The influence of cryotherapy and kinesitherapy on lower back pain reduction and improvement of quality of life in elderly women

Wpływ krioterapii oraz kinezyterapii na zmniejszenie dolegliwości bólowych kręgosłupa oraz poprawę jakości życia u starszych kobiet

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Key words
Lower back pain, Cryotherapy, Kinesitherapy, Quality of life, Older women

Abstract
Introduction: Cryotherapy and kinesitherapy are commonly used methods in treating lower back pain
Aim: The main aim of the study is to compare the effects of whole-body cryotherapy, cryotherapy combined with kinesitherapy, and kinesitherapy alone on pain and quality of life in older women with spinal arthritis.
Material and methods: The study group comprised 69 women between the age of 65 and 70 who were diagnosed with lumbar spine arthritis and were undergoing physical therapy due to back pain. The women were divided into 3 subgroups which participated in different rehabilitation protocols (cryotherapy, cryotherapy with kinesitherapy and kinesitherapy alone). Physical therapy lasted for 2 weeks, from Monday to Friday. Quality of life was investigated with the SF-36v2 questionnaire, completed on the first and last day of physical therapy.
Results: The study with the SF-36v2 questionnaire observed statistically significant improvement in quality of life among all groups.
Conclusions: Physical activity effectively reduces pain and improves quality of life among women with osteoarthritis, which casts doubt on the viability of using cryotherapy for this purpose.

Słowa kluczowe
Zespół bólowy kręgosłupa, krioterapia, kinezyterapia, jakość życia, kobiety w starszym wieku

Streszczenie
Wstęp: Krioterapia i kinezyterapia są powszechnie wykorzystywanymi metodami terapii u pacjentów cierpiących z powodu bólu kręgosłupa lędźwiowego.
Cel: Głównym celem pracy jest porównanie wpływu krioterapii ogólnoustrojowej, krioterapii połączonej z kinezyterapią oraz samej kinezyterapii na ból oraz jakość życia starszych kobiet z chorobą zwyrodnieniową kręgosłupa.
Materiał i metody: Grupa badanych składała się z 69 kobiet ze stwierdzoną chorobą zwyrodnieniową kręgosłupa lędźwiowego, pomiędzy 65 a 70 rokiem życia, które z powodu bólu kręgosłupa uczestniczyły w fizjoterapii. Wyłoniono 3 podgrupy uczestniczące w różnych protokołach fizjoterapeutycznych (krioterapii, krioterapii z kinezyterapią lub samej kinezyterapii). Fizjoterapia trwała przez okres 2 tygodni, od poniedziałku do piątku. Jakość życia zbadana została za pomocą kwestionariusza SF 36v2, wypełnionego w dniu rozpoczęcia fizjoterapii i w dniu jej zakończenia.
Wyniki: W badaniu kwestionariuszem SF 36v2 statystycznie istotną poprawę jakości życia zaobserwowano we wszystkich grupach.
Wnioski: Aktywność fizyczna skutecznie redukuje poziom bólu i poprawia jakość życia kobiet z osteoartrozą poddając w wątpliwość zastosowanie w tym celu krioterapii.

The individual division of this paper was as follows: a – research work project; B – data collection; C – statistical analysis; D – data interpretation; E – manuscript compilation; F – publication search

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INTRODUCTION

Cryotherapy is the stimulative action of extremely low temperatures (below -100°C) on external body surfaces for approximately 3 minutes[1,2]. According to the methodology for applying this type of treatment, cryotherapy should be immediately followed by kinesitherapy. Indications for the usage of cryotherapy include, above all, chronic musculoskeletal diseases accompanied by pain and reduced physical fitness[3], i.e. conditions commonly occurring in the elderly and significantly lowering their quality of life. Due to the fact that extremely low temperatures are contraindicated in people with severe cardiac, cardiovascular or hematopoietic diseases, some authors indicate older age as a contraindication to cryotherapy. The effect of cryotherapy, as well as other stimulating treatments, depends on the initial state of the body, including age, skin and body composition, comorbidities. In the Polish practice, geriatric patients, mainly due to chronic pain, often benefit from this procedure, although there is a lack of scientific reports on the impact of cryotherapy on the body and its safety in older people. Only one work was found[5] confirming the beneficial effects of cryotherapy on pain reduction in older males[6].

STUDY AIM

The main aim of the study is to compare the impact of whole-body cryotherapy, cryotherapy combined with kinesitherapy and kinesitherapy itself on pain reduction and quality of life in older women with degenerative spinal diseases, and, most importantly, to answer the following questions:

1. Are cryotherapy, kinesitherapy applied individually and together with cryotherapy effective methods in the reduction of lumbar spine pain and do they improve quality of life among older women?
2. Which of the above-mentioned methods is particularly recommendable, considering its effectiveness and availability?

RESEARCH MATERIAL AND METHODS

The study group consisted of 69 elderly women residing in Krakow, who reported for physiotherapy due to spinal pain caused by osteoarthritis. Women with moderate pain (up to 5 points on the 10-point visual-analogue scale, where 0 means no pain and 10 unbearable pain) were qualified for the project. Persons with absolute contraindications for cryotherapy or suffering from other serious musculoskeletal or inflammatory diseases were excluded. Each patient provided informed, written consent to participate in the study.

The group of subjects was randomly divided into 3 groups: group 1 – 22 persons subjected to whole-body cryotherapy, group 2 – 23 individuals subjected to kinesitherapy, group 3 - 24 participants receiving whole-body cryotherapy and kinesitherapy.

The mean BMI (Body Mass Index) in each group was at a similar level: in group 1 it was 27.24 kg/m^2, in group 2 it totalled 27.09 kg/m^2, and in group 3, 28.15 kg/m^2.

The research project obtained the consent of the Bioethics Committee by the District Medical Chamber in Krakow, No. 60/KBL/OIL/2011

Quality of life assessment

The SF 36v2 questionnaire, with high reliability and accuracy indicators, was used to assess quality of life[7]. The questionnaire was used as a tool to evaluate changes in the quality of life (conditioned by health) as a result of physical therapy. The participants from all groups were tested with the questionnaire twice, before and after physiotherapy. In the project, a version of the questionnaire was used to assess changes in the perception of health over a short period of time (the so-called acute version).

Applied methods of physical therapy

Between January 2011 and September 2013, all the women participated in 10 physiotherapy treatments – 5 days a week for a period of 2 weeks, according to the group classification.

Cryotherapy treatments using liquid nitrogen were performed in a JUKA 2005 cryogenic chamber, on the premises of the University of Physical Education in Krakow. During the cryotherapy treatment, the temperature prevailing in the vestibule of the chamber was -60°C, while in the main chamber, the temperature reached -120°C. The first 2 treatments were aimed at adaptation to extremely low temperatures, for the 3rd to last treatments, the time spent in the vestibule was 30 seconds, and in the main chamber, 3 minutes. The women participating in the treatment were dressed in special costumes according to the methodology of participating in the procedure.

Conditioning gymnastics was led by one physiotherapist in groups of 5-12 participants. It started with a warm-up lasting 5 minutes, followed by a 20-25 minute main part, composed primarily of exercises strengthening the trunk muscles and limbs, performed in low positions, without external loads, and then, a 5-10 warm-down period based on stretching, breathing and balance exercises.

The intensity of the exercises was selected according to modified recommendations given by the US Centers for Disease Control and Prevention[8].

Statistical analysis

The test results were analysed using the Statistica 10 computer programme (StatSoft®, USA). The results obtained in subsequent measurements (before and after physical therapy), including division into groups of subjects, were compared using the analysis of variance

– the ANOVA model with repeated measurements. In the situation where significant relationships appeared, they were additionally tested using post hoc tests (Tukey's test). In cases when the distribution of results deviated from normal distribution, analysis of the dependence was performed using nonparametric tests for dependent variables – Kruskal-Wallis test and Kendall's coefficient. Here, in cases in which significant relationships were also found, they were additionally tested using the Friedman ANOVA post hoc test.

Results were considered statistically significant at the level of $p<0.05$.

RESULTS

ANOVA with repeated measurements, taking an additional factor into account (division into groups), examines changes in results over time, and at the same time, it additionally examines whether these changes differ among groups. There were no significant differences between the groups, however, significant differences over time were noted, but the changes were similar in all groups, which means that the baseline level of indicators in each group was similar and that the changes that took place as a result of physiotherapy were also similar to one another. The charts show the expected marginal means (bespoke way of illustrating the results by the authors of the test).

As a result of the applied intervention, the Physical Functioning (PF) index increased significantly ($p<0.05$) in all groups, but most strongly in group 3, the weakest increase noted in group 1 (Figure. 1).

An increase in the Role Physical (RP) index was observed in the studied groups, with a significant increase in the groups participating in kinesitherapy (group 1 $p=0.012$, and group 2 $p=0.003$) (Figure 2).

After the applied physiotherapy, the Role Emotional (RE) index (limitation in performing roles, performing everyday tasks due to emotional problems) increased significantly only in group 3 ($p=0.03$).

In all the examined groups, the level of pain decreased significantly ($p<0.05$) (as indicated by the increase in the Bodily Pain – BP index). The most significant change was observed in the group of people participating in both cryotherapy and gymnastics, in which the baseline level of pain was the highest. The smallest change occurred in the group of people undergoing only cryotherapy treatments (Figure 3).

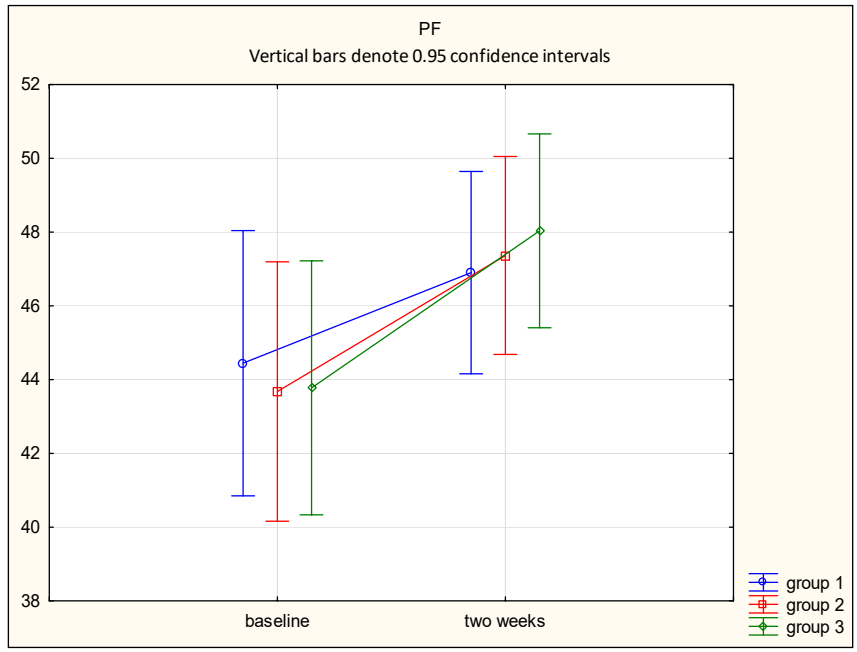

Figure 1

Changes in level of Physical Functioning (PF) according to applied intervention

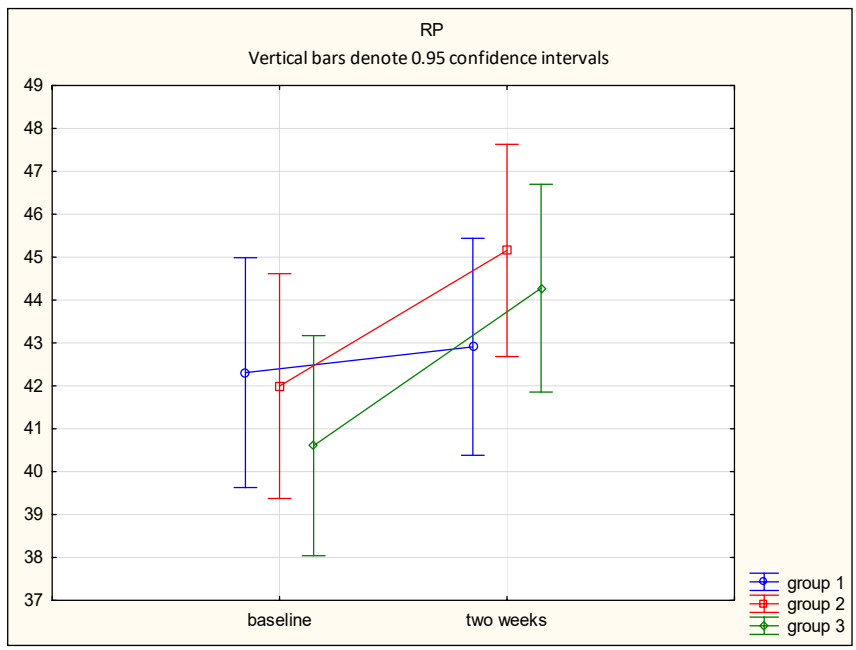

Figure 2

Changes in limitation range regarding role performance (RP) due to problems with physical health according to applied intervention

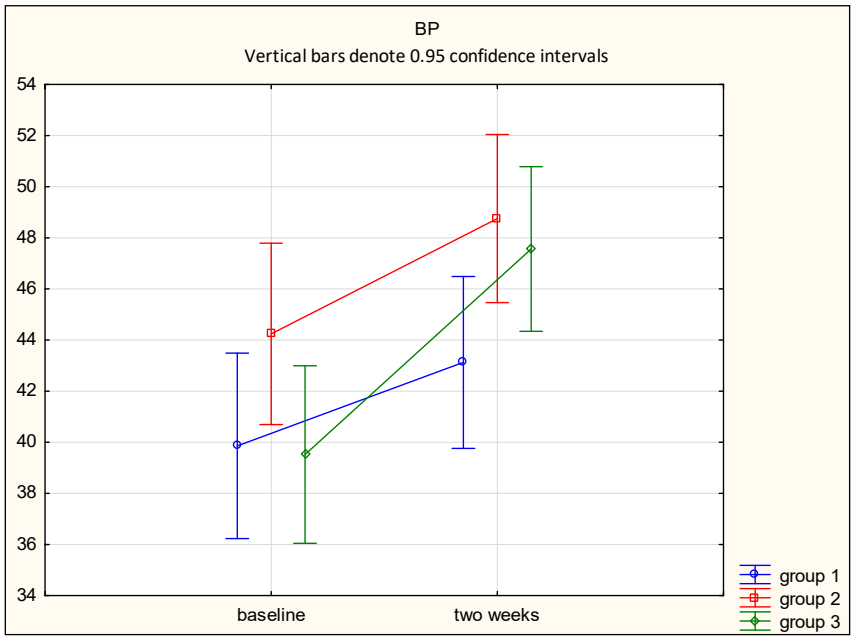

Figure 3
Changes in level of Bodily Pain (BP) according to applied intervention

In each of the studied groups, the level of General Health (GH) index increased significantly. The largest increase concerned group 1 ($p=0.007$), the smallest, group 2.

As a result of physical therapy, the Vitality (VT) index significantly increased in all groups ($p=0.027$).

In all examined groups, an increase in the Social Functioning (SF) index was observed, with a significant increase only in group 3 ($p=0.005$).

A significant increase in the Mental Health (MH) index was observed in all the studied groups ($p<0.05$).

The Physical Component Summary (PCS) index was increased in all the groups. The largest, significant increase ($p=0.001$) concerned groups undergoing kinesitherapy (groups 1 and 2), while the smallest was noted in the cryotherapy group (group 3), in which both before and after physiotherapy, the PCS values were the lowest.

The Mental Component Summary (MCS) index was increased in all of the studied groups, with a statistically significant increase in group 3 ($p=0.003$), for which the baseline MCS levels were the lowest. The smallest increase in MCS was observed in group 2 in which its baseline values were the highest.

DISCUSSION

Osteoarthritis is one of the most common reasons for targeting older people for cryotherapy. It is also the leading cause of disabili-

Table 1

Outcome of Brown-Forsyth test and analysis of variance for chosen parameters

	Brown-Forsyth's homogeneity of variance test		Analysis of variance	
Group	**F**	***p***	**F**	***p***
Physical Functioning PF	0.79	0.45	0.07	0.93
Role Physical RP	1.55	0.21	0.51	0.59
Bodily Pain BP	0.52	0.59	2.01	0.13
Physical Component Summary PCS	1.42	0.24	0.16	0.85
Mental Component Summary MCS	0.51	0.59	3.02	0.05

Table 2

Mean values and standard deviations for chosen parameters before and after therapy

	Before treatment			After treatment		
Group	**I**	**II**	**III**	**I'**	**II'**	**III'**
	Mean value, standard deviation (*SD*)					
Physical Functioning PF	44.53 ±6.57	43.67 ±9.15	43.77 ±9.26	47.68 ±5.46	47.36 ±6.71	48.03 ±6.31
Role Physical RP	42.40 ±4.96	41.99 ±7.72	40.60 ±5.91	43.00 ±5.87	45.15 ±6.95	44.27 ±4.71
Bodily Pain BP	40.23 ±7.06	44.23 ±9.76	39.52 ±8.53	43.51 ±7.98	48.75 ±7.93	47.56 ±8.17
Physical Component Summary PCS	42.13 ±5.06	42.88 ±8.10	43.34 ±7.91	44.05 ±5.26	46.73 ±5.79	47.09 ±5.74
Mental Component Summary MCS	47.94±10.26	48.21 ±8.52	42.10±10.03	51.89 ±7.96	50.16 ±6.95	47.96 ±7.68

Table 3

Level of significance of differences for particular SF 36v2 subscales before and after the applied physical therapy according to groups (post hoc test)

SF 36v2 subscales	Statistical significance indicator	Group 1	Group 2	Group 3
Physical functioning PF	*p*	**0.051**	**0.003**	**0.049**
Social functioning SF	*p*	0.613	0.113	**0.005**
Role physical RP	*p*	0.631	**0.012**	**0.003**
Role emotional RE	*p*	0.689	0.695	**0.0366**
Mental health MH	*p*	**0.009**	**0.027**	**<0.001**
Vitality VT	*p*	**0.027**	**0.031**	**0.027**
Bodily pain BP	*p*	**0.052**	**0.007**	**<0.001**
General health GH	*p*	**0.007**	0.143	**0.032**
Physical Component Summary PCS	*p*	0.115	**0.001**	**0.001**
Mental Component Summary MCS	*p*	0.067	0.320	**0.003**

ty among elder individuals[9]. Its occurrence and severity depends on many factors, the modification of which reduces the risk of osteoarthritis, preventing or reducing accompanying pain, preventing disability[10]. One way to modify the course of this disease is physical therapy, including cryotherapy and appropriately selected kinesitherapy. One of the methods assessing health and well-being of patients, including their sense of fitness and pain are quality of life questionnaires, in which the patient becomes a predictor of the results of rehabilitation[11]. The SF 36v2 questionnaire is one of the easily available questionnaires with high indicators of accuracy and reliability, examining, among others, problems that are indications for cryotherapy among older people suffering from chronic back pain.

Older people often experience difficulties in performing everyday tasks, mainly related to physical work[12]. Seniors more often see themselves as people with limited physical fitness than with limited mental performance. Assessment of deteriorating physical fitness increases with age and deteriorating health[13]. The main objectives of therapy among seniors are most often placed in the area of physical functioning[14]. The results of our research indicate a significant increase in physical fitness and reduction in difficulty when performing everyday tasks due to physical health problems in groups attending kinesitherapy. The smaller influence of cryotherapy on the seniors' motor skills compared to physical activity may be related to the fact that the muscles of the elderly react, to a limited extent, to cold temperatures, compared to the muscles of healthy people[15].

Another important factor directly affecting the ability to effectively perform everyday activities is pain, which is one of the main symptoms of degenerative diseases[9]. Pain hinders functioning, impairs quality of life and reduces a patient's movement capacity, which is one of the main reasons why older people undergo physiotherapy. What is more, musculoskeletal system pain is common among the elderly, contributing to significant functional and psychological limitations. Degenerative diseases are one of its main causes, and prevention and therapy are one of the most important challenges in the sector of public health[16]. Cryotherapy demonstrates analgesic effects[17,18]. However, no works have been found comparing the effectiveness of cryotherapy's analgesic action to other methods of therapy. The attempt to compare the analgesic effect of various cold-therapies has been undertaken by Hivronen et al.[19], while questioning the use of cryotherapy as an expensive and limited method (only at cryotherapy centres), since similar analgesic results can be obtained with other cold-therapies e.g. traditional cold packs. Comparison of the use of cryotherapy to kinesitherapy (the authors' research) indicates that the best results can be achieved by using both therapeutic methods simultaneously. Nevertheless, kinesitherapy itself, also statistically significant, effectively modifies the main indication for physiotherapy, i.e. pain, which is confirmed by other authors[20,21,22,23].

In our research, in each group, there was a statistically significantly increase in Vitality (VT), referred to in the questionnaire as lack of fatigue, a sense of energy and fullness of life. Mental Health (MH) functioning, expressed as a decrease in the sense of nervousness, a reduced mood in favour of being calm and happy, improved significantly. Social Functioning (SF) described as the influence of physical and mental health on maintaining/limiting social relations and the RE index defining the limitation in performing roles, performing daily tasks due to emotional problems, showed an upward trend in all groups, however, statistical significance was only confirmed in the group involved in both cryotherapy and kinesitherapy.

The beneficial effects of cryotherapy on the improvement of self-esteem, well-being, increased vigour and vitality[24,25] are known. The au-

thors indicate the possibility of its use in the treatment of depression and neuroses[25,26]. The improvement in mental functioning as a result of cryotherapy may be associated with hormonal changes in the hypothalamus, pituitary and peripheral glands, and with the secretion of endogenous opioids[27].

Significant improvement in mood following cryotherapy, as previously mentioned, manifested in hormonal changes, may also be responsible for increasing the GH index in the 1st and 3rd groups. This indicator reflects the perception of one's own health at the moment of completing the questionnaire, in relation to the peer group and to the time elapsed. Patients involved in kinesitherapy also improved regarding indicator, but this effect was not statistically significant.

In conclusion, it should be emphasised that although only in individuals using both forms of therapy was there a significant increase in the value of each subscale estimating the quality of life, kinesitherapy used as a sole method of improvement also significantly improved the quality of life of older women. Reduction in pain, improvement in physical functioning and reduction of limitations in performing everyday activities due to physical health problems, i.e. the limitations of which older people complain most often and the reason why they undertake physiotherapeutic activities, are effectively modified by physical activity adapted to the needs of patients. Changes within these subscales also affect changes at a psychological level. These dependencies cast doubt on the legitimacy of using cryotherapy as an expensive method, hardly available and poorly researched regarding its safe usage among seniors.

CONCLUSIONS

The conducted research allowed to formulate the following conclusions:

1. Both cryotherapy and kinesitherapy used as separate methods, as well as used together, significantly reduce lumbar spinal pain and improve quality of life among older women.
2. Kinesitherapy is a method particularly recommended for older women, as it is highly effective in reducing lumbar spinal pain and is an inexpensive and widely available method.

Conflict of interest: none

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