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Original Article

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Effect of knee strengthening exercises with and without hip-strengthening exercises in women with knee osteoarthritis: randomized controlled trial

[a]Mariam Umer Hayat, [b]Anam Ashfaq, [c] Maria Manzoor, [d]Kanwal Arshad, [e]Kamran Hanif.

[a] *Student, University Institute of Physical Therapy, the University of Lahore.*
[b] *Student, University Institute of Physical Therapy, The University of Lahore.*
[c] *Doctor of Physical Therapy, Allied Health Sciences, University of South Asia.*
[d] *Assistant Professor, University Institute of Physical Therapy, the University of Lahore.*
[e] *Assistant Professor, University Institute of Physical Therapy, The University of Lahore.*

Correspondence: mariamumerhayat@gmail.com*

ABSTRACT

BACKGROUND & OBJECTIVE: Weakness of hip muscles was observed in knee osteoarthritis patients and strengthening of hip muscles was beneficial in patients with knee (KOA). The aim of study was to determine the effects of knee strengthening exercises with and without hip strengthening on knee pain, function and quality of life in women with knee osteoarthritis.
METHODOLOGY: Seventy women 40-70 years old with II–III grades on the Kellgren-Lawrence scale knee OA were included and randomized to the experimental group (EG) and control group (CG) 35 in each Group. The strengthening program consisted of knee with hip strengthening exercises for EG, and only knee strengthening exercise for CG.; four4 supervised sessions per week for 6-weeks were carried out. Knee injury and osteoarthritis outcome score were used for assessment of clinical outcomes and performed at baseline, 2nd week, 4th week and 6th week.
RESULTS: 61 patients with KOA are analyzed, 31 in EG and 30 in CG, with mean ages 53.48 ±7.685 & 53.48 ±7.685, respectively. There was a significant improvement observed in the 6th week between groups in the clinical measures, 82.19±7.472 &72.53±5.237 with p≤0.001 for pain, 81.19±6.036 & 67.94±3.984 with p≤0.001 for function and 80.84±7.148 & 67.27± 7.821 with p≤0.001 for Quality of life.
CONCLUSION: Knee strengthening exercises with hip strengthening exercises provide more significant enhancement in the clinical outcomes that are function and quality of life and reduction of knee pain in women with osteoarthritis of the knee.
KEYWORDS: Hip Strengthening, Knee Osteoarthritis, Pain, Quality of Life, Randomized Control Trial, Women.

INTRODUCTION

Osteoarthritis (OA) is the most common degenerative joint disorder; 20% of the global population is affected by OA [1]. The knee is one of the most common joints affected by the OA [2]. The prevalence of Knee osteoarthritis (KOA) increases with age groups, 6% in the 30-year older population while 11% in the 65-year older population as reported [3]. A study said that KOA is more common in women, and their quality of life is lower than that of same-aged men [4].

Impairments that are caused by KOA include knee pain, limited ROM of the knee, muscle weakness and knee instability [5]. Quadriceps is a most common muscle group that is prone to weakness and leads to functional limitation and increases both pathogenesis and progression of KOA in patients [6-8]. A number of different studies reported hip muscle weakness. For example, Jennifer Rowe et al. reported the weakness of the hip abductor and extensor muscles,[9] Wang, Jianxiong reported the hip abductor weakness [10], and a study reported that external and internal hip muscle weakness [11].

Literature reported that exercise therapy is effective for KOA patients; a systematic review reported that quadriceps-based resistance training has positive results in decreasing pain and improving function in patients with KOA [12]. RCT have the same results that isometric exercise for KOA reduces pain and improves function for patients with KOA [13]. Furthermore, few studies checked the role of hip muscle strengthening and suggested that hip strengthening exercises should be considered as treatment options for patients with knee OA and reported positive findings [14-16].

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However, a number of studies reported that patients with KOA faced hip muscle weakness [9,11]. While a small number of studies have countered the hip muscles strengthening program for the rehabilitation of KOA, it also mainly focus on the effects of hip abductors and adductors muscles. In an attempt to fill this knowledge gap, the current study highlights the strengthening of all hip muscles, including flexor, extensor, rotators, adductors and abductor muscles, by using elastic Thera-Band for dynamic Resistance that will gradually increase the load on women with KOA. In the current study, a combined exercise protocol was used to determine the effect of the knee strengthening exercises with hip strengthening exercises on the pain, function and quality of life in women with knee OA because no previous study was conducted on it.

METHODOLOGY

A single-blind randomized controlled trial, in which the participants were blinded, was executed in the Physical therapy department of WAPDA Teaching Hospital Lahore. Approval for this randomized controlled trial was granted by the ethical committee of the University of Lahore' IRB-UOL-FAHS/831-VII/2021' and retrospectively registered with 'Iranian Registry of Clinical Trials' number IRCT20230124057196N1. Written informed consent was taken from all the participants, participants remained anonymous throughout the study, and subjects were informed that there were no disadvantages or risks in the procedure and that they were free to withdraw at any time during the process of the study. The study was conducted from February 2021 to December 2021.

The population of the study was women with unilateral KOA with grades II to III by the Kellgren– Lawrence scale. Criteria were 40-70 years aged, female with unilateral knee OA, diagnosed patients of knee OA by orthopedic surgeon, grade II to III by Kellgren– Lawrence scale and no previous surgery specific to the knee joint, steroid injection history within the last 6-months to the knee joint. The exclusion criteria considered was, bony abnormalities like as Genu valgus & varum that affected the knee, flexion deformity of the knee, plan of surgical procedure within the time frame of the study, a history of injury that may cause OA, systemic inflammatory and medical disease that have prevented physical activity.

Calculation of sample size was done by the Open Epi tool, which was 28 per Group. After adding 20% of the dropouts, it became 35 per Group (70 in both groups). For the selection of sample size, 180 patients from the out-patients department (OPD) of physical therapy referred by an orthopedic surgeon, diagnosed with KOA were visited; some patients were not willing to participate in the study, so they were excluded, only 114 patients were assessed for the study. Out of 114 patients, 70 patients were included. Seventy subjects with unilateral knee OA were randomly allocated to the groups, EG and CG 35 in each group. There were four dropouts in the EG and five dropouts in CG due to personal and health-related problems as shown in flowchart figure-I. Purposive sampling technique was used to include the sample. Allocation of participants into groups was carried out by the lottery method in which every participant was assigned a number, after which numbers were allocated randomly into groups (experimental and control). The participants in the current study were blind. They did not know which Group they belonged to. Written consent was obtained from all participants.

Subjects completed assessment for the following outcome measures; pain, function and quality of life by using knee injury and osteoarthritis outcome score (KOOS) which is a validated questionnaire to measure for knee pain, function and quality of life [17]. KOOS, self-administered questionnaire, holds 42 items divided into five subscales: pain, function, symptoms, sport and quality of life; all items have five possible answers: 0 (no problem) to 4 (extreme problems). Scores were transformed to a 0–100 scale, with zero representing extreme knee problems and 100 representing no knee problems [18]. The evaluations were carried out at baseline (0 weeks), in the 2nd week, in the 4th week and finally in the 6th week.

After the initial assessment and allocation of participants, the resistance exercise program was carried out for both groups. The subjects in EG underwent a resistance exercise program, including hip exercise with knee exercise (hip flexors, hip extensor, hip abductor/adductor, hip external and internal rotators) and knee strengthening (knee flexors, knee extensor). The subjects in CG underwent a resistance exercises program including only knee exercises (knee flexors, knee extensors, leg press, heel press and calf hold). For the resistance loop, Thera- Band (Live Up) was used with different resistances. 1. Medium Resistance for first two weeks, 2. Strong Resistance for the next two weeks 3. X- Strong Resistance for the last two weeks for both groups. The participants of both groups received supervised exercise programs 4 times per week for a period of 6 weeks [19] . A total of 24 sessions were provided. After every 8 sessions, reevaluation was done, and the dynamic resistance was increased while the repetition was 10 and 3 sets for every exercise.

The data was tabulated and analyzed using the statistical package for social sciences (SPSS) version 25. The quantitative variables; age, height, weight, and BMI were represented with mean and standard deviation. After checking the normality of the data by Kolmogorov-Smirnov, a Mann-Whitney U Test was used to compare the outcome variables at different follow-ups. P values ≤ 0.05 were considered as significant.

RESULTS

A total of 61 patients with KOA were analyzed, and those aged between 40 and 70 years were recruited. The mean age was 53.48 ±7.685 in the experimental group &53.48 ±7.685 in the control group; the characteristics of all participants are presented in Table- I.

Assessment of patients was done at baseline 2nd, 4th and 6th weeks for symptoms, pain, function and quality of life. Experimental and control groups were compared to analyze the improvement in symptoms, pain, function, and quality of life at baseline in the 2nd, 4th, and 6th weeks. The experimental group showed significant improvement as compared to the control group in symptom, pain, function and quality of life at the 2nd, 4th and 6th weeks $p \leq 0.005$ in Table- II.

Figure I: : Flowchart of study

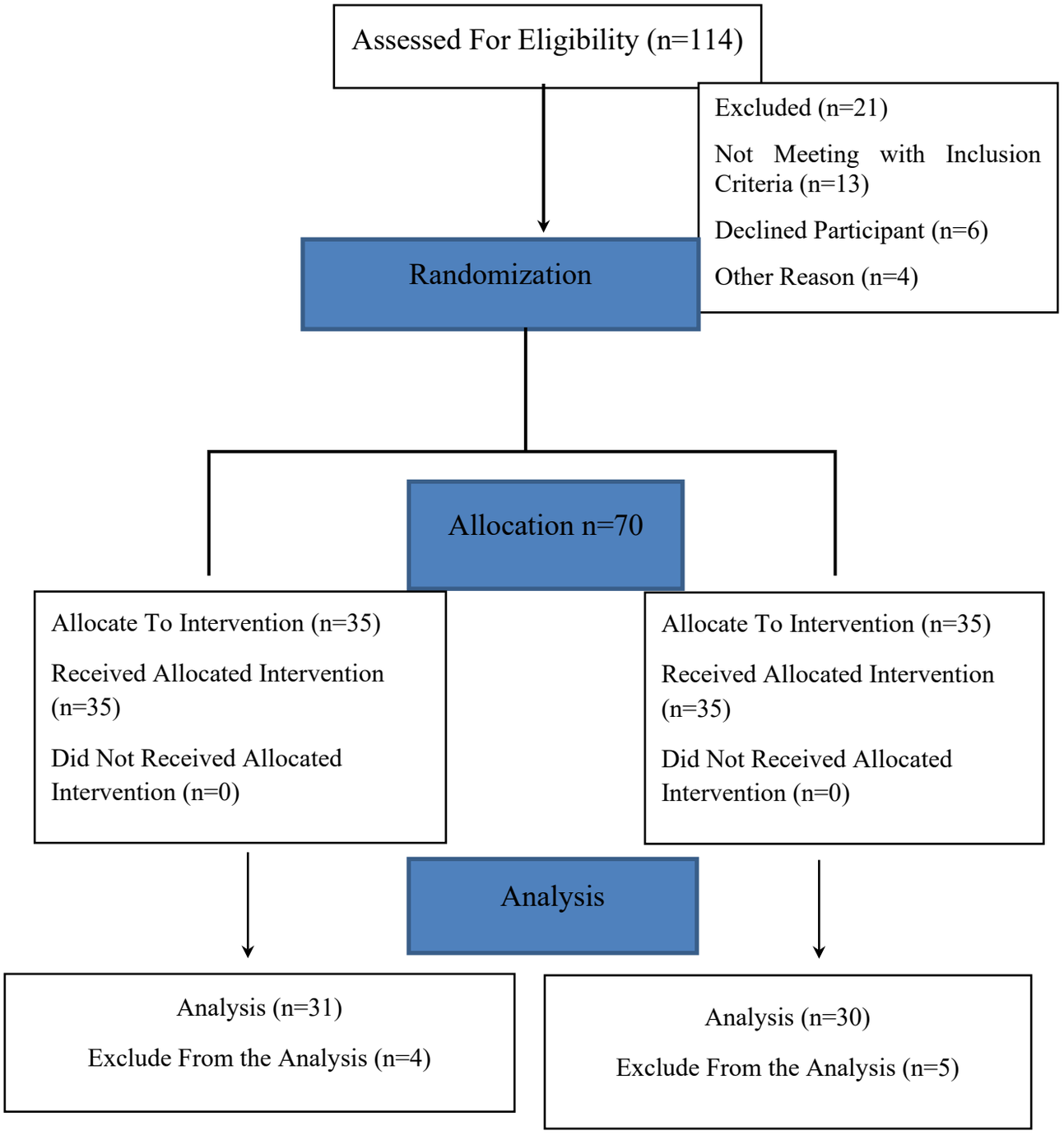

Table-I: Demographic characteristics of the subjects

	EG (n=31)	CG(n=30)
Age (year)	53.48 ±7.685	53.48 ±7.685
Weight (kg)	88.65 ±11.06	89.40 ±11.15
Height (feet)	5.12 ± 0.18	5.07 ± 0.17
BMI (Kgm2)	36.47 ± 4.77	37.12 ± 4.53

Table-II: Comparison of Koos subscale between the experimental and control groups

KOOS Subscale		Experimental Group Mean ± SD	Control Group Mean ± SD	p-value
Symptoms	Baseline	29.06±6.340	33.33±9.018	0.180
	2nd Week	49.81±12.139	38.20±7.801	≤0.001
	4th Week	59.23±8.958	53.73±4.646	0.003
	6th Week	78.87±6.682	76.90±5.346	≤0.001
Pain	Baseline	36.94±8.718	22.97±4.165	≤0.001
	2nd Week	42.29±9.606	29.00±4.243	≤0.001
	4th Week	67.03±10.022	46.87±3.919	≤0.001
	6th Week	82.19±7.472	72.53±5.237	≤0.001
Function	Baseline	29.71±9.389	24.14±4.927	0.007
	2nd week	42.35±10.384	31.72±4.669	0.187
	4th week	62.81±8.994	42.06±3.056	≤0.001
	6th week	81.19±6.036	67.94±3.984	≤0.001
Quality of life	Baseline	27.06 ±7.806	24.30± 6.271	0.195
	2nd week	38.68±13.654	28.40± 5.289	≤0.001
	4th week	60.61±10.148	46.37± 5.229	≤0.001
	6th week	80.84±7.148	67.27± 7.821	≤0.001

Table-II represented the mean with SD (standard deviation) checked by using Mann-Whitney U Test at baseline, 2nd week, 4th week and 6th week of KOOS Subscale symptoms, pain, function, and quality of life for both groups(experimental & control).

DISCUSSION

The current study investigated the effect of knee strengthening exercises with and without hip strengthening exercises on pain, function of daily living and quality of life in women with knee osteoarthritis by using elastic Thera-Band with medium to heavy resistance, KOOS was used to measure the outcomes and elaborated the positive results toward symptom, pain, function of daily livings and quality of life in both groups. There were significant improvements in the EG (knee strengthening exercises with hip strengthening exercises).

Hip muscle strengthening exercises have positive effects on decreasing pain, improving the functional capacities of patients with KOA, and slowing down the progression of the disease, but the mechanism is not clear [14,16]. So, in the current study, hip-strengthening exercises were used for women with KOA. As far as we know, most of the previous literature was found on the effects of abductors and adductors of hip strengthening exercise programs but did not focus on the other hip muscles. For example, clinical trials conducted in which hip abductor and hip adductors strengthening programs with knee strengthening were used and concluded that hip muscles strengthening improved the pain and function in patients with KOA [1]. Lack of randomization and single-arms study designs compromised the credibility of the results.

RCT reported that strengthening of the hip abductor muscle in KOA patients significantly improved functional measures [20]. A study used a hip abductor and hip extensor strengthening exercises program and gave positive results regarding reduced knee pain and improved functions, but absence of control group and small sample size were the limitations of this study [21]. A recent systematic review conducted on hip abductor muscle role in KOA patients reports that strengthening of hip abductor muscles reduces the knee adduction moment through which load on the knee is decreased, leading to the reduction of pain and improvement of functional capabilities such as gate [22]. The role of physical activity is not only important in KO but in other diseases of women too like osteoporosis [23].

In a comparative study, the experimental group received the hip abductors-based strength exercise while quadriceps-based strength exercise to the control group and they concluded that the hip abductor-based strength program is more effective than a quadriceps-based program to reduce pain and increase functional performance [10]. A comparative study which evaluated the isolated effects of hip strengthening exercises with quadriceps-based strengthening exercises reported that both leg and hip strengthening exercises provided an equally significant improvement in clinical outcomes including decreased pain, increased ROM, improved functional status such as daily activity of living as well as the quality of life in patients with knee OA [16]. This contradicts from the present study because we analyzed combined effects of hip strengthening and knee strengthening treatment for women with KOA. Other possible reasons are both male and female subjects were included while the results were generalized, they did not mention specifically in female. Also supervised sessions were provided for the first three weeks and 3 sessions per week only while in current study supervised sessions for six weeks and four sessions per week were provided.

As far as we know there were no study in which isotonic strength mode was used for the patients with KOA and there are few studies [16]. In which elastic Thera-Band was used to

=evaluated the dynamic strengthening of knee, both studies reported that the used of elastic bands were cost effective and easy to by the patients as compared to the other equipment such as free weights and gym machines. In the current study both groups have reduced pain, improvements in function and quality of life because literature supports that both quadriceps-based strength-based exercise and the hip muscle strength-based exercise are effective.

CONCLUSION

Current study results show that the strengthening of hip muscles with knee muscles has superior effects in reducing pain and enhancing function as well as improving the quality of life in KOA patients. The knee strengthening exercise with hip strengthening exercises provide more significant enhancement in the clinical outcomes that are pain, function of daily living and quality of life in women with KOA.

RECOMMENDATION

Future research should assess the long-lasting effects of strengthening exercises on the hip muscles, and the mechanism should be explored by which hip strengthening exercise improves function and reduces the pain in women with knee OA. The studies also needed to determine the effects of hip strengthening exercises separately and knee strengthening exercises separately and combine effects on the patients with KOA.

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DISCLOSURE/CONFLICT OF INTEREST:

There is no conflict of interest to disclose.

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Author's Contribution:

Mariam Umer Hayat: Conception, design of the work and writing the manuscript.
Anam Ashfaq: The acquisition, analysis, and interpretation of data for the work.
Maria Manzoor: Drafting the work.
Kanwal Arshad: Writing the manuscript and reviewing it critically for important intellectual content.
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