge for primary care, as physicians acknowledge a lack of substantive training for serious mental illness, and two thirds report they cannot secure an appropriate referral for clients with mental health issues [3,25]. Mental illness has become the leading cause of disability in the

United States, with access to treatment available for less than 20% of persons needed it [25]. Moreover, one in four persons in the United States has two or more multimorbid conditions, defined as the conjoint presence of physical and mental health problems, influencing their overall health status [21,26]. In other words, the presentation and treatment of many physical health-related problems are complicated by interactions with mental health conditions, including anxiety and depression and conditions with social components, such as loneliness, isolation, trauma history, and substance abuse [27].

The provision of mental health treatment and social work services in a PCBH practice offers the possibility of care planning based on comprehensive assessments [8]. For people who live in urban areas, where healthcare is readily available, primary care is typically accessed through visits to brick-and-mortar establishments. In rural areas, however, where primary services are less or not available, people in need cannot always walk into a doctor's office or clinic. This is especially true for persons with mental health conditions [28], even as research shows that mental illness prevalence in rural areas is similar to that seen in urban areas. Rural areas are known to be underserved for mental health services, which disproportionately affects ethnic and racial minorities and low-income persons who report work schedule conflicts, childcare needs, and transportation difficulties as barriers for service reception [29–31]. In the United States, even though two thirds of all counties are considered rural, less than 10% of the mental health workforce is located in rural settings [28]. Research has shown that practitioners of disciplines that provide specific training in mental health conditions, including social work, psychology, and psychiatry, are more likely to locate their practices in urban, affluent, high population areas [32,3]. This mal-distribution of services is further complicated by stigma and embarrassment associated with mental health conditions, and attitudinal differences, with persons residing in rural areas being more distrustful of and less likely to seek mental health treatments [33].

TELEHEALTH CARE OPTIONS

The transition to PCBH comprehensive treatment and care planning has been made possible, in part, through advances in communication technologies. There now exists a wide range of care options utilizing online capabilities – collectively called telehealth – to replace or supplement traditional care, which has required providers and clients be in the same location at the same time. This extension of the therapeutic relationship – the foundation for successful mental health treatments – beyond the standard "appointment" is providing professionals and clients with unprecedented access to one another, creating new opportunities for types of care not previously available in traditional practices [29], and reducing disparities by bridging the geographic gap for rural and urban mental health service provision [34].

Telehealth comes in two forms: synchronous and asynchronous. Synchronous telehealth refers to in-person, real time connections that include audio and video data streams [35]. Although telephone calls technically fall into this category, the virtual communication increasingly seen in PCBH settings employs videoconferencing techniques: secure, face-to-face, two-way interactions allow providers and clients to connect to one another virtually, with more possible ways for interactions to occur [36] and more options for patient empowerment [37]. Other communication tools, such as texts and email, although useful in the management of patient care, are referred to as asynchronous because they lack the real-time component of in-person communication. It is possible, of course, for patient care to bridge the gap, utilizing both synchronous and asynchronous forms of communication, such as when asynchronous techniques are used as supplements to in-person treatments, often as reminders, boosters, or for self-management purposes. Asynchronous tools are collectively called behavioral intervention technologies (BITs) and include automated, preprogrammed content of interactive, computer-based applications [38]. There are already thousands of BITs available [29,35,39]; a review of asynchronous technologies is beyond the scope of the present report.

VIRTUAL TELEHEALTH CARE DELIVERY

Synchronous telehealth interventions using virtual (i.e., videoconferencing) technology can be offered in supervised and unsupervised settings [29], depending on whether clinical staff persons are available at the client site. For PCBH providers located in single settings, the supervision of services (including logistics of intake and client escort within the facility, etc.) can take place by staff members and through onsite referrals; face-to-face service-delivery sessions are conducted in-person, with a provider and client in the same room. Telehealth service delivery in single site PCBHs comes into play when a needed specialist, such as a tele-behavioral health provider (i.e., a mental health counselor) is not available onsite and so synchronously connects with patients. Virtual service delivery is increasingly common in PCBHs with multiple locations, when a need arises to share specialists across locations; in these situations, a patient can check in at any of the PCBH locations for assessment and/or treatment, and then, as needed, be connected virtually to the additional provider(s).

Given the complicated nature of virtual technologies [40,29], it is recommended that an IT (information technology) person be on staff to coordinate technical aspects of equipment; this includes such issues as purchase and setup of equipment, connecting and maintaining virtual links during sessions, software and hardware updates, and trouble-shooting in moments of equipment failure (due to storms, power surges and outages, etc.). There is also a need in synchronous telehealth for technical proficiency on both ends of a con-

nection (i.e., where the service is provided and where the service is received) and for providers to be able to talk-the-talk with IT personnel in moments of system interruption and failure. This requirement for competency in telehealth equipment usage makes unsupervised service delivery (i.e., where staff are not present at the client site) largely untenable, at this point in time; although technology in the home setting is increasingly common, many prospective clients for mental health services lack the expertise to maintain the virtual service continuity necessary for providers to meet ethical standards for mental health service delivery [41,30,31,35].

The consideration of how to securely transmit and store digital information is also of paramount importance in virtual care delivery. Two categories of videoconference platform are in use: 1) standards-based, which uses a connection specific for a freestanding system (e.g., a PCBH); applications must be installed in computers at both provider and client sites; and, 2) consumer-grade, which uses the internet to transmit information from one IP address to another. The standards-based platform is more expensive to install and maintain, but more secure. Consumer-grade platforms are commercially available and gaining in popularity, but are slower and may use third party servers, which raises concerns about offsite storage of electronic records and regulation of access to confidential data. For similar security issues, public platforms, such as Skype and smartphones, are considered inappropriate for clinical usage, at this time [see 29,40, for detailed explanations of technology issues].

Some PCBHs using standards-based videoconference platforms partner with existing community services, such as schools, where supervision by personnel (e.g., nurses, social workers) can readily be provided. Schools in the United States have offered nursing services as a way to effectively provide healthcare in communities for many decades [42]. School-based services, with mostly asynchronous links to physicians and pharmacies, offer families convenient and efficient access to care. With the addition of social workers, present now in most schools in the United States [43,44], services are increasingly going online, and schools can offer synchronous mental health services. For example, a child with an identified mental health need can be virtually connected from the school site to a tele-behavioral health counselor operating under the aegis of a PCBH-school relationship. With the aforementioned difficulties of maintaining technical access, and in light of existing ethical and operational standards, such as needs for confidentiality and informed consent, schools are nonetheless seen as good points-of-contact and points-of-entry for clients to real time access to medical and mental health services.

CHALLENGES FOR VIRTUAL SERVICE DELIVERY

Mental health care is becoming a priority for health-care systems, and great strides have been made toward

incorporating telehealth services into overall diagnostic and treatment processes [2]. Significant hurdles remain, however, for virtual mental health service providers to be fully accepted in the PCBH setting. Among identified areas of challenge specific for providers are legal [45] and ethical [34] concerns. There are two regulatory structures outlining legal and ethical responsibilities of practicing mental health professionals in the United States: the Health Information Portability and Accountability Act (HIPAA) [46] and the Health Information Technology for Economic and Clinical Health Act (HITECH Act) [47]. Both sets of guidelines specify “reasonable” (45, p. 3 of 10) standards for what providers can and cannot do when using technology in service provision, including how to create, transmit, and maintain secure digital records.

Two core ethical principles, beneficence and non-maleficence – provide benefit for the client and do no harm – have been central in the development of ethics guidelines for mental health practice, as persons with mental health conditions are considered to be an especially vulnerable population [48]. There are now concerns, however, that technological advances are outpacing ethical guideline development [36]. Campbell and Norcross [49] provided a framework for issues of competency and identified four areas of focus for “telepsychology” – the term approved by the American Psychological Association in 2013 for the use of telehealth technologies in psychological practice – to reach the standard of care acceptable to meet ethical guidelines of the field: 1) clinical competence, 2) technology competence, 3) client/patient competence, and 4) cultural competence. Other disciplines engaged in clinical mental health service provision, such as social work, are having similar conversations and recognize the need for education and training for practitioners engaged in team-provided telehealth services and private practice. As it is common for social workers to become behavioral health providers and join PCBH teams, Olfson suggested that current and future mental health workforce shortages could be addressed by “...training social workers in relevant evidence-based psychosocial interventions; and building team-based mental health services in primary care” [3, p. 988]. This can help reduce disparities in care, as there are more social workers practicing outside of urban areas (i.e., in rural settings) than the number of psychiatrists and clinical psychologists combined [3]. Further, clinical social workers are licensed and qualified to provide mental health diagnoses and treatments as tele-behavioral health providers and are already the go-to discipline for community-level organization of care. In any event, the demand for virtual services is expected to increase. The ubiquity of familiar devices, such as smart phones and online-access tablets, has led an increasing number of people to become more comfortable with virtual technology and accept its everyday use as inevitable. People now routinely reach for their phones for information and entertainment purposes, and video-based chatting has

become commonplace and a viable choice for communication with family and friends. This acceptance of technology has allowed its spread into the healthcare arena, as people search online for medical information and shop for treatments. Although many clients still show preference for traditional treatment modes [31], providers report that clients increasingly expect to use technology as part of the treatment process [41,45].

There are opportunities to use virtual therapy in an unsupervised setting, e.g., a client’s home, to reach someone in need who might not be served otherwise [45]. A significant strength of this approach is the development of a more thorough understanding of a client’s home environment [50], and there are treatment-based comparison studies of tele-mental and office-based care showing good retention of clients, good client engagement, and equivalent measures of therapeutic alliance for both treatment modalities [29]. Provision of services in unsupervised settings, however, includes revisiting basic issues, long addressed in face-to-face interactions, such as client distraction, reduced ability to assess body language (non-verbal cues) of clients during sessions [51,31], maintenance of professional boundaries [45], and how to obtain informed consent of clients for treatment [52,53]. A suggestion for informed consent is to obtain “teleconsent” [53, p. 57], which includes a digital signature based on facial verification of a client. This technique is discussed by Lopez and associates [53] for research purposes but might also have relevance for clinical practice.

CONCLUSIONS

The acceptance of behavioral health and tele-behavioral health providers in PCBH practices holds great promise for increasing access to mental health services, particularly for persons in underserved rural areas. The most common form of mental health service in integrated care includes supervised, synchronous connections, but tele-behavioral health providers are increasingly being shared across PCBH settings and working in private practices to address shortages of mental health specialists. Policies for telehealth provider licensing (i.e., where the client is located relative to where the therapist is located) and reimbursement for virtual service provision are under development at this time [45,51]. Telehealth communication technologies are also proving useful in other areas of healthcare, for example, in the diagnosis (but not treatment) of dementia and cognitive decline [54] and to reach special management populations, such as inmates [55] and children with autism [56]. Researchers in all areas of usage, however, recognize the immaturity of telehealth approaches and support the further development of the field through empirical examinations [57]. Indeed, the commonly expressed sentiment throughout the literature for disciplines actively pursuing telehealth, even as formal training lags behind, is, nonetheless, that “...technology is here to stay in mental health practice and research” [49, p. 4 of 5].

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INTERREGIONAL COORDINATION FOR A FAST AND DEEP UPTAKE OF PERSONALISED HEALTH (REGIONS4PERMED) – MULTIDISCIPLINARY CONSORTIUM UNDER THE H2020 PROJECT

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ABSTRACT

Personalised medicine (PM) represents a paradigm shift away from the ‘one size fits all’ approach to the treatment and care of patients with a particular condition, to one which uses emergent technologies such as diagnostic tests, functional genomic technologies, and molecular pathway profiling to better manage patients’ health and employ target therapies. The current challenge for national and regional authorities is to facilitate the shift from a reactive healthcare system based on episodic and acute care models to a personalized health (PH) system that uses preventive and predictive measures, where at-risk individuals are stratified to intervene before the onset of symptoms or risk is predicted using cutting-edge technologies before symptoms appear. While PH is paving the way toward better and more efficient patient care, it still lacks the cooperation and coordination needed to organise the fragmented field, which is a severe drawback to its development and to the placement of effective financial investments. For this reason, it is crucial to direct major efforts towards coordinating and aligning relevant stakeholders across Europe and beyond, creating a participatory approach, building trust, enabling a multi-stakeholder process, and channeling investments towards PH. Thus, Regions4PerMed aims to coordinate regional policies and innovation programmes in PM and PH to accelerate the deployment of PH for patients.

KEYWORDS: personalised medicine, personalised health, prevention, regional policies interregional cooperation

BACKGROUND

The Horizon 2020 Advisory Group has defined personalised medicine as “a medical model using characterisation of individuals’ phenotypes and genotypes (e.g. molecular profiling, medical imaging, lifestyle data) for tailoring the right therapeutic strategy for the right person at the right time, and/or to determine the predisposition to disease and/or to deliver timely and targeted prevention” [1].

Scientific evidence shows that a change in the model from “high-risk population models” to a “whole population model” [2] would allow huge gains, both for patients in term of health and for healthcare systems in terms of cost reduction. In this context, personalised medicine becomes a basic/translational research approach. Moreover, as we develop a system that uses data and technology to provide personalised care, the concept of personalized medicine broadens and needs

to include variables such as policy, regulation, industry, technologies, and patient associations. A better use of data and technology has the power to improve health and to improve the quality of health and care services while simultaneously reducing the cost.

Regional ecosystems are increasingly characterised by strong leadership, a culture of openness and learning, and commitment to being 'data-driven'. This is a critical observation because in countries where health policies are shaped and applied at the federal level, regions are the focal point in the process of transforming European health and care policies towards sustainable and resilient systems.

Scientific and technological advancements need adequate, community-tailored policy frameworks that enable uptake of personalised medicines and health. Deep knowledge of the demographic, epidemiological, academic and industrial context of the healthcare system, together with its financial capacities, allows regions to plan and implement strategic investments to adapt and modernise key enabling health infrastructures. The possibility to establish joint collaborations with other EU regions reinforces their capacities and multiplies impacts while minimising risks. In addition, these collaborations can pave the way to the setting of transnational and transregional models for healthcare that can be replicated in less developed regions and countries thus empowering citizens and patients. At a regulatory level, cross-regional collaborations are the key to increase data interoperability and to multiply the impact of health investments while ensuring adequate levels of training for health professionals. This effort will eventually result in a reduced burden from chronic disease, enhanced capacity for disease prevention, and it will support the development of new medicines and treatments.

Taken together, then, the real challenge for national and regional authorities is to tackle the shift from a reactive healthcare system based on episodic and acute care models to a preventive and predictive health care system. The preventative and predictive health care system is one that stratifies at-risk individuals and ensures that preventive action is taken to intervene well before the onset of symptoms and one that leverages and integrates cutting-edge technologies to not only stratify risk but to predict risk and intervene even before symptoms appear.

In the face of this potential huge leap forward, personalized health (PH) lacks the cooperation at the regional, interregional, and intergovernmental level to coordinate and to organise an adequate level of policy and investments. This represents a severe drawback to effective PH development. For this reason, major efforts need to be directed toward coordinating and aligning regional stakeholders like public institutions, governments, industry, civil society, and patient organisations into action across Europe and beyond in order to create a participatory approach, build trust, enable a multi-stakeholder process, and channel investments towards PH.

The administrative structure of countries, i.e. the competencies and the autonomy of the regions, accounts for the diversity of the regional innovation strategy for smart specialization (RIS3s). For example, regions that have responsibilities in the healthcare system can address PH more globally, linking research and health policies. One recognised added value of RIS3 is the association of policy makers, industries, public stakeholders and the breaking up of data silos through top-down strategies.

These considerations are taken into account by European policy makers. In order to assess the status of interregional coordination in PM, a workshop was organised in Brussels on May 4, 2017, by the European Commission with the aim to compare the regional strategies on PM and to:

- Disseminate information on the role of personalised medicine in regional R&I Smart Specialisation Strategies (RIS3) on European PM activities and on the International Consortium for Personalised Medicine (ICPerMed).
- Exchange information and views on how PM is prioritised at the regional level and on how R&I activities are being implemented at a regional level.
- Identify needs and possibilities for interregional cooperation and synergies for PM R&I.
- Identify information gaps and needs for further data collection/analysis.

Within the workshop, some main challenges have been identified which Regions4PerMed will address:

- Establish a platform and initiative to facilitate interregional cooperation in PM.
- Organise and employ infrastructures, programmes and financial instruments in a way that brings together all relevant stakeholders (public authorities, SMEs- Small and Medium-sized Enterprises, universities, healthcare providers, etc.) and that creates a favourable ecosystem for the development and the implementation of personalised medicine.
- Support the ICPerMed network (the International Consortium for Personalised Medicine) in facilitating a fruitful dialogue between regions, health ministries and research funders.
- Implement reflection and actions to organise the flow of information, share experience, identify barriers, spread good practice, and facilitate dialogue and cooperation between regions. This should include the organisation of similar events that involve more regions.
- Seek tighter contacts between the regions and the Programme Committee for the specific programme implementing H2020 (Configuration 'Health, demographic change and well-being') [3].

OBJECTIVES OF THE PROJECT

Regions4PerMed's overarching goal is to set up the first interregional cooperation on PM, align strategies and financial instruments, identify key investment

areas and release a European regional agenda in order to foster the delivery of PH services to patients and citizens. The consortium was established to:

- Support the coordination of regional policies and innovation programmes in PM in order to accelerate the employment of PM for citizens and patients.
- Strengthen cooperation between Horizon 2020 and ESIF on PM aspects.
- Ensure complementarity between RIS3 diagnostics priority and RIS3 personalised medicine priority mappings.
- Establish a permanent dialogue between European regions regarding a fast and full implementation of PM.
- Strengthen industrial specialisation areas in Europe and allow PM to flourish as an emerging industry.
- Enable interregional joint investment on PM including a stable link with the Vanguard Initiative and with the European Innovation Council.
- Provide guidance to the EC for the next Multi-annual Financial Framework (MFF) as well as Research Framework Programme.
- Provide guidance to EC, Member States and regional authorities on the next European Structural and Investment Funds (ESIF) Operational Programme.

The other specific objectives of the project are:

- Organise the technical dialogue among regions around five Key Strategic Areas (KA) and through five thematic workshops.
- Provide a final action plan of strategic areas of investments.
- Establish a HUB of European initiatives and partnerships on personalised medicine (PerMed HUB).
- Contribute to the realisation of the IC PerMed action plan.
- Provide guidelines in the form of a report to regional authorities on how PM can boost local economies and keep the EU competitive.
- Provide guidelines in the form of a report on how to address PM within the Smart Specialisation Strategies (RIS3).
- Build and maintain a database of PH research and innovation and monitor programmes and projects that can be easily replicated elsewhere [4].

METHODOLOGY

At the core of the project are five regional authorities and organisations representing European regions strongly committed to PM and the Wrocław Medical University as an academic partner of the consortium. These authorities act as the Executive Board for the interregional coordination and are mainly responsible for the implementation of the project activities concentrated around the five key strategic thematic areas:

medical big data and health medical records, connected health in terms of better system integration and patient management, health industry in the context of health-care innovations, facilitation of the innovation flow in the healthcare and socio-economic aspects rationale.

Regions4PerMed establishes a continuous dialogue among the European PM community. It brings together regional authorities that primarily take decisions, academics and stakeholders within organised cross-sectoral and cross-regional workshops and conferences on the five key thematic areas.

This dialogue is organised into five steps:

1. Elaboration of a preparation paper which analyses the state-of-the-art aspects and highlights the challenges of each Key Strategic Area.
2. Organise a thematic interregional workshop around the topic. Carry out five capacity-building workshops for regional authorities in order to build up expertise and skills within the regional authorities about the use and exploitation of the knowledge created within Regions4PerMed.
3. Organise five conferences in different regions and cities in order to have a wider geographical outreach, plus the kick-off and the final conference.
4. Carry out two *in situ* visits for each Key Strategic Area to highly innovative labs, institutes or companies and gather innovative models and best practice examples.
5. Issue a workshop report containing, among others:
 - a. Policy recommendations for European, national and regional policy makers.
 - b. R&D investment recommendations.
 - c. Innovation models and best practices.

The methodology sought in order to achieve the project objectives is based on the organised technical dialogue with relevant stakeholders [4].

KEY STRATEGIC THEMATIC AREAS UNDERTAKEN IN THE PROJECT

1. Medical Big Data, Electronic Health Records and Health Governance

Technological innovation has triggered an explosion in data production that will soon reach exabyte proportions. There is great potential for “big data” to improve health, but at the same time, “big data” also engenders new challenges. One emerging challenge is the issue of capacity, where the amount of data generated will strain the infrastructure of an individual hospital or institute. Integrated solutions for data sharing and analysis will need to allow for the combination of data coming from multiple sources and potentially different research disciplines. At the European level, one of the main hurdles is the construction and sharing of a common data storage platform for research purposes. Service models need to be developed in order to deliver better health care and strengthen the health industry.

Big data technology has many applications in health-care, such as predictive modelling, clinical decision support, disease or safety surveillance, public health, and research. Big data analytics frequently exploit analytic methods developed in data mining like classification, clustering, and regression. Technologies that can extract large quantities of data from samples or biopsies are permitting discovery of previously unknown disease factors, which may be utilised as drug targets or disease biomarkers. Data is also able to expose the complexity of a disease, especially cancer, and it can highlight the fact that there will never be one drug or treatment option that works for every patient. Through the “datafication” of patient tissue samples and genomic fingerprints, clinicians can systematically extract more information from each patient without requiring multiple rounds of testing. By having all available information at the same time while determining diagnosis and the patient prognosis, the best treatment decisions can be made on an individual basis at a faster rate. National health systems are heterogeneous in terms of the level of government influence, main source of financing, and main levels of organization. Some systems, for example, are self-governed as in Germany, some have regional autonomy, while others are national systems. Moreover, some systems are tax-financed and some deduct a fee from monthly income. Hence, solutions and fundamental approaches differ between European member states and are not entirely portable and scalable.

As recalled in the EC Communication on digital health, health care systems in Europe face serious challenges [5] such as ageing, chronic disease, multi-morbidity, health workforce shortages, the rising burden of preventable, non-communicable diseases caused by risk factors such as tobacco, alcohol, and obesity, as well as other neuro-degenerative or rare diseases [6]. Public spending on health and long-term care is steadily rising in EU Member States and is expected to continue to do so. In 2014, the EU-28’s total healthcare expenditure was €1.39 trillion (10% of the EU’s GDP). This is expected to increase to 30% by 2060. These trends pose significant problems for the sustainability of EU Member State health care systems.

Even though the health sector is data intensive, the data has been underutilized for enhancing public interests.

While health data is available in various forms and formats, it is not managed in the same way by all EU Member States, nonetheless within an individual national health system. Furthermore, health data is often difficult to access by patients themselves or by medical staff or researchers that develop and deliver better diagnoses, treatments or personalised care. Even where it exists, health data often depends on technologies that are not interoperable, thus hindering its wide-spread use [5].

Big data is also becoming a crucial tool for leading companies to outperform their peers. This is especially

true in the health sector where the quality, availability, and accessibility of health-related data is vital to maintain a competitive stake in the European health industry, in which medical technologies can boost the economy, employment and efficiency of health care system as a whole.

Among the technical challenges to be solved is the lack of standards applicable to collecting, analysing and storing data. Additionally, the potential for health funding agencies to promote standardisation is still untapped even though standardisation also affects the technological developments and the industrial competitiveness of the health industry.

Big data and digitalisation can support measures to promote health and prevent disease, as well as to reform health systems, ease the transition to new patient-centred care models, and to integrate new care structures [7,8].

The aim of this Work Package is to explore all the potential, the risks and the roles that regions can play in the governance process of health data, focusing on Electronic Health Records (EHR) and health research data.

Data can be a key enabler of digital transformation and development of new forms of technology, to benefit patients and healthcare staff, and to aid medical research and health technologies industries. Nonetheless, the increasing amount of data and the collection, storage, access and protection of the data have created numerous legal, economic and ethical issues. Current national legislations struggle to manage these issues and are trying to find a common ground for regulating IT technology and its impact on citizens.

Big data technology has a variety of healthcare applications, such as the creation of electronic medical records (EMRs), predictive modelling and clinical decision support, disease or safety surveillance and research. Big data analytics frequently exploit analytic methods developed in data mining, including classification, clustering, and regression [9]. A recent article published in *Science* [10] highlighted the potential healthcare applications of big data. The UK Biobank recently made a systematic analysis of the full genotyping data of 500,000 people available to 7000 registered researchers. The UKB data is being used for 1400 projects and has resulted in nearly 600 published papers, focusing on the link between gene variants to a disease or trait such as arthritis, type 2 diabetes, depression, neuroticism, and heart disease, for example.

If PH is to be realised, tremendous amounts of data specific to an individual must be captured, synthesised and presented in an analysed form to clinicians when care decisions are needed. This can only be accomplished by using sophisticated EHR systems that are designed to support this function. By having all available information at the same time while determining diagnosis and patient prognosis, it would be possible to ensure the best and most timely treatment decisions on an individual basis.

On a larger scale, a joint declaration on artificial intelligence was recently signed to create a cloud infrastructure for data sharing to ensure Europe's competitiveness in the research and deployment of AI and to deal with the associated social, economic, ethical and legal questions. On the heels of this declaration, the new General Data Protection Regulation (GDPR) was initiated and it influences the exploitation of big data in healthcare. Among others, some big data challenges to be addressed are 1) how to enable cross-border data exchange, 2) how to promote legal, organisational, semantic and technical interoperability, 3) alignment of the OECD council recommendations and EU privacy regulations, 4) creation and dissemination of codes of conduct on how to handle secondary data use and how to de-identify patient data for secondary use [4]. Other challenges that emerged throughout the year of new big data initiatives were the need to invest in staff and not just infrastructure and the need to demonstrate the benefits of big data.

2. Connected health: Better system integration and patient management

With many personal human genome map initiatives launched worldwide (Personalised Medicine Initiative in the USA, 100.000 Genomes Initiative in the UK and the Million European Genomes Alliance in Europe), it is possible to envision a future where treatments are tailored to individuals' genetic structures, prescriptions are analysed in advance for likely effectiveness, and researchers study clinical data in real-time to determine success. The implementation of these regimens will create a situation where treatments are better targeted, health systems save money by identifying therapies not likely to be effective for a particular patient, and researchers have a better understanding of comparative effectiveness [11].

Yet, despite these benefits, consumer and system-wide gains remain limited due to an outdated policy regime. With scientific innovation running far ahead of public policy, physicians, researchers, and patients are not receiving the full benefits of the latest developments. Current policies need to leverage new advances in genomics and PM in order to individualise diagnosis and treatment. Similarly, policies creating incentives for the adoption of health information technology should ensure that the invested infrastructure is one that supports new-care paradigms as opposed to automating yesterday's health care practices.

European health systems require a seamless and rapid flow of digital information, including genomic, clinical outcome, and claims data. Research derived from clinical care must feed back into assessment in order to advance care quality for patients. Currently, there is discrete data on diagnosis, treatment, medical claims, and health outcomes that exists in parts of the system, but it is hard to determine what works and how treatments differ across subgroups. As more infor-

mation on treatment, lab tests, genomics, and costs is integrated into healthcare, it is hard to incorporate data from medical history, vital signs, genetic background, and lab testing into diagnosis and treatment. Predictive modelling represents a way for physicians to move towards systematic and evidence-based decision-making. While the first step toward enabling personalised medicine is to ensure clinicians have access to what is known about patient gene variants, computer models can go beyond this approach and predict which treatments are likely to be most effective given observed symptoms. Public policy should incorporate rapid learning and predictive modelling to gain the full benefits of PM.

Concerning the emergence of Artificial Intelligence (AI), it is necessary to deal with its effects on the transformation of the market in an appropriate and contemporary way. An environment of trust and accountability including analysis of new legal and ethical questions will permit healthcare systems to benefit fully from AI.

Finally, the combined intellect of the leading European experts in e-health and m-health (mobile health) is required to identify future approaches to e-health/m-health that can redefine ways of interaction within the healthcare system. All mentioned connecting systematic approaches and platforms require consented, open and interoperable connections that follow international standards. This does not only apply to existing aspects, e.g. IHE profiling, but also to defining new standards on topics like cross-platform authentication and data exchange. Standardisation in healthcare services is a major requirement for improving patient treatment by way of modern technology.

All this considered, the second phase of the project will address:

- m-/e-health technologies for continuous monitoring and self-empowerment;
- m-/e-health technologies for data integration;
- AI for predictive models;
- Personal data management;
- Remote monitoring and tele-assistance.

One of the main goals of this phase is the employment of medical data registered systems. Additionally, this phase aims to increase big data capacity to solve such problems as the poor quality of collected medical data, like weak or insufficient, incomplete, or incorrect data, or data saved in various formats, for example. Big data could also improve medical professional and patient awareness regarding medical event documentation and could provide diagnostic support and therapy personalisation through the use of AI. It could also support the creation of information and communication technology (ICT) systems for data collection and their enhancement for PM in European regions, enabling a personalised approach to integrated care for the elderly based on the use of intelligent ICT solutions.

The other goal considered in this phase is to increase knowledge and to strengthen the involvement of citi-

zens and communities in the monitoring system; measurable /inadequate use of ICT is the result of inadequate access to medical data and lack of trust in its quality.

Also, integrated care for patients with multiple diseases is going to be discussed in this phase using Multi-Criteria Decision Analysis (MCDA). MCDA will account for understanding care-focused people, improving the health and well-being of citizens through integrated health care, implementation of integrated care systems, innovative models of integrated care and systems, and assessment and improvement of monitoring quality. Implementation of this new model of integrated care needs to occur quickly to meet the increasing demand for such care due to the aging of the European population and the increase in vulnerability, cognitive impairment and chronic diseases associated with the aging process [4].

3. Health industry: Driving healthcare innovations

Currently, a diagnosis is made using tests and investigations of a patient's symptoms. However, while two patients might share the same symptoms, the underlying cause could be different. Knowledge of an individual's complex molecular and cellular processes, informed by other clinical and diagnostic information, will help to more fully determine the true cause of the symptoms. Precision diagnoses can be further optimised when coupled with new technologies such as those that provide rapid and real-time results and those that can be used at the point of care.

These technological developments have the potential to significantly change the way that the health industry operates to the benefit of the patient. Due to an ageing population and the current increase of lifestyle-related diseases, the cost of healthcare is expected to increase significantly. The healthcare industry is among the fastest growing industries and it is expected to continue its significant growth. The further development of PM and especially of PH has the potential to cause a quantum leap in respect to the efficiency of the healthcare system and to ensure its long-term sustainability. The developments in PM and PH may change the entire way the healthcare industry operates, shifting toward prediction and prevention of disease instead of curative treatments.

To enable this drastic change in how the healthcare industry operates, several steps need to be taken. First, there is a need to distinguish health research from clinical practice. Mechanisms to connect data from multiple sources into databases for secondary research use and population cohort analysis need to be established. It is nearly impossible to evaluate treatment effectiveness without being able to aggregate data and compare results, thus big data needs to be accessible and usable. Faster knowledge management could enable physicians and public health officials to employ "rapid learning" models and evidence-based decision-making. Funda-

mental innovations often flow from basic research to clinical studies to different scaling-up stages; it is the task of policy makers to facilitate this process by providing the necessary framework for successful translation especially where innovations may have a disruptive character on current healthcare processes. This holds true for several relevant aspects:

- Exchange of research data, including data interoperability and access to databases.
- Intellectual property rights, its tangibility and exchange.
- Transfer of relevant information between neutral market actors like networking agencies, non-governmental organizations (NGOs), and public or governmental consulting bodies.
- Entrepreneurial activities, foundation of SMEs, exit strategies.
- Private venture capital, public sources of capital to ease market access or change of market.
- Reimbursement policies regarding innovative technologies or processes and their introduction to state-paid or self-governed systems.

It is furthermore necessary to broaden the widely accepted, but narrow view on the costs and benefits of introducing e-health/m-health and of implementing a PH approach. Healthcare industry partners, SMEs and research institutes would greatly benefit from a coordinated European approach to include quality of life and systemic outcome measurements in the cost-benefit analysis. Ultimately, the value of preventive and predicative approaches needs to be assessed in light of possible reimbursement policies for these approaches to make them financially more attractive when compared to the current primarily curative approaches.

Also, even discounting spin-offs, a major share of innovation is created by SME's. SMEs are therefore crucial for the further development of the health industry. They have a significant role in the following fields:

- a. Diagnostics such as in vitro diagnostic devices (IVDs), genomic diagnostics, biomarkers, medical devices, and imaging.
- b. Technological transfer.
- c. Disease management innovative tools.
- d. New business models for a wider health market uptake.
- e. Payment models.

This key strategic area will be elaborated in the third workshop and will impact clinical studies, joint research, standardisation, Living Labs, training, technology transfer and demonstration activities [4].

4. Facilitate the innovation flow in healthcare

PM must play a decisive role in the long-term sustainability of health systems. The one-treatment-serves-all-patients traditional approach seems unsustainable, inefficient, and it offers low-value interventions to patients. Implementation of PM has the potential to

reduce financial and time expenditures and to increase quality of life and extend the lives of patients. This next technological revolution – the technology redefining the healthcare industry of the future – combines highly powerful biotechnologies like biomarkers, genetics or proteomics with vast amounts of available data, cloud computing services, machine learning, artificial intelligence (AI)-based or similar ICT solutions. Together, these provide expert insights and highly valuable information to support clinical decision at a relatively low cost. Presently, connected medical devices and highly innovative diagnostics together with stratification technologies are already transforming the way the healthcare industry works. The widespread adoption of technology-enabled care will ensure that the concept of the “Smart Hospital” becomes a reality. The industry appears ready to deploy these technologies in large healthcare settings, but open-minded healthcare organisations are also needed in order to pave the way for the future. Some regional and national systems have already created innovation tools like Innovative Procurement and screening programmes to facilitate the adoption of these technologies in routine hospital practices. Other healthcare organisations are creating and refining systems to increase and accelerate the innovation flow around PM in their facilities. Hospitals are also favouring links with industry through their research and innovation infrastructures. Important lessons learned from all these experiences will help to accelerate the adoption of PM technologies across Europe. They should also contribute to the definition of new policies and investment decisions at European, national and regional level. The fourth workshop will invite leading organisations and experts with successful programmes and experience in the adoption of PM technologies by healthcare organisations, and it will be organised around five sub-areas:

- a. Research & Innovation infrastructures exploitation models to boost innovation
- b. Innovative Procurement Tools (PCP & PPI)
- c. Screening and prevention programmes
- d. Procurement based on clinical outcomes from PM technologies
- e. Smart and future hospitals [4].

5. Socio-Economic Aspects Rationale

From an economic point of view, personalised health, intended as a paradigm shift from a reactive to a preventive and predictive healthcare, poses some concerns. Massive financial investments are required to modernise the European health systems and personalised health needs to become a new driver for the economy as building and automotive sectors have been in the past century. Investment policies should facilitate the integration of different industrial sectors. The transition to personalized health will also help to achieve healthcare sustainably, which is currently a major challenge.

Another major concern is the possible inner discrimination of personalised health and the necessary

mitigation by policy interventions. In fact, as PH potentially offers 1-to-1 services, the costs tend to increase and the access to the best care available might be hampered. Therefore, in order to guarantee the social and economic sustainability of healthcare, according to Prof. Borgonovi [12], PH needs to produce changes in A) training/education, in training new managers and professional figures; B) vertical integration between basic, translational research, technological development and innovation processes; C) empowering patients and citizens; 4) guaranteeing interdisciplinary approaches. In the last ten years, as the technology and promise of personalised medicine developed, bioethics scholars began to contemplate the ethical, legal, economic and social implications of the applications of this approach to medicine, forming the field of investigation known as ‘ELSI’ scholarship. Some of the foundational issues considered were safety and efficiency, informed consent, access to PH and reimbursement. In recent years, technologies such as next-generation sequencers and gene expression assays have become less expensive and more suitable for clinical application, and as a result, personalised medicine has become established in a growing number of clinical areas. With these clinical applications, however, the implications of personalised medicine have expanded in scope and complexity. This trend is likely to continue in the coming years, with wider adoption throughout the healthcare system creating a need to broaden the focus of ELSI scholarship. Finally, PH needs to guarantee that the criteria of the so-called Responsible Research and Innovation are met regarding public engagement, gender, ethics, and open science. Additionally, principles like social justice/inclusion, sustainability, privacy, transparency etc. are to be respected. According to the 1st Interregional Workshop on personalised health in Milan on April 11, 2018, personalised health in terms of RRI needs to guarantee data access and control, avoid excessive claims and promises from research findings and avoid genetic discrimination and misuse of genetic profiling. This Key Strategic Areas will explore regional challenges from the following points of view:

- a. Regulatory
- b. Economics
- c. Cultural
- d. Responsible Research and Innovation
- e. Gender discrimination [4].

EXPECTED IMPACT

The most important impact of Regions4PerMed will be a strengthening of links between European regions setting up or planning personalised medicine healthcare approaches. This will be achieved by ensuring regional representatives interact directly with each other, sharing activities, plans and strategies on PM, exchanging views and concerns, finding fields of cooperation, and finally, committing themselves to concrete joint cooperation actions in the short-medium term.

Commitment is crucial for any real and lasting impact. Therefore, the Consortium will maximise its efforts and leverage already established projects and initiatives.

Stakeholders relevant to PM in each region and Europe-wide will come together in the frame of Regions4PerMed and exchange best practice as well as highlight the key challenges ahead. The continuous technical dialogue through preparatory papers, thematic workshops, and on-site visits will thus ensure policy mak-

ers receive the best possible information and advice, and in consequence, will minimise risks to PM employment on the political level. Regional representatives will have the opportunity to understand how other EU regions are tackling relevant challenges, get state-of-the-art analyses from relevant stakeholders, share views and update policies, contribute to shaping a common agenda, and identify common investment areas.

Overall, this will result in a coherent, science-founded basis for decision-making [4].

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CORRECTIVE FACTORS OF INTESTINAL MICROFLORA DISORDERS IN THE PERINATAL PERIOD

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ABSTRACT

Intestinal microflora is found at approximately 10^4 bacteria per ml of intestinal fluid. Although this ecosystem is very diverse with dynamic changes taking place within it, there is a certain stability in the type and number of species, referred to as the core microbiome, found in 95% of the human population. Genetic variation of microorganisms is relatively small, and their functions are strictly defined and highly conservative. The microbiome exists symbiotically with the host, protecting it against colonization by pathogenic microorganisms, providing essential metabolites, and stimulating the immune system. Colonization begins prenatally and its development is greatly influenced by the course of pregnancy, method of delivery, food supplied to the child during the first moments of life, and post-birth environment. The appropriate intestinal microflora composition is a key determinant of health and homeostasis, and any intestinal dysbiosis can be associated later in life with the development of obesity, diabetes, allergies or cancer. Due to the increasing number of hospitalised pregnancies and deliveries, affecting the intestinal microflora of a newborn, efforts are being made to minimize this process and restore the newborn's microbiome. The use of the Vaginal seeding procedure raises up great hopes, but also some fears concerning its safety. Some very simple and most natural factors have been recently also appreciated and promoted, such as breastfeeding or direct contact of the baby's skin with the mother's skin, which are allies to probiotic bacteria. The purpose of this paper is to emphasize the importance of microbial colonization of the human body and to present the latest and most effective procedures that are designed to correct the existing dysbiosis or to reduce the risk of its occurrence. The literature for the compilation of this study has been obtained from databases such as PubMed, Google Scholar, Web of Science.

KEYWORDS: caesarean section, intestinal microflora, vaginal seeding, breastfeeding, probiotics

DOES THE METHOD OF TERMINATION OF PREGNANCY INFLUENCE THE FORMATION OF NEONATAL MICROFLORA?

The manner in which pregnancy is terminated is very important in the context of the health of both the mother and the child. The development of a normal microflora depends on the number and type of bacteria species acquired during delivery. Newborns, born physiologically, breastfed, not subjected to antibiotic therapy [1] are considered to possess the most optimal composition of the intestinal microflora – they have a direct

contact with the bacterial flora of the vagina and gastrointestinal tract of the mother. Immediate skin to skin contact and breastfeeding are also of great importance. The positive health effect is attributed mainly to *Lactobacillus* and *Bifidobacterium* [2] – colonization with these bacteria is much greater in children who were born naturally than in those whose delivery was terminated in a surgical procedure. The latter in the first weeks of life are much more often colonized by mother skin microorganisms and hospital strains, i.e.: *Enterococcus*, *Clostridium*, *Klebsiella*, *Streptococcus*, *Haemophilus* and *Veillonella* [2] – while colonization with *Bifidobacterium* bacteria is

delayed by about 180 days in comparison with physiologically born infants [2]. Children born by caesarean section, apart from differences in microbial formation, are more likely to develop adaptive disorders, which additionally prevents the skin contact between the mother and her child and delay the start of breastfeeding. Their presence also often prolongs the time of newborn's hospitalization and the need to implement antibiotic therapy. Planned caesarean sections often take place before the due date of delivery – it is connected with shortening the third trimester of pregnancy, during which the fetus swallows non-sterile amniotic fluid, which also leads to colonization of the gastrointestinal tract with bacteria from the mother [3,4]. The ever-growing number of scheduled Caesarean sections also coincides with the increasing incidence of non-communicable diseases such as food allergies, asthma, obesity, diabetes and autism spectrum disorders, prompting researchers to study the possible causal relationship between these factors.

This work is for illustrative purpose only; it has been compiled on the basis of an analysis of the results of scientific research published in peer-reviewed journals in the years 2000–2018. The following terms were used in electronic search: # caesarean section, # intestinal microflora, # vaginal seeding, # breastfeeding, # probiotics, in databases such as: PubMed, Google Scholar, Web of Science.

VAGINAL SEEDING – INNOVATION OR STANDARD?

In connection with the reports of impaired intestinal microflora coupled with the occurrence of many diseases later in life, there are more and more ideas to restore the natural microbiome. One of the most recent procedures is vaginal seeding – it is aimed at transferring bacteria from the mother's vagina to the newborn, who was born by caesarean section and thus had no contact with the natural microflora from the mother's birth canal. This procedure starts before the surgery, by removing the secretion from the woman's reproductive tract and the colonizing bacteria into a sterile gauze, and then storing it in a sterile container until the baby is born. The next step is to wipe the face and the rest of the newborn's body with the gauze, so that the colonization with bacteria from the mother can begin. In a study conducted in 2016, swabs from the oral cavity, skin and anus were taken from 18 newborns: 7 born naturally and 11 by caesarean section, 4 of whom were subjected to vaginal seeding. Samples were collected from both newborns and their mothers 6 times within one month from the date of delivery (1, 3, 7, 14, 21, 30 days). The results of the study show that in children born by caesarean section, who underwent vaginal seeding treatment, the microbe was similar to the one of children born naturally. Moreover, on the first day after the delivery, the microflora of children born naturally and subjected to vaginal seeding was more similar to that of the mother's vagina, whereas

the microflora of children born by caesarean section resembled that of the mother's skin [5]. The results of the study are very promising, however, further formation of the microbiome in children undergoing the study and its impact on their long-term health is not known. Since only four children underwent the procedure, this study is not sufficiently reliable to draw proper conclusions and confirm the safety of the procedure [6].

There are also critical opinions about this procedure – it is believed that during vaginal seeding many pathogenic microorganisms may be transmitted from a mother to a child, which at the moment do not cause active infection and the pregnant woman is not aware of the carrier. *Chlamydia trachomatis*, *Neisseria gonorrhoeae*, human papillomavirus, cytomegalovirus and group B streptococci are just some of the potentially life-threatening microorganisms that newborns can be infected with [7]. At the moment, with the current state of the scientific knowledge, the American College of Obstetricians and Gynaecologists does not recommend vaginal seeding until more extensive research and more detailed data is obtained in the context of the safety of the procedure.

USE OF PROBIOTICS AND PREBIOTICS AND THEIR EFFECT ON INFANT'S HEALTH

If the delivery was performed without complications, there was no need to apply antibiotic therapy to a mother or a child and the newborn is breastfed, the intestines colonize with probiotic bacteria, whose presence is optimal and allows for proper development of the child. However, the intestinal microflora in children born as a result of a hospitalised labour differs significantly from the microflora of their peers. One way of restoring normal microbial activity is through the supply of probiotics. While the best source is of course breast milk, when children cannot be breastfed, preparations containing different species of beneficial microorganisms and adapted for newborns are used. Probiotic bacteria are also present in artificial mixtures recommended for infant feeding. In the current recommendations of the Polish Society of Neonatology (PTN) from 2015, a cautious approach to routine use of probiotics in newborns has been retained [8]. However, the experts from the World Allergy Organization (WAO) suggests the administration of probiotics in several clinical situations: pregnant and breastfeeding women (where there is a high risk of allergy development in their children) and newborns with a high risk of developing allergies. Probiotics can help prevent autoimmune diseases such as type 1 diabetes. In a large TEDDY study, it was shown that administration of probiotics – mainly *Lactobacillus* and *Bifidobacterium* – during the first 27 days of life was associated with a lower risk of autoimmunization against pancreatic beta cells islets, especially in newborns at risk of developing type 1 diabetes (compared to children who

did not receive probiotics or received them after 27 days of life) [9]. As with all medical devices, probiotics have certain restrictions as to their use, such as sepsis, NEC and post-surgical conditions in the gastrointestinal tract. The situation with prebiotic substances is completely different, they are common in food, but they are also produced on an industrial scale. Prebiotics have a beneficial effect on human health, among others: the addition of prebiotic saccharides to the diet of newborns not fed with breast milk, accelerates the colonization of bifidobacteria in the gastrointestinal tract [9]. Fructan, commonly known as fructooligosaccharides (FOS), are also considered prebiotics. They stimulate the proliferation of bacteria that have a positive effect on the human body. On the other hand, they inhibit the development of pathogenic microflora, including carcinogens (factors that affect the development of cancer), improve digestion, facilitate the absorption of many elements and reduce the amount of toxins in the body. Prebiotics are also readily available, as they are commonly found in food products such as yoghurts, fruits and vegetables.

BREASTFEEDING – CONSTANTLY APPRECIATED SINCE PREHISTORIC TIMES

In the pre-Neolithic period, prior to the domestication of farm animals, mother's milk was the only way to feed babies – however, with the development of civilization, attempts at artificial feeding began to emerge. Despite the great convenience and salvage for children who were deprived of their mother's milk, the appreciation of natural breastmilk has not ceased. In ancient Egypt and Mesopotamia, a new form of employment appeared – a wet-nurse. Such a woman was employed to breastfeed orphans. Nowadays, most of the beneficial properties of breast milk have been recognized. It is one of the safest and most beneficial ways to influence the development of proper intestinal microflora of a newborn. The goal to be pursued in newborn nutrition is to provide exclusive breastfeeding during the first six months of life. Female breastmilk produced in sufficient quantities by a healthy, well-nourished mother fully satisfies the newborn's need for all necessary nutrients, at the same time ensuring its proper development in the first half-year of life [10]. The benefits of breastfeeding are enormous for both sides of the process. In a woman who is breastfeeding, oxytocin is secreted, which reduces the length of postpartum period. In addition, the risk of developing breast cancer and ovarian cancer is also decreed [11]. Breast milk contains a number of natural oligosaccharides that stimulate the growth of pro-health bacteria in the baby's intestine and over 300 different species of bacteria and their genetic material, including *Staphylococcus*, *Streptococcus*, *Veillonella*, *Lep-totrichia*, *Prevotella*, *Lactobacillus*, *Enterococcus*, *Staphylococcus*, *Bifidobacterium* – they are found in sulphur as well as in transitional and mature milk. It has been dem-

onstrated that *Enterococcus faecalis* bacteria and lactic acid bacteria (*Lactobacillus sp.*) show antimicrobial activity directed against *Staphylococcus aureus* [2]. Epidemiological studies in the United States have reported that 64-82% of skin infections caused by meticillin-resistant *Staphylococcus aureus* concerned newborns delivered by caesarean section [12]. Such a large variety of bacteria present in breast milk contributes to its anti-infectious and immunomodulatory properties. Consumption of such many natural prebiotics and probiotics by a child facilitates proper digestion and positively influences the development of its immune system. An extremely important element of newborn care is administration of colostrum (infant milk), which, due to its composition and properties, has a significant impact on the proper colonization of the neonate's digestive tract [13]. Compared to mature milk, it contains more protein and vitamin A, less fat and less lactose. This accelerates the excretion of meconium and prevents jaundice in newborns. It contains *Bifidobacterium* and *Lactobacillus* bacteria and a significant number of oligosaccharides that promote their growth and has high levels of antibodies (Class A secretory immunoglobulin – IgA), cytokines as well as anti-inflammatory factors.

Delayed colostrum secretion in the mother after caesarean section and postponement of natural feeding adversely affect the development of newborn microflora [14]. Breastfeeding is a natural and safe way to restore proper colonization of newborn mucous membranes after caesarean section or antibiotic therapy as well as a chance for proper development, since even the best mixtures dedicated to newborns will not replace breastmilk. Numerous studies suggest that it is possible to restore normal composition of the bacteria that inhabit a child's body, even if the child or pregnant woman has undergone perinatal antibiotic therapy by feeding the newborn only with natural food from the mother.

CONCLUSIONS

Since conception, a man is exposed to the influence of medication and supplements as well as many other factors that can affect his intestinal microflora in either way. In connection with the development of science and microbiological research, the beneficial effects of microorganisms on the human body have been appreciated with attempts made to explain when exactly the symbiosis between a man and probiotic bacteria begins. It has been proved that there is a correlation between abnormal composition of human intestinal microflora and the occurrence of many allergic, autoimmune and other diseases. As a result, numerous ideas have emerged aimed at restoring proper microbiota, including vaginal seeding. However, due to the still relatively small number of studies in this field, there are no clear recommendations for the use of these methods. It can therefore be concluded that the most beneficial for the human body is being subjected to everything that is as close to nature as possible and from the earliest moments of life.

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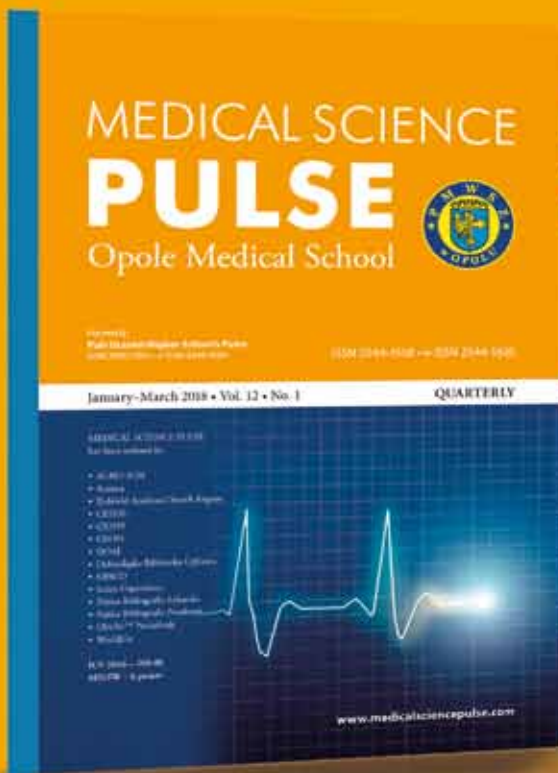
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