



EFFECT OF AQUATIC CLOSED KINEMATIC CHAIN EXERCISES ON KNEE DISABILITY AND QUADRICEPS STRENGTH IN OBESE INDIVIDUALS

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ABSTRACT

Aim: To study the efficacy of aquatic CKC exercises on knee disability and quadriceps strength in obese individuals.

Background: Obesity affects knee joint function as most weight bearing is rendered on knee during weight bearing exercises causing knee disability and weak quadriceps. This limits exercise prescription for knee disability in obese. Very little data is found to be published on CKC exercises for knee disability in obese.

Methodology: This was an experimental pre/post study. 30 obese individuals with Grade 1 obesity between 40-50 years were evaluated. Knee Disability and Quadriceps Strength were assessed by KOOS Scale and pressure bio-feedback respectively at start and end of program (6 weeks). The exercise program included CKC exercises which was continued for 6 weeks, thrice each week. The data was analysed statistically using Paired t test.

Result: The results showed statistical difference in pre and post values of the KOOS scale and pressure biofeedback. At the end of week, the post KOOS score reduced for knee disability and increased strength for quadriceps muscle was noted in pressure bio-feedback.

Conclusion: The above study concludes that aquatic CKC exercises are effective to reduce knee disability and improve quadriceps strength in obese.

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INTRODUCTION

Obesity is defined as 'a physiological condition in which excess body fat has accumulated to an extent that can negatively affect health'. Individuals are labeled as obese when their BMI (Body Mass Index) is above set values of kg/m² according to the values set by WHO. BMI or Quetelet index is the body mass (weight) divided by the square body height and is universally expressed in the units of kg/m² and is a tool for medical diagnosis of obesity.⁽¹⁾⁽³⁾

Due to obesity, various musculoskeletal disorders can occur in individuals, among which knee pain is the most common.⁽¹⁾⁽³⁾

Due to knee pain various activities of daily living such as walking, running, stair climbing, etc. can get hampered which ultimately limits functional independence, thus leading to knee disability.⁽³⁾ Also, quadriceps muscle weakness has also been seen in patients with knee disability in obese individuals.⁽²⁾ In such cases, very few exercises prove to be effective.

Various studies have shown that Close Kinematic chain exercises are effective in improving functional disability and quadriceps strength of an individual when administered.⁽⁷⁾⁽¹⁰⁾⁽¹¹⁾

However, the knee is a vulnerable joint, more stress is rendered on it when land-based CKC exercises are administered. This leads to increased pain and discomfort and the patient might discontinue the exercise because of pain.⁽⁸⁾ Also due to knee pain and disability, studies have shown a decrease in muscle mass and strength which leads to the affection of knee function.

Aquatic therapy in such cases proves beneficial. It benefits the joint by acting on its principles of buoyancy when CKC exercises are performed in an aquatic therapy pool because when a body is submerged in water it feels weightless.⁽⁴⁾⁽⁵⁾⁽⁶⁾

This exercise is better to improve joint function and strength and promotes early weight bearing to give better results.

MATERIALS AND METHODS

Study Design

Type of study: Experimental

Population: Class 1 Obese individuals

Duration of study: 1 year

Sample Design

Type of sampling: Convenient

Sample size: 30

Location: Metropolitan City

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Materials Used

- Weighing Machine
- Measuring Tape
- KOOS Scale
- Pressure Biofeedback Unit
- Swimming pool and costume
- Papers and Markers

Inclusion Criteria

1. Class 1 obesity.
2. Knee pain.
3. Patients with age group 40-50 years.
4. Patients who are willing to participate.

Exclusion Criteria

1. Recent fractures.
2. Recent ligament injury.
3. Diagnosed case of knee osteoarthritis.
4. Recent trauma to the joint.
5. CNS disease, especially epilepsy.
6. Patient with hydrophobia.
7. Infectious skin diseases
8. Inflammatory arthropathy of knee joint

Procedure

30 subjects who are willing to participate will be included in the study. All the patients will be screened as per the inclusion and exclusion criteria. Purpose of the study and procedure will be explained to the subject prior study. Written consent will be taken from the subjects prior to participation.

KOOS scale will be taken to asses knee disability and quadriceps strength will be assessed using pressure biofeedback prior to the study. The subject will be taken to the pool and the level of water will be upto the xiphisternum of the subject.

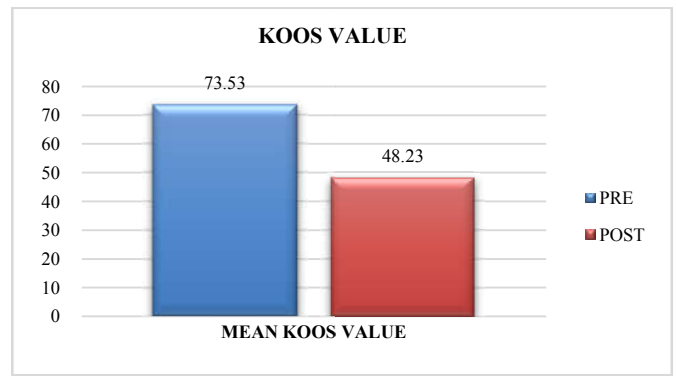
A pool guard will be present in case of an emergency. Assistance will be taken from an aquatic therapist during the intervention.

Closed kinematic chain exercises such as double leg squat, dynamic lunge and step up and step down will be conducted thrice a week for six weeks consecutively and at the end of sixth-week re-assessment will be done by using KOOS scale and pressure biofeedback. (4)

The data will be collected and statistically analyzed.

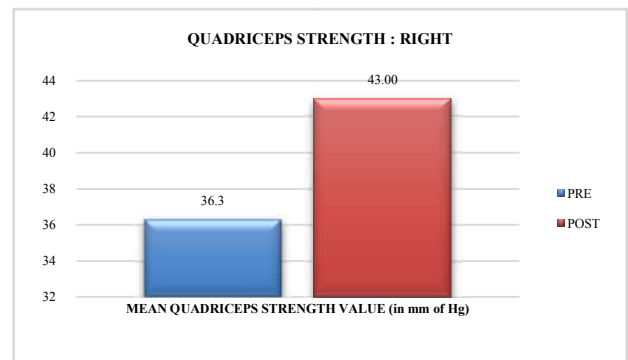
RESULT

Our study showed that there was a statistically significant difference in the effect of aquatic closed kinematic chain exercises and quadriceps strength in obese individuals ($p < 0.0001$). At the end of 6th week, the KOOS score for knee disability reduced and the quadriceps strength assessed using pressure bio-feedback showed increased values.



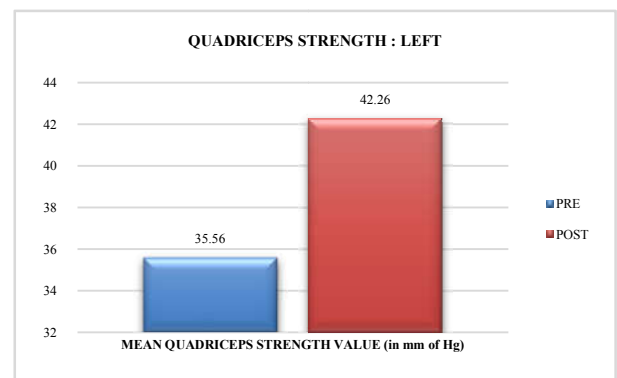
Graph 1 Comparison of Pre and Post values of KOOS Scale for Knee Disability

Mean (PRE KOOS VALUE)	73.53
Mean (POST KOOS VALUE)	48.23



Graph 2 Comparison of Pre and Post values of Quadriceps strength: Right leg

Mean (PRE VALUE in mm of Hg)	36.3
Mean (POST VALUE in mm of Hg)	43.0



Graph 3 Comparison of Pre and Post values of Quadriceps strength

Mean (PRE VALUE in mm of Hg)	35.56
Mean (POST VALUE in mm of Hg)	42.26

DISCUSSION

The study was done among the sample size of 30 Class 1 Obese individuals according to WHO classification, the age group ranging from 40 to 50 years.

Knee Disability and Quadriceps Strength were assessed by using KOOS Scale and pressure bio-feedback respectively before the program and after the completion of the program at 6th week. The exercise program was continued for 6 weeks, thrice each week.

The purpose of the study was to study the efficacy of aquatic closed kinematic chain exercises on knee disability and quadriceps strength in obese individuals.

Obesity (excessive or abnormal fat accumulation) has a negative effect on an individual's health. A significant relationship exists between knee disability and BMI- 30 kg/m².

It has been observed that load exerted on the knee per step during daily activities, which could hasten its destruction and aggravate pain, is likely to be greater in adults with a high body mass compared with a lower body mass ultimately leading to knee disability and difficulty in carrying out day to day activities. Obese subjects have also been shown to exhibit weakness in isometric knee extensor strength⁽²⁾. Dekker et al, has also hypothesized the resultant low activity level of an obese individual, induced muscle weakness leading to instability of the joint, and therefore pain and disability⁽²⁾. Previous studies show that exercises performed in the aquatic pool in patients with knee pain have been proven beneficial for ameliorating the effects of pain on knee joint⁽⁵⁾. It has been recognized that exercising in water can be an effective and useful mode of therapeutic exercise.

The result of the study indicates that there is statistically significant effect of aquatic closed kinematic chain exercises on knee disability and quadriceps strength in obese individuals.

The reason for improvement is that aquatic exercises allow early active mobilisation and improves neuromuscular performance, especially during the initial phase of a rehabilitation programme. Reduced gravity under water decreases the detrimental effects of weight bearing and impact forces on joint structures⁽⁹⁾. Also, closed kinematic chain exercises have several advantages over open-chain exercises. Rather than having muscle groups work in isolation, closed-chain exercises allow for the simultaneous activation of antagonistic muscle groups (e.g., the quadriceps and the hamstrings during leg squats), thus promoting increased joint stability and a simulation of functional movement patterns⁽⁷⁾⁽¹⁰⁾. CKC exercises are more reliable and functional and is more effective than OKC exercise at restoring quadriceps femoris muscle strength⁽⁷⁾⁽¹⁰⁾. Thus, the combined effect of performing CKC exercises in water while weight-bearing are more effective at muscle strengthening and increasing joint range of motion. These exercises are considered to be better for restoring normal knee function and weight-bearing. Thus, these exercises being conducted with weight-bearing, improves the early mobilization and functionality of the patients.

Thus, all these factors contribute in reducing knee disability and improve quadriceps muscle strength.

CONCLUSION

Our study concludes there is a significant effect of aquatic closed kinematic chain exercises on knee disability and quadriceps strength in obese individuals.

Limitations

1. The study was done with convenient sampling and no proper randomization was done.
2. The sample size was small and limited.

Suggestions

1. Randomization of the sampling should be done.
2. The study can be performed using a large sample size.
3. The study can be done in older age groups to see the effectiveness of aquatic CKC exercises on knee disability and quadriceps strength.
4. The study can be performed using two controlled groups, one receiving the intervention and the other a

placebo to compare the extent of the effects in both groups.

Clinical Implication

1. Aquatic closed kinematic chain exercises can be used to reduce knee disability and to improve quadriceps strength in obese individuals.
2. Weight bearing exercises in an aquatic pool can thus be introduced earlier in the rehabilitation protocol as compared to doing land-based weight bearing exercises, as doing them on land tends to increase the discomfort and pain, due to which it is introduced in the later stages of the protocol. However, this trend can be changed with the introduction of aquatic closed kinematic chain exercises.
3. The effect of buoyancy acting on the joints also reduces the pain sensation and the stiffness of muscles, thus providing a therapeutic effect for the joints and the muscles.
4. As water provides a natural resistance to the muscle, strength training can also be started earlier in the protocol devised to reduce the knee disability.

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