Effects of Aquatic Exercise Training on Pain, Symptoms, Motor Performance, and Quality Of Life of Older Males with Knee Osteoarthritis

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ABSTRACT

Clinical experiences indicate that aquatic exercises may have advantages for osteoarthritis patients. The purpose of this study was to examine the effects of aquatic exercise training on the knee pain and its symptoms as well as on the motor performance associated with daily living activities (ADL), sport-recreational activities, and the quality of life in men over 50. 30 men over 50 years old who suffered from knee osteoarthritis were selected voluntarily and were randomly assigned to aquatic exercise therapy and control groups. The means and standard deviations of age, height and weight of participants in each group were 54.26 ± 3.08 and 57.6 ± 5.76 yr; 169 ± 4.99 and 168.13 ± 4.76 cm; and 76.33 ± 8.11 and 71.53 ± 8.09 kg, respectively. Aquatic exercise training was carried out 3 times per week for 6 weeks. Knee pain, symptoms, motor function in daily activities and sport- recreation and quality of life were measured before and after exercise training. Results showed that the knee pain, symptoms, motor function in daily and sports – recreational activities and quality of life after the exercise protocol significantly improved in the aquatic exercise group (P < 0.05); however, there was no significant change in control groups from pre to post-test (p> 0.05). The results showed that aquatic exercises, as a safe and effective exercise method, could be incorporated to improve the pain, motor functions and quality of life in over-50-year-old males with knee osteoarthritis.

Key Words: Osteoarthritis, Knee Pain, Aquatic Exercises.
INTRODUCTION

Arthritis is the most common joint disease (1, 2). About a billion people around the world suffer from degeneration of joints (1). Osteoarthritis (OA) includes 50% of the problems of people over 65 and it has been estimated that 40% of people over age 70 suffer from osteoarthritis (3). Knee problems are the most common joint injuries after fingers and vertebrae. OA is the most common synovial joint disease that is often associated with structural changes (4) and is called in various names such as degenerative joint disease and aging arthritis. OA often occurs in the elderly people. Knee osteoarthritis (knee OA) usually starts with covering of hyaline articular cartilage (5). Osteoarthritis involves a series of clinical and laboratory signs and symptoms that occur due to different reasons. It seems that the loosening of the collagen network, abnormal development of proteoglycans and tissue swelling are the most important causes of the beginning of OA (6).

Common symptoms of OA can be pain, stiffness, decreased range of motion, joint deformity, muscle weakness, and atrophy. Common factors affecting the incidence of osteoarthritis are aging (6), gender, previous trauma, chronic stress over the joints, and obesity (7). Treatment options may include pharmacological treatment, non-pharmacological treatments and surgery (8, 9). Among the non-pharmacological therapeutic methods, most studies have been assigned to exercise therapy (10, 11). Patients with knee osteoarthritis are reluctant to participate in these activities due to fear of a worsening condition. It has been shown that regular physical activity have significant benefits in the treatment of osteoarthritis, while inactivity and disuse of affected limbs can worsen the mechanical damage of joint and cause loss of joint fluid and inefficiency of the matrix which can accelerate the loss of cartilage (12).

Aquatic exercise can minimize the load on the joints in obese people or people who are seriously ill, and can be especially useful in the early stages of training on land. Minor (2003) suggested that patients who suffer knee osteoarthritis to exercise at least three days a week for 30 minutes of moderate intensity (metabolic equivalents 3 Met) (13). Bartles et al. (2007) compared the effect of aquatic exercise in treatment of knee and hip osteoarthritis with the other treatment methods and concluded that aquatic exercise improves function and quality of life (14). Figueira (2010) examined the effect of aquatic exercise on daily activities in patients with knee and hip OA and discovered that most people deal with fewer problems in daily tasks due to aquatic exercise (6).

National Institute of Arthritis in the United States (1997) suggested aquatic exercise program for the community arthritis patients (15). Aquatic exercise has many advantages, because water properties such as resistance, reducing weight and pressure affected on joints. Exercise will be done with less injury and easier to learn in water (16).

Quality of life is described as general well-being of individuals. Some of important indicators of it include physical and mental health, recreation and leisure time (6, 17). Aquatic exercise decreases pain and improves quality of life in these patients due to strengthening the muscles around the joint and reducing pressure on it (17). In South Korea, aquatic exercise training is widely used in recent years (18).

Wyatt et al. (2001), Cochrane, Davey, and Matthes Edwards (2005), Hinman, Heywood, and Day (2007), Silva et al. (2008) and Mehrabian et al. (2012) compared exercises on land to in water and concluded that aquatic exercise group reported less pain which means exercise in water is an effective treatment method for the management of knee osteoarthritis (17, 19-22). However, Lund et al. (2008) and Wang et al. (2011)
recommended that pain was only observed in land exercise group (23, 24). Lim, Tchai, and Jang (2010) designed two exercise programs, on land and in water to increase knee function and decrease body fat in obese patients with knee OA and concluded that body fat rate significantly decreased in the aquatic exercise group and pain, disability and quality of life significantly improved at the end of the protocol, even though, there was no significant difference in general traits in these people at first. Notably, pain decreased in water group more than land group (25).

Few studies have been conducted on the effects of aquatic exercise on the knee which have conflicting findings in some variables (22-24). So, on the basis of the emphasis of aquatic exercise benefits for strengthening of muscles and reducing of probable sport injuries on joints, the aim of this study was the effects of aquatic exercise training on knee pain, symptoms, motor performance in daily and sports – recreational activities and quality of life in men over 50 years with knee osteoarthritis.

MATERIALS AND METHODS

Participants. Thirty middle-aged males were voluntarily selected on the basis of their medical histories that have had knee osteoarthritis for at least six months (d2). Participants were randomly divided into two aquatic (n=15) and control (n=15) groups.

Protocol. All subjects signed a written informed consent. As an initial assessment (pre-test), all participants filled knee and Osteoarthritis Outcome Scores (KOOS) questionnaire which has 42 patient-centered questions. This questionnaire contains 5 concepts about the situation of patients. Concepts included are pain (9 items), other symptoms (swelling, stiffness, and hardness) related to the disease (7 items), daily activities (up and down stairs, standing, and bathing) (17 items), sport-recreational activities (jumping, running, and spinning) (5 items), and quality of life in relation to knee problems (4 items). Participants answered the questions based on 5 Likert pain scale (0= none, 1=slight, 2= moderate, 3= severe and 4= extremely severe) (26).

After the initial assessment, participants in the experimental group started exercise training for 6 weeks under the supervision of the researcher. Aquatic exercise program was performed three days per week for 50 minutes (22, 23). At the end of the sixth week, the final assessment (post-test) was executed, and participants again completed KOOS questionnaires. Some of the aquatic exercises are shown in figures 1 and 2.

Aquatic exercise program included strength, endurance, balance, and stretch exercises in moderate intensity that was recommended by the American Association...
of Geriatric Medicine (27). Each session was included 50 minutes whose 10 minutes was allocated to warm up, 20 minutes to strength and endurance training, 5 minutes to balance exercises, 10 minutes to stretching exercise, and 5 minutes to cooling down (22, 23). Type and duration of aquatic exercise program in each session are shown in table 1.

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Duration (min)</th>
<th>Type of exercises</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm up</td>
<td>10</td>
<td>Forward, backward, lateral walking and running</td>
</tr>
<tr>
<td>Strengthening/Endurance</td>
<td>20</td>
<td>Double-leg Squat, lunge, knee flexion and extension, hip flexion and extension, hip abduction and adduction and breast stroke leg</td>
</tr>
<tr>
<td>Balance</td>
<td>5</td>
<td>Double-leg calf raises and knee up</td>
</tr>
<tr>
<td>Stretching</td>
<td>10</td>
<td>Quadriceps and hamstring stretch, sitting knee flexors and extensors stretch</td>
</tr>
</tbody>
</table>

Two weigh ankle weights and elastic bands for strengthening and endurance exercises, chairs for sitting movements and kickboards to maintain the patients balance were used during aquatic movements.

None of the participants had a history of participating in aquatic exercise for treatment of their knee pain and did not take any oral drug in order to reduce their pain for at least 1 month before and during the study.

**Statistical Analysis.** The data were expressed as mean values and their standard deviation (SD). The significance of difference between control group and mastic intake group was analyzed using t-test at p<0.05. The variables were analyzed by two-way analysis of variance (ANOVA) with mastic intake and exercise as factors. When a significant interaction effect was found, Tukey post hoc tests were performed. When a significant mastic intake or exercise effect was found and the interaction effect was insignificant, one-way ANOVA was used to compare the means of the groups. The statistical significance level was set at p<0.05.

**RESULTS**

T-test revealed no significant difference between the mean of age, height, weight and duration of osteoarthritis with 95% in both aquatic exercise and control group. Table 2 shows the mean and standard deviation of the personal characteristics (table 2).

<table>
<thead>
<tr>
<th>Table 2. Participants’ personal characteristics (Mean ± SD)</th>
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<tr>
<td>Age (year)</td>
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<tr>
<td>Height (cm)</td>
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<tr>
<td>Weight (kg)</td>
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<td>OA duration (year)</td>
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Results showed that pain, symptoms, motor performance in daily and sports -recreational activities and quality of life got significantly improved in the aquatic exercise group after participating in the protocol. However, in the control group, no significant difference was found in any of these variables. The mean and standard deviation of the KOOS questionnaire scores are shown in table 3 in two water exercise and control groups in pre and post-test assessment.
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One-way ANOVA was used for pre-test data in relation to measuring difference in aquatic and control groups, and it was found that there was a significant difference between the post-test scores of pain, symptoms, motor performance in daily and sports - recreational activities and quality of life (QOL) in two groups. One-way ANOVA test results for measuring the post-test differences in water and control groups are shown in Figures 3 to 7.

DISCUSSION

Based on the findings and testing of these research hypotheses, results showed that...
pain, symptoms, motor performance in daily
and sports-recreational activities and QOL in
participants significantly improved in water
exercise group after performing the protocol,
while no significant changes were observed
in any of these variables in the control
group.

Results showed that water exercise
training for males over 50 with knee OA has
a significant effect on reducing pain. The
results of this study are in agreement with
findings by Lim, Tchai, and Jang (2010),
Wang et al. (2011), Silva et al. (2008),
Bartles et al. (2007), Foley et al. (2003) and
Wyatt et al. (2001) (14, 16, 19, 21, 24, 25).
On the other hand, Lund et al. (2008)
immediately at the end of the study and
Wang et al. (2007) observed no significant
differences in pain scores (23, 28). The
probable reason for this difference may be
due to a variety of training period, the type
of equipment and the gender of participants.

It is noted that pain is the most important
symptom of knee OA. So, the main goal of
any treatment method is reducing the clinical
signs. Silva et al. believed that strengthening
of the thigh muscles caused these
improvements (21), but we were not able to
confirm this because we did not directly
measure the thigh strength. Studies have
shown that excess cytokine production in
body is the cause articular cartilage loss and
joint problems such as osteoarthritis.
Physical activity reduces cytokine
production, and then reduces pain and
improves function (29). In addition, the
other factor that may cause pain and loss of
function is muscle atrophy which can be due
to lack of activity (30, 31). Bartles et al.
(2007) reviewed the effect of aquatic
exercise on knee OA and showed that
decreased pain and improved water function
in patients with knee osteoarthritis is due to
improved neuromuscular functions related to
the movement of the muscles around the
knee (increased power, strength and
endurance) (14).

The results, also, showed that water
exercise training has a significant effect on
symptoms of knee osteoarthritis in men over
50 years old. It has been shown by Wang et
al. (2011), Silva et al. (2008), Lim, Tchai,
and Jang (2010) and Hinman, Heywood, and
Day (2007) that a significant improvement
was observed in the symptoms of knee
osteoarthritis (17, 21, 24, 25), but it is the
opposite of results by Mehrabian et al.
Possible reasons for this difference can be
the gender of participants and the severity of
osteoarthritis. Although the participants had
2 or 3 degrees of osteoarthritis, the number
of people with 2 degree of OA was more in
the current study compared to the other one.
Finally, as said before, Lund used special
equipment for aquatic exercise.

Symptoms of knee OA include stiffness,
pain and inflammation in the areas
mentioned. Symptom score decreased after 6
weeks of exercise in water. It can be probably
due to more flexibility of soft tissues, less
swelling and inflammation and strengthening
the muscles around the knee area.

The findings of this study showed that
aquatic exercise training improves motor
performance in daily activities and sports
recreation of elderly men with knee
osteoarthritis. This conclusion is the same of
the results of Wang et al. (2011), Silva et al.
(2008), Lim, Tchai, and Jang (2010) and
Hinman, Heywood, and Day (2007)
Cochrane, Davey, and Matthes Edwards
(2005), Bartles et al. (2007) and Mehrabian
et al. (2012) (14, 17, 20-22, 24, 25), but it is
the opposite of Wang et al. (2007) and Lund
et al. (2008) findings which have been
shown no improvement in physical function
(23, 28). Possible reasons for different
results could depend on older participants
and the type of used joint in the present
study.

According to the physiological view,
improvement of muscles around the knee by
exercise can cause more consistent joint and
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more absorption of forces on the joint by muscles and these can reduce pain and knee OA symptoms which can improve knee function to do daily activities (17, 30). In addition, physical exercise causes endorphins excretion, resulting in increased resistance to musculoskeletal injuries and pain threshold (32).

The results showed that aquatic exercise training has a significant effect on quality of life in males over 50 with knee OA. The result was the same as the results by Mehrabian et al. (2012), Wang et al. (2011), Lim, Tchaj, and Jang (2010), Bartels et al. (2007) and Hinman, Heywood, and Day (2007) (14, 17, 22, 24, 25), But with the Wang et al. (2007) and Lund et al. (2008) were in conflict (23, 28). The probable reason for this difference could be the gender of participants, the period of the research and the higher age average.

According to the physiological view, the effect of doing exercise is obvious on the central nervous system, soft tissue flexibility, tendons, and ligaments, balance, muscle strength and metabolism. Also, endorphin excretion and other hormonal changes psychologically contribute to happiness (32) and increase hope which can affect quality and style of life.

Overall, the results of this study and other studies have shown that aquatic exercise in patients with knee osteoarthritis has beneficial effects on reducing pain and increasing motor performance and quality of life. Less strain on joints during water exercise is one of the benefits of it, too. However, randomized and controlled research on this subject is so few that we cannot give more suggestion to how to do it.

CONCLUSION

In summary, the main finding of this study was that aquatic exercise program can reduce pain and improve symptoms, motor function in daily and sport recreational activities and quality of life. It is recommended that professionals and practitioners apply the results of this research in control and rehabilitation programs of patients with knee osteoarthritis who have the same conditions as these participants.

REFERENCES

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اثر تمرینات ورزشی در آب بر درد، علائم بیماری، عملکرد حرکتی و کیفیت زندگی مردان مسن مبتلا به استئودرتیز زانوها

اسلامان انصاری،* ژهرا حجتی

چکیده

شواهد بالینی نشان می‌دهد که تمرین در آب می‌تواند برای بیمارانی که مبتلا به استئودرتیز مفید باشد. هدف پژوهش حاضر، بررسی اثر برنامه تمرین ورزشی در آب بر میزان استئودرتیز های روزانه و ورزشی-تفنیجی (ADL) و کیفیت زندگی مردان بالای 50 سال مبتلا به استئودرتیز زانوها بود. تعداد 50 مرد بالای 50 سال مبتلا به استئودرتیز زانوها به صورت دو مدت، به عناوین انتخاب شدند و در یکی از دو گروه تمرین در آب و شاهد به صورت تصادفی قرار گرفتند. میانگین و انحراف استاندارد سن در دو گروه به ترتیب ±3/08 و ±5/76 سال، قدر ±1/08 و ±1/4/16 سانتیمتر، وزن ±1/9/17 وزن، ±63/7/22 وزن و ±71/5/3 وزن کیلوگرم بود. شرکت کنندگان گروه اول برنامه تمرین ورزش در آب را به مدت 6 هفته و 3 جلسه در هر هفته زیر نظر محفظ انجام دادند. موارد ارزیابی در دو مرحله قبل و بعد از 6 هفته شامل درد زانوها، علائم، عملکرد حرکتی فعالیت‌های روزانه و ورزشی-تفنیجی و کیفیت زندگی بود. شدت درد زانوها، میزان علائم بیماری، عملکرد حرکتی فعالیت‌های روزانه و ورزشی-تفنیجی و کیفیت زندگی پس از اجرای برنامه از میزان معنی‌داری در گروه تمرین در آب پیوسته یافت (p<0/05). در حالی که در گروه کنترل تغییرات معنی‌داری در هیچ یک از متغیرها مشاهده نشد (p>0/05).

نتایج نشان داد که برنامه تمرینی ورزشی در آب می‌تواند به عناوین یک روش تمرینی ایمن و مؤثر در پیگیری درد، علائم، عملکرد حرکتی و کیفیت زندگی مردان بالای 50 سال دارای استئودرتیز زانوها توجه قرار گیرد.

واژگان کلیدی: استئودرتیز، درد زانوها، ورزش در آب

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