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Changing the Pain and Quality of Life after Two Kind of Aquatic Exercise Program in Patients with Chronic Knee Osteoarthritis

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ABSTRACT

Objective: the present study aims at comparing the effects of aquatic exercise in shallow and deep water on the postural control and the quality of life in elderly women with chronic knee Osteoarthritis. **Method:** 43 elderly women suffering from knee OA aged over 55 years old participated in the present study. Based on the preliminary examination and pretest, the subjects were divided by random matching into 3 homogeneous groups: shallow- water exercise program (n=14); deep- water exercise program (n=14); control group (n=15) without intervention. Pain and quality of life were evaluated using two section of KOOS questionnaire (pain section and quality of life section). Their exercise intensity and perceived exertion were evaluated by measurement of the percentage of the maximum heart rate and Borg questionnaire respectively. Data were analyzed using two-factor repeated measure ANOVAs and post hoc LSD and paired t-tests at $p<0.05$ significance level. **The results:** After the intervention, the pain and quality of life in the shallow water were significantly improved compared with the deep water (respectively: $p<0.001$, $p<0.001$), and with the control group ($p<0.001$) and ($p<0.001$) respectively. Furthermore, the pain and quality of life in the deep water were significantly improved compared with the control group ($p< 0.001$) and ($p<0.001$) respectively. **Conclusion:** Findings support the effectiveness of physical exercise in water. It seems that training exercises in shallow water more significantly affects the pain and the quality of life compared to such exercises in deep water.

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INTRODUCTION

Osteoarthritis is the most common degenerative disease of joints which causes destruction of cartilages and reactive changes in borders of joints and in subchondal bone [12]. The clinical manifestations are ongoing arthralgia, joint stiffness, and limited movements and impaired balance [12]. Patients experiencing this type of pains, especially knee pain and low back pain are unable to undertake their routine or social activities, thus they suffer from psychological crisis and abnormalities such as depression, anxiety, and aggression. Eventually this leads to low quality of life and will become worse with increase in age of the patients [17,18]. Previous studies show that exercise can prevent progression of osteoarthritis, pain, and finally decrease in quality of life. Therefore to increase quality of life we have to encourage doing exercises which remove pain from the joints and reinforce their peripheral muscles. So exercise in the water is recommended for these patients, because it prepares an immune environment, decreases the body weight and pressure on joints.

For old people and those who have pain because of osteoarthritis and cannot exercise on the land, water prepares a good environment for movement and relaxation. It seems that painless movement in water allows the patient to achieve more success in comparison to exercise on land, and this increases the self-confidence of the person. The fear of drop and injury to damaged parts is lower in water. In addition to joyfulness and pleasure of the water, group exercise increases the social interaction of the patient and enhances his incentive to get better in the course of healing of the disease [1]. During walking and running in water, there is low risk of slight trauma to the muscles and bones that happen through eccentric contractions in land exercise [1]. However previous researches in this area show the beneficial effect of water exercise on quality of life and some biomechanical functions such as balance in osteoporotic post menopausal women [24], patients with fibromyalgia [8] and

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elderly [23], that are all done in shallow water. A few studies addressed the effect of deep water on biomechanical and physiological factors which are restricted to healthy persons or sport mans [7]. In other studies under taken in deep water, physiological responses of sport mans are investigated [9], or they are compared with running on the treadmill [5,6,13,4].

To compare the effect of water depth on factors like maximum heart rate, heart rate, rate of respiration changes [11] and maximum metabolic reflexes [25], studies have been made on runners, whereas they have not been made on biomechanical factors, and doing exercise in the water has been compared with exercise in the land. The studies on elderly osteoarthritis also have been made just on the effect of doing exercise in water on factors like flexibility, strength and cardio-respiration endurance [26], range of motion [19] and postural sway [27].

Some other researches were accomplished on comparing the exercise remedy in the water and the land in patients with pelvis and knee osteoarthritis on variables such as quality of life, muscle strength and physiological performance [15] and other variables such as postural sway and physical performance, muscle strength and flexibility of lower extremities in elderly with knee osteoarthritis [27].

However, in these study and many other studies, water depth is the same in all stages and is not upper than breast level [1]. Since different depths affect the relevant parameters in exercising in water- like gravity and hydrostatic pressure, it is possible that exercise in shallow and deep water has different impacts on pain, and then quality of life of patients with knee osteoarthritis.

So, regarding the shallow and deep water advantages, this question arises that which has the most effect on decrease the pain, and finally enhancing quality of life: exercising in deep water or exercising in shallow water? There is not a vast literature in comparing doing exercise in deep water to in shallow water. Therefore, to determine the efficient water remedy methods, the present study aims to compare the effect of doing exercise in deep water and in shallow water on the pain and quality of life in elderly female with chronic osteoarthritis patients.

Methodology:

43 elderly women suffering from knee OA aged over 55 years old participated in the present study. Table 1 shows the descriptive statistics related to the individual specifications of the participants in the research among separated groups. To take the importance of the groups being homogeneous from the viewpoint of body mass and fat percentage in to consideration, multi-variable analysis of variance was used for studying the probabilistic differences among groups.

Table 1: Descriptive data related to the individual specifications of the participants.

	Groups		
	Shallow-water (n=15)	Deep-water (n=14)	Control (n=14)
Age (year)	62.41±5.16	63.11±5.37	63.41±5.16
Height (Cm)	154.92±4.63	155.22±4.03	154.85±3.99
Weight (Kg)	59.84±10.45	61.03±11.20	60.13±10.86
BMI (Kg/m^2)	25.71±3.96	26.11±4.09	25.83±4.21
Fat percentage (%)	30.69±7.24	31.83±6.88	31.17±7.55

The results obtained from multi-variable analysis of variance showed that the effect of group type on the two important variables of body mass and the fat percentage are not significant ($p=0.428$, $F(4, 78)=1.08$, Wilks's Lambda=0.897), showing that the whole groups join a similar level from the viewpoint of the mentioned variables.

The water exercise program was performed three session per week on shallow water group (water until chest and feet touch the floor) and deep water group (patient do exercise while the body is immersed in the water and feet do not touch the floor) underwent a 12 weeks period as was prescribed by Zamanian and *et al*. [28].

To measure the rate of pain and quality of life from two values, KOOS questionnaire was used. This questionnaire includes 42 questions with 5 values having the pain names (9questions), knee disease signs (7 questions), performance in everyday life (17 questions), sport performance and healthy recreations (5 questions) and the life quality related to the knee (4 questions). The questionnaire replies in all sections (with different expression) in related using lickert 5- point to degree from zero to 4.The score for the questionnaire aspects is obtained via sum of the questions score related to each section. To have a better interpretation, the questionnaire marks are converted to 0 to 100, So that the rates close to zero are indicative for more pain in the knee and less life quality [22].

In the present research, to control the rate of participants' engagement in the exercises, their heart rate and that of the Rating of the Perceived Exertion (RPE) (Borg 10 score modified version) were measured (Borg, 1970). the maximum heart rate percentage and that of the RPE in each week have been measured via the mean for measured values during weekly meetings. Based on the data on exeperimental groups, the participants' heart

rate range has been, while doing the exercise, between 55% to 65% of the maximum heart rate. Also, the RPE reported has been in the range of 4 to 6, which is indicative of the rate of the perceived exertion from moderate to intense.

Data were analyzed using two factor repeated measure ANOVAs and follow up tests included LSD and paired samples t test at $p<0.05$ significance level.

Results:

Table 2 shows the descriptive statistics related to the pain rate and quality of life among the groups in the pretest and the post-test.

Table 2: The data of descriptive statistics related to the pain and quality of life among the groups in the pretest and the post-test.

Groups	Variables	Measurs		% Changes
		Pre-test	Post-test	
Shallow-Water	Pain	31.21±8.64	48.29±7.41	↑*%54.73
	Quality of Life	28.99±7.12	48.46±6.85	↑*%67.16
Deep-Water	Pain	32.05±8.10	40.76±8.10	↑*%27.18
	Quality of Life	29.02±6.93	40.95±6.36	↑*%41.11
Control	Pain	32.63±7.43	31.22±7.85	↓%4.32
	Quality of Life	30.52±9.01	30.02±8.92	↓%1.64

Attention: an increase in the score for the pain rate is indicator of the pain decrease.

Based on in the table 2, the score for pain rate from the pre-test to the post-test in the shallow water group and that of the deep water and that of the control group have changed from31.21±8.04 to 48.29±7.1, from 32.05±8.10 to 40.76±8.10 and from 32.63±7.43 to 31.22±7.85.

Based on the measured rates, the score from pain rate in the shallow water group and that of the deep water has had an increase of 27.18, 54.73 percentages respectively, while it there been a reduction of 4.32 in the control group.

Also, based on the data in table 2 the score for quality of life from the pre-test to the post-test in the shallow water group and that of the deep water and that of the control group have changed from 28.99±7.12 to 48.46± 6.85, from 29.02± 6.93 to 40.95±6.36 and from 30.52± 9.01 to 30.02±8.92 respectively.

Based on the measured rates, the score for life quality in the shallow water group and that of the deep water group has had an increase of 67.16 and 41.11, percent respectively. While it there been a reduction of 1.64 in the control group.

The results obtained from two factor repeated measure ANOVAs for analysis of main effects for independent variables (within group factor: exercise in the water; between group factor: water depth) on the pain rate and quality of life has been stated in table 3.

Table 3: Data of analysis of main effects for pain and quality of life.

Source of Changes	Variables	*df1*	*df2*	*F*	*P*	$^2\eta$
Exercise in the Water	Pain	1	40	9.043	***<0.001	0.211
	Quality of Life			9.891	***<0.001	0.220
Depth of Water (shallow-water/ deep-water/ control)	Pain	2	40	9.671	***<0.001	0.240
	Quality of Life			10.537	***<0.001	0.258
Exercise in the water × Depth of Water	Pain	2	40	12.975	***<0.001	0.355
	Quality of Life			13.078	***<0.001	0.364

***Mean difference at level of p≤0.001

Considering the significant difference of the interaction effect for the two independent variables, the paired-t test for performing within group post hoc comparisons and considering the significant difference of the main effect for water depth LSD test for performing multiple comparisons were used the result of which have been shown in tables 4, 5, respectively.

Table 4: The data of paired-t test for performing within group comparisons for pain and quality of life.

Groups	Variables	Mean Difference (pretest-posttest)	*T*	*Df*	*P*
Shallow-Water	Pain	-17.08	-12.91	13	***<0.001
	Quality of Life	-19.47	-13.42	13	***<0.001
Deep-Water	Pain	-8.71	-10.57	13	***<0.001
	Quality of Life	-11.93	-9.98	13	***<0.001
Control	Pain	1.41	0.213	14	0.802
	Quality of Fall	0.50	0.189	14	0.873

***Mean difference at level of p≤0.001

Table 5: The data of LSD test for performing between groups post hoc comparision for pain and quality of life.

Variables	Groups		Mean Difference	Standard Erorr	P
Pain	Shallow-water	Deep-Water	7.35	0.78	<0.001***
		Control	17.07	0.54	<0.001***
	Deep-Water	Control	9.54	0.69	<0.001**
Quality of Life	Shallow-water	Deep-Water	7.51	0.88	<0.001***
		Control	18.44	1.64	<0.001***
	Deep-Water	Control	10.93	1.97	<0.001***

***Mean difference at level of p≤0.001

The effect of independent variables on the pain and quality of life has been shown in figure 1 and 2 respectively.

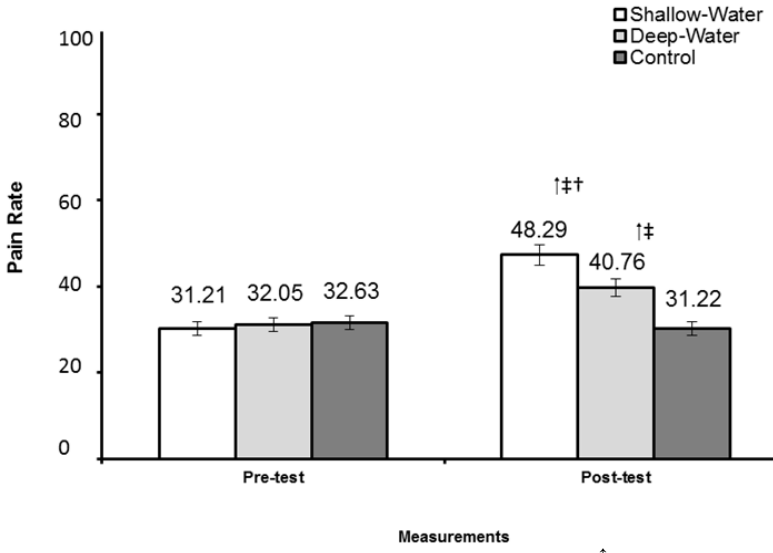

Fig. 1: The effect of exercise in the water and the water depth on the pain.[↑] Significant increase to the pre-test (p<0.05). [‡]Significant mean difference to the control group (p<0.05). [†]Significant mean difference to the deep water group (p<0.05).

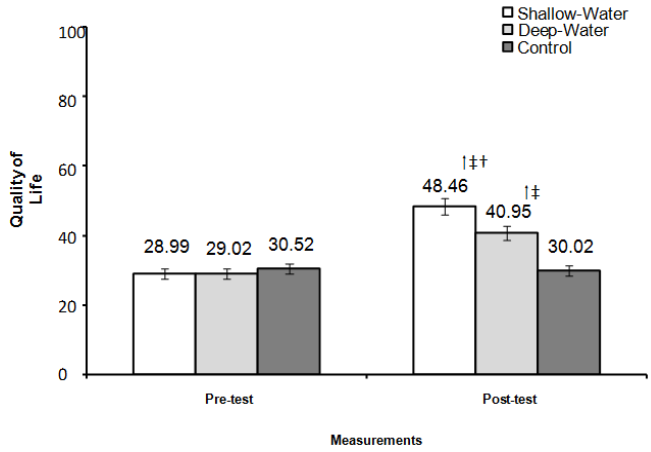

Fig. 2: The effect of exercise in the water and the water depth on the quality of life. [↑]Significant increase to the pre-test (p<0.05). [‡]Significant mean difference to the control group (p<0.05). [†] Significant mean difference to the deep water group (p<0.05).

Discussion and conclusions:

Buoyancy in the water causes keeping the body up against gravity and can be used as an auxiliary force to decrease the weight [14]. Consequently, the pressure on the joint which is the effect of gravity and the body weight is reduced and the pain associated with arthritis symptoms as well subsequent reduced. As a result, the patient can do exercises in a greater range of motion and involvement, and more time doing exercises that can be considered cause of raising water training effectiveness in reducing the pain of knee joint. On the other hand, due to hydrostatic water pressure, pain perception is less in parts submerged in the water. This occurs due to sensory saturation of nerve terminals in the skin sensation. Consequently, the patients do exercises in the water with less pain perception. The rate of pain was reduced in two groups (deep-water exercise group and shallow-

water exercise group). However, the rate of pain after 36 sessions of water exercise was improved significantly at the group with exercise in the shallow-water than the deep-water exercise group.

The results of this study about the quality of life suggest that exercise in the both shallow-water and deep-water increases the quality of life of elderly women patients with chronic osteoarthritis of the knee joint. Dias, Dias & Ramos [10] argue that any type of exercise that decrease the pain can improve physical function and quality of life in osteoarthritis that the research results also confirmed this claim. In another study, Brady, Kruger, Helmick, Callahan & Boutaugh [3] and Patrick, Ramsey, Spencer, Kinne, Belza, & Topolski [20] reported that water treatment courses had a positive effect on increasing performance in daily activities and quality of life in patients with osteoarthritis, which is consistent with the findings of the present study. Besides being refreshing and delightful water feature, a group practice has strengthened social interaction in elderly patients and raises patient's motivation to do exercise and reduce the pain in different stages of recovery [21].

Review of studies on pain and quality of life of elderly patients with osteoarthritis shows that aging increases pain in these patients and the quality of life is diminished [16]. There is a strong correlation between the parameters resulting from osteoarthritis, pain and quality of life which eventually is leading to reduce quality of life by decreasing in the pain.

This means that elimination or reduction the pain lead to increase in the quality of life. It was showed exercise in the shallow-water decrease significantly the pain after 12 weeks. Therefore, shallow-water exercise increased quality of life in patients with knee OA more than deep-water exercise.

Overall, as it is showed exercise in the water is a way to involve patients in the exercise in addition it decreases their pain during activity after a few weeks. Therefore, water exercise especially in the shallow-water for improving pain and quality of life in patients with knee osteoarthritis is recommended.

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