Effect of Aqua-Aerobics on Pulmonary Functions in Subjects with Knee Osteoarthritis

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ABSTRACT

Osteoarthritis (OA) is a most common type of degenerative disorder. It is a type of joint disease that results from breakdown of joint cartilage and underlying bone. Knee is the commonest joint affected in OA. Aqua-aerobics refer to the use of water that facilitates the application of established therapeutic intervention, including stretching, strengthening, joint mobilization, balance and gait training and endurance training. It is done in a vertical creating resistance and developing strength. Objective of this study is to determine the effect of aqua-aerobics on pulmonary functions in subjects with knee OA.

Methods: Ethical clearance was obtained by institutional ethical committee. Study design was experimental study. A total of 50 knee OA individuals were included in this study based on inclusion criteria. The treatment protocol was done in hydrotherapy pool, which included warm-up session (10 minutes), aerobic session (25 minutes) and cool-down session (10 minutes). Pre and post-test were done for peak expiratory flow rate (PEFR), Borg scale, respiratory rate (RR) and visual analogue scale (VAS), and the outcome measures were analysed after 4 weeks.

Results: Statistical analysis for Peak expiratory flow rate (PEFR) had significant improvement (p= 0.0001), Borg scale had significant improvement (p= 0.0001), respiratory rate had significant improvement (p= 0.0443) and visual analogue scale (VAS) had significant reduction (p= 0.0016) noted.

Conclusion: The study results concluded that aqua-aerobics was significantly effective in improving pulmonary functions in subjects with knee OA.

Keywords: knee osteoarthritis, aqua-aerobics, pulmonary functions, hydrotherapy.

INTRODUCTION

Osteoarthritis (OA) is a most common type of degenerative disorder. It is a type of joint disease that results from breakdown of joint cartilage and underlying bone. It is an inflammatory joint condition. The most common features are joint pain, stiffness, osteophyte formation, sclerosis, reduced joint space, joint swelling and decreased range of motion. Causes of OA are previous joint injury, abnormal joint or limb development and some inherited factors. Articular cartilage has a limited tolerance for inappropriate force. It’s avascular and aneural status renders it unable to repair itself. Hyaline cartilage lacks a direct blood supply, receiving nutrition through the synovial fluid released because of normal movement and joint compression. 80% of persons above 45 years of age have OA in at least 1 joint. Knee is the commonest joint affected in OA. OA knee is a major cause of disability among the ageing population of the industrialized world. A major hallmark of OA is loss of cartilage.

Initially, OA involves only 1 or few joints, and the onset is very gradual: if
excess forces are put on the joint then it damages the cartilage, leaving a bone-on-
bone situation within a joint. Articular cartilage has a limited tolerance for excess
force. As we know it is avascular in nature it is unable to repair itself. Hyaline cartilage
does not have a direct blood supply; it receives nutrition through synovial fluid which is released due to normal joint
movement\(^4\). Knee pain and disability may occur in the apparent absence of
radiographic OA\(^6\). There is moderate to
strong evidence that physical workload, high intensity sporting activities and obesity
are risk factors for OA\(^7\).

Osteoarthritis is more prevalent joint
disorder and is strongly associated with
ageing\(^8\). Considering the increase in OA
prevalence, the need to identify risk factors, progression, associated physical function
decline and disability is a high priority\(^9\). The
prevalence of OA knee is 27%. Subjects
with OA knee complain that they spend
more days in bed than others in their age\(^10\).

Traditionally treatments include
medications for pain control and some form
of exercises. Bradly found that
pharmacological treatments initially start
with topical analgesics or NSAID’s\(^4\). Chronic use of NSAID’s in OA results in
increase in blood pressure resulting in heart
attack, stroke, heart failure, arrhythmias,
and sudden cardiac death. Studies have
shown that various forms of exercises are
beneficial in managing symptoms of OA
knee, among which aquatic therapy has
been effective due to properties of water.
Reduced pulmonary functions in these
patients affect their independence in
performing everyday activities. They also
mentioned walking difficulty results in
reduction in cardiovascular factors; these
events can be prevented by managing OA\(^11\).

Aqua-aerobics refer to the use of
water that facilitates the application of
established therapeutic intervention,
including stretching, strengthening, joint
mobilization, balance and gait training and
endurance training\(^12\). It is done in a vertical
creating resistance and developing strength.

The buoyant force of water results in a
significant reduction of body weight in the
water which allows greater movement. This
dramatically decreases compression stress
on weight-bearing joints, bones and
muscles. Water is the optimal environment
for providing full-body resistance. The
density of water is approximately 800 times
that of air, which is an important factor, is
contributing to the energy expenditure of
aquatic exercise. Thus, the water
environment allows high levels of energy
expenditure with relatively little strain to the
body\(^13\). According to previous studies pain
severity, obesity, quadriceps strength, age
and helplessness were the most important
determinants of disability\(^14,15\). According to
previous studies pain levels, systolic blood
pressure and triglycerides were reduced
after water based exercises\(^16,17\).

METHODS

Ethical clearance was obtained from
the institutional ethical committee,
KIMSDU, Karad. The study included totals
of 50 knee OA individuals were included in
this study. Exclusion criteria included
Rheumatoid arthritis, Chronic OA, Patients
undergone knee surgery in past 3 years and
Neurological conditions or Orthopaedic
condition. The treatment protocol was done
in hydrotherapy pool, which included warm-
up session (10 minutes)-this included brisk
walking, jogging and stretching,
aerobic session (25 minutes)-this included aerobic
steps which were: walking, marching on
place, front toe touch, side toe touch, side
stepping, side kicks, high knees, squatting,
lunges and jumps, and cool-down session
(10 minutes)-this included walking, jogging and stretching. Pre and post-test were done
for peak expiratory flow rate (PEFR), Borg
correlation, respiratory rate (RR) and visual
analogue scale (VAS), and the outcome
measures were analysed after 4 weeks.

Intervention was given for 4 weeks,
4 days per week. Data was analysed after 4
weeks. Treatment protocol had 3 parts:-
Warm up session (10 minutes)-this included brisk walking, jogging and stretching,
Aerobics session (in pool for 25 minutes)—this included aerobic steps which were: walking, marching on place, front toe touch, side toe touch, side stepping, side kicks, high knees, squatting, lunges and jumps, and Cool down session (10 minutes)—this included walking, jogging and stretching. Primary outcomes used for the results were PEFR, Borg scale, respiratory rate and VAS.

**Statistical analysis**

The data was analysed manually and by using the statistics software’s INSTAT so as to verify the results derived. Data of all outcome measures was measured as pre training and post training values. Arithmetic mean and standard deviation was calculated for each outcome measures. Arithmetic mean was derived from adding all together and dividing the total number of values. Within the group comparison was done by applying ‘Wilcoxon rank sum test’ to pre and post training values of same group for all outcome measures.

**RESULTS**

**Age distribution**

The age distribution in this study included was 11 and 14 male and female respectively of 45-55 years of age group and 10 and 15 male and female respectively of 55-65 years of age group.

**Gender distribution**

The gender distribution in the study included 21 male and 29 females.

**Peak expiratory flow rate**

In this study there was extremely significant difference in PEFR values.

**Borg scale**

In this study there was extremely significant difference in Borg scale values.

<table>
<thead>
<tr>
<th>Values</th>
<th>PRE</th>
<th>POST</th>
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<tbody>
<tr>
<td>Borg scale</td>
<td>15.34</td>
<td>14.96</td>
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</table>

**Respiratory rate**

In this study there was significant difference in respiratory rate.

<table>
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<tr>
<th>Values</th>
<th>PRE</th>
<th>POST</th>
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<tbody>
<tr>
<td>Respiratory rate</td>
<td>14.98</td>
<td>13.06</td>
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</table>

**Visual analogue scale**

In this study there was significant difference in VAS values.

<table>
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<tr>
<th>Values</th>
<th>PRE</th>
<th>POST</th>
</tr>
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<tbody>
<tr>
<td>VAS</td>
<td>4.08</td>
<td>3.86</td>
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**DISCUSSION**

Patients with OA knee typically have reduced physical activity compared with the general population. Besides the primary complaints it is also found that PEFR level in these subjects is also reduced. A reduced PEFR level in these patients affects their everyday activities. Often these secondary complaints are not addressed. Traditionally treatments include medications for pain control and some form of exercises. Bradly found that pharmacological treatments initially start with topical analgesics or NSAID’s. Chronic use of NSAID’s in OA results in increase in blood pressure resulting in heart attack, stroke, heart failure, arrhythmias, and sudden cardiac death. It is necessary to maintain good health in these subjects to reduce pain and disability and prevent further complications.

In 2017, Kendzerska et. al. in a study comprising 18,490 patients with 10% hip OA, 15.3% OA knee and 16.34% hand OA found that 31.9% cardiovascular events occurred in approximately 13.4 years in these patients, especially in the OA knee group. They also mentioned that the walking difficulty in OA knee severely increased the risk of a cardiovascular event.
Many cardiovascular events could be prevented by managing OA, with an increase in the cardiovascular capacity and mobility.

Objectives of my study were to determine the effect of aqua-aerobics on pulmonary functions in subjects with OA knee.

This study was conducted on 50 subjects with OA knee. Prior consent was taken. Treatment was given for 4 weeks, 4 times a week for 45 mins. The outcome measures for this study were peak expiratory flow rate, Borg scale, respiratory rate and visual analogue scale. Treatment was given in therapeutic pool; the session was divided into 3 parts warm up, aerobic and cool down session.

The result of this study showed there was significant improvement in pulmonary functions and pain perception after 4 weeks intervention. Within the group comparison was done by applying ‘Wilcoxon rank sum test’ to pre and post training values of same group for all outcome measures. Peak expiratory flow rate had significant improvement (p= 0.0001), Borg scale had significant improvement (p= 0.0001), respiratory rate had significant improvement (p= 0.0443) and visual analogue scale had significant reduction (p= 0.0016) noted in subjects undergoing aqua-aerobics to improve pulmonary functions with OA knee. Therefore, result of this present study showed that aqua-aerobics improved pulmonary functions in subjects with OA knee.

CONCLUSION

On the basis of the results of our study, it was concluded that aqua-aerobics was significantly effective in improving pulmonary functions in subjects with knee osteoarthritis.

ACKNOWLEDGEMENT

We would like to acknowledge the guidance and support of Vishva Bhuva from faculty of physiotherapy.

Conflict Of Interest
The authors of this study do not have any conflicts of interest.

Source of Funding
This project was self funded by the authors.

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How to cite this article: Bhosale AD, Sagar JH. Effect of aqua-aerobics on pulmonary functions in subjects with knee osteoarthritis. Int J Health Sci Res. 2020; 10(12):37-41.