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Research Article

EFFECT OF STRENGTHENING EXERCISES ON PAIN, STIFFNESS, PHYSICAL FUNCTION AND BODY MASS INDEX IN KNEE OSTEOARTHRITIS PARTICIPANTS WHO WERE OVERWEIGHT OR OBESE: A RANDOMIZED CONTROL TRIAL.

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Abstract

Background: One of the main risk factors for developing osteoarthritis of the knee is obesity; common joint disease characterized by pain, stiffness, and reduced physical function. There is still little data on strengthening exercises for overweight and obese Indian patients with KOA, despite the recommendation that exercise therapy be used as a conservative first line of treatment.

Methods: Ratanlal Hospital in Ghaziabad and Santosh Medical College and Hospital in Ghaziabad provided data for a prospective randomized controlled experiment that was carried out at Santosh College of Occupational Therapy.56 people between the ages of 45 and 60 were assigned randomly to control group (N=28) received standard occupational therapy and instructions for daily care, the experimental group (N=28) engaged in non-weight-bearing lower-limb strengthening exercises for four weeks, three times a week, for sixty minutes. Outcome measures included BMI and WOMAC scores evaluated at baseline and post-intervention. Ethical approval and participant consent were obtained.

Results: The groups' baseline characteristics were similar ($p > 0.05$). The experimental group WOMAC ratings significantly improved ($p = 0.001$) after intervention, compared to another group, demonstrating reduced pain and stiffness and enhanced function. Between-group post-intervention BMI differences were found to be within-group reductions, although the results did not reach statistical significance ($p = 0.112$).

Conclusion: For overweight and obese people with KOA, a 4-week lower limb strengthening program is a safe, efficient, non-pharmacological approach that dramatically improves symptoms and physical function.

Keywords: BMI,knee osteoarthritis, obesity, strengthening exercises, WOMAC

1. Introduction

Osteoarthritis is the most prevalent kind of arthritis with low-grade synovial joint inflammation. The knee, hip, and hand interphalangeal joints are the most affected by osteoarthritis. Genetic predisposition, advancing age, sex, mechanical stress, obesity, and metabolic syndrome are recognized risk factors for OA. In addition to increasing the mechanical strain on joints that bear weight, such as the knees and hips, obesity also causes systemic inflammation, which exacerbates osteoarthritis (OA). [1]These inflammatory processes may encourage osteoarthritis (OA) in joints that do not support weight, such as the hands, indicating that fat influences the disease's progression through both metabolic and biomechanical pathways. [1]The femur, tibia, and patella articulate to form the knee, a complex synovial joint.

The ligaments, muscles, tendons, menisci, articular cartilage, synovial membrane, joint capsule, and fat pads are among the supporting elements that preserve its stability and normal function. [2]

Smooth joint motion is enabled by synovial fluid and articular cartilage, which minimize friction between the opposing surfaces. [2] In addition, articular cartilage helps in load distribution and protects the underlying subchondral bone from excessive

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mechanical stress. [2] In knee OA, increased joint loading can contribute to cartilage degeneration and progressive joint damage. [2]
Inflammation, discomfort, and swelling may result from increased mechanical stress on the knee joint in OA. [2]Evidence suggests that obesity worsens the impact of knee osteoarthritis in older adults, leading to impaired mobility, reduced walking speed, heightened pain, and increased difficulty in carrying out routine daily tasks compared with individuals who are not obese. [2] Excess body weight adds extra load on the knee joint, which further limits movement and aggravates OA symptoms. [2]
The World Health Organization reports that 9.6% of men and 18.0% of women over 60 have OA. [3]Approximately 25% have trouble performing everyday tasks, and 80% experience mobility limitations. [3]Over 100 million cases of knee OA have been reported worldwide, making it the most prevalent type. [3]Patients with knee OA frequently reduce physical activity, leading to muscle weakness, frailty, and impaired physical function. [4]
Initially non-pharmacological treatment for KOA is exercise therapy, according to clinical standards. [5]Muscle weakness is strongly linked to joint discomfort and dysfunction. [1] Progressive resistance training performed in situations that don't require bearing weight, as sitting or sleeping in a supine position, reduces stress on the knee joint while building essential lower-limb muscle strength. [8]Therefore, the purpose of this study was to ascertain how obese or overweight individuals with knee OA reacted to a lower limb rehabilitation protocol that emphasizes not bearing weight strengthening activities in relation to stiffness, pain, physical function, and BMI.

2. MATERIALS AND METHODS

2.2.1 Study design and setting

Santosh College of Occupational Therapy's Institutional Ethics Committee reviewed, discussed, and approved a prospective, randomized controlled trial (RCT) (Ref No.-SCOT/JULY 25/ECORTHO-01). Data was gathered from Santosh Medical College and Hospital and Ratanlal Hospital, Ghaziabad. Before being included, each participant gave signed, informed consent.

2.2 Participants

Among the participants were adults between the ages of 45 and 60 who had a history of knee discomfort lasting more than three months and a clinical diagnosis of knee OA. Using established standards, Individuals were classified as Overweight or Obese.
Secondary arthritis was an exclusion criterion, spinal abnormalities, severe foot deformities, prior knee surgery, intra-articular knee injections within the preceding 6 months, or severe cardiovascular conditions precluding exercise. A computer-generated basic randomization process was used to recruit volunteers.

2.3 Intervention

For four weeks, the experimental group (EG) conducted lower-limb strengthening exercises three times a week without bearing any weight (seated and supine) in accordance with the protocol for lower limb rehabilitation (LLRP). The Control Group (CG) participants received Instructions of Daily Care (IDC)and traditional occupational therapy during each 60–80 minute session, It involved increased lower limb resistance exercise for 45- 60 minutes after the warm-up targeting major muscle groups (quadriceps, hamstrings, and gluteal), and a 10-minute cool-down.

2.4 Outcome Measures

McMaster University and Western Ontario Osteoarthritis Index (WOMAC) used 5-point likert scale (0–4) to assess physical function, joint stiffness, and discomfort. Higher scores indicate more physical disability, discomfort, and stiffness (Salaffi et al., 2003). The BMI (kg/m2) is computed by dividing height in meters squared by weight in kilos.

2.5 Statistical Analysis

Data analysis was conducted using IBM SPSS version 29.0.1.0. The baseline was compared using the characteristics of independent t- tests.Sample is independent, while paired t-tests were employed to assess within-group changes prior to and following the intervention, t-tests were utilized to examine post-intervention comparisons between groups. Statistical significance was set at $p < 0.05$.

3. RESULTS

3.1 Demographic Characteristics

The study comprised 56 participants with a mean age of 53.07 +- 5.86 years and an equal gender distribution (28 males, 28 females). Detailed demographic distributions are presented in Table 1.

Characteristic	Category	Control Group (n=28)	Experimental Group (n=28)	Total (N=56)
Age (Years)	<= 45	6	1	7
	46–59	20	23	43
	>= 60	2	4	6
Gender	Male	15	13	28
	Female	13	15	28
Intervention		ICD &Conventional OT	LLRP Strengthening Exercises	—

3.2 Baseline Comparisons of the outcome variables

The experimental and control groups did not differ statistically significantly at baseline for pre-test BMI ($p = 0.258$) or pre-test WOMAC scores ($p = 0.957$), confirming group comparability (Table 2).

Outcome Scale	Control Group (Mean)	Experimental Group (Mean)	t-Value	p-Value	Interpretation
Pre-test BMI	Baseline	Baseline	1.143	0.258	No significant difference
Pre-test WOMAC	Baseline	Baseline	-0.054	0.957	No significant difference

3.3 Post-Intervention Analysis

After the intervention, between-group analysis showed that the experimental group overall WOMACscores were substantially lower than the control group ($t = -3.423$, $p = 0.001$). The post- intervention analysis revealed no statistically significant between- group difference in BMI ($p = 0.11$).
(Table 3).

Outcome Scale	Control Group	Experimental Group	t-Value	p-Value	Interpretation
Post-test BMI	Post-treatment	Post-treatment	-1.617	0.112	No significant difference
Post-test WOMAC	Post-treatment	Post-treatment	-3.423	0.001	Statistically significant

Within-group comparisons using paired t-tests indicated substantial improvement in both groups from pre and post ($p < 0.001$), with the experimental group demonstrating markedly greater improvements in WOMAC parameters.

.4 DISCUSSION

The efficacy of a 4-week non-weight-bearing strengthening training regimen in overweight and obese people with osteoarthritis in their knees was assessed in this study. The primary findings demonstrate that lower-limb resistance exercises produce significant reductions in pain and joint

stiffness, alongside substantial gains in physical function.

The significant improvements in WOMAC scores observed in the intervention group supports earlier research by [2] [4], which found that focusing major lower-limb muscle groups improves joint stability, enhances neuromuscular control, and lowers joint loads during daily activities. Performing strengthening exercises in non-weight-bearing positions allowed participants to build muscular strength without placing excessive mechanical compressive stress on already degenerated articular cartilage. [6]

Although within-group reductions in BMI were observed, post-intervention between-group differences in BMI was not statistically significant. This result is in line with research showing that brief exercise regimens(such as 4 weeks) without accompanying dietary interventions produce only modest changes in body weight. [7] Long-term dietary modifications combined with regular physical activity are required for substantial weight reduction. Nevertheless, the pronounced clinical relief in joint symptoms and functional capacity achieved without major weight reduction highlights the clinical utility of strength training as a main non-pharmacological therapy for osteoarthritis in the knee. [5]

5. CONCLUSION

For people who are overweight or obese and have osteoarthritis in their knees, a 4-week lower limb rehabilitation program that includes non-weight-bearing strengthening exercises successfully lowers pain and stiffness while enhancing functional independence. Although significant functional improvements were made in the short term, long-term follow-up and dietary integration are recommended for optimal BMI management. Non-weight-bearing strength training serves as a safe, feasible, and effective conservative intervention in clinical occupational therapy practice.

6. DECLARATIONS

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- **Authors' Contributions:** SM conceptualized the study, drafted the protocol, carried out data collection, and wrote the initial manuscript draft. RKS supervised the project and critically revised the manuscript. PR manuscript submission and editing were overseen, and all authors critically reviewed and approved the final manuscript.
- **Ethical Approval and Consent: Ethical Clearance: SCOT/JULY-25/EC-ORTHO-01**Approved by Santosh College of Occupational Therapy's Institutional Ethics Committee. All study participants provided informed consent before participating in the intervention.
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7. Conflict of Interest: Nil

8. References:

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