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Impact of Functional Task Training on Gait Parameter of OA Knee

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Abstract The study's aim was to assess the effects of functional task training on treating patients with arthritis in the knee while improving gait parameters. This research trial was carried out at ACS Hospital and Medical College, where 24 participants aged 45 to 60 years diagnosed with grades 2 and 3 osteoarthritis of the knee were randomly selected and divided into 2 different groupings. Functional task training was conducted by the treatment group (Group A) and the comparison group (Group B), performing conventional exercises for 12 weeks. The data was collected by assessing the patients in terms of gait parameters and WOMAC scores before and after interventions. According to the static analysis, the Experimental Group (Group A) has an initial mean value of 1.22 to 1.35 in post-test walking speed values with a t test value of 9.078 and Group B has an initial mean value of 1.21 to 1.22 with a t test value of 6.166 only and also in the WOMAC questionnaire. Experimental Group (Group A) shows a change in the mean value of 72.0 to 65.4 with a t test value of 15.852, in the control group (Group B), the mean value changes from 72.2 to 69.2 with a t test value of 10.457. These data show that there is more significance in the experimental group (Group A). By comparing the mean values and t test values of both groups, it shows that functional task training improves the walking speed of subjects with OA knees and further increases the patients' level of well-being.

Keywords Degenerative Arthritis, Walking Speed, Activities of Daily Living, Task Specific Training, Movement Component

1. Introduction

Osteoarthritis is a chronic joint illness that affects people all over the world and causes pain, reduced mobility, and a loss of independence [1]. Osteoarthritis was the fourth most common cause and accounted for 3% of years of healthy living lost (YLD) in the Global Burden of Diseases 2000 study [2]. The gradual degenerative changes in cartilage in joints and the joint surfaces of the knee joint that result in osteoarthritis eventually cause spontaneous development as osteophytes on the articular surface [3]. Two types of arthritis are primary and secondary, depending on the underlying cause. Elderly persons, women, people with diabetes, and obese individuals frequently develop primary osteoarthritis, while any damage may lead to subsequent osteoarthritis [4]. The subjects' functional independence is restricted by their decreased joint mobility in arthritic knees, which lowers their quality of life. This decrease in physical mobility may be brought on by discomfort, restricted joint movement, weak muscles, decreased coordination of the joint and the

tissues around the joint, and muscle weakness [5].

Previous studies have demonstrated that the physical impairment brought on by OA knee has resulted in functional challenges including trouble urinating when necessary and difficulty using the toilet, increasing the risk of urinary tract infection and significantly lowering their quality of life [6]. Additionally, the degenerative changes in the knee joint cause challenges with daily tasks such as prolonged standing, walking, stair climbing, and difficulty transitioning from sitting to standing and vice versa, which lowers their quality of life [7, 8].

Patients with OA knees frequently have impaired neuromuscular control, slower walking speed, decreased functional capability, and higher fall risk [9]. It has been observed that knee-related subjects move more slowly than healthy subjects. It is hypothesized that a decrease in walking pace may be brought on by pain and the patient's attempt to lessen the strain on the knee's medial compartment [10].

Previous studies indicate that osteoarthritis knee management should not only focus on pain relief and medical management but also take other treatment strategies into account to combat the declining quality of life brought on by the progression of osteoarthritis. By enhancing the participants' muscle strength, flexibility, and balance, functional task workouts in this case help the subjects' functional independence and quality of life.

Task-specific training aims to increase physical activity levels through the practice of regular tasks and postural adjustments to suit environmental demands [11]. Training for functional tasks necessitates the simultaneous activation of numerous groups, dynamic balance, and movement coordination. Collectively, these have a favorable impact on the individuals' physical aptitude [12].

Functional task training was said to enhance pain, balance, and physical mobility by KK Singh et al in 2016, but they did not specifically address grade II and grade III OA knee patients. Additionally, it did not mention how functional task training affected the subjects' walking speed [13].

In a single case study in 2022, Suresh et al. investigated how functional task retraining affected knee osteoarthritis and found that it decreased pain and enhanced physical performance. It also suggested conducting the same study on significant numbers of samples from the orthopedic department, but it did not specifically focus on the individuals' walking speed [14].

There are currently no studies looking into how functional task training impacts gait cadence as measured by the walking speed test. Current research also focuses on the effects of function-specific training on OA knee patients in grades II and III. Perhaps a goal for such research would have been to investigate the variations in functional ability and, consequently, walking speed at the conclusion of functional task training and conventional exercises.

2. Materials and Methods

2.1. Research Method

It is an experimental method of study that investigates and tests the systematic relationship between independent variables, such as walking pace and living quality in osteoarthritis knee patients, and dependent variables, such as functional task exercises and traditional exercises. In the outpatient physiotherapy department of the ACS Medical College and Hospital, Velappanchavadi, an experimental pilot study of a pre- and post-comparative kind was done.

2.2. Research Duration

Following the selection of the necessary samples, the study lasted for 14 weeks and the intervention for 12 weeks. The Dr. MGR Educational and Research Institute received permission from the institutional ethical committee to carry out the study.

2.3. Inclusion Criteria

1. subjects aged 45 to 60 years;
2. subjects with primary osteoarthritis;
3. grades II and III radiographic severity according to the Kellgern Lawrence scale.

The study comprised patients who had been given an OA diagnosis in accordance with the American College of Rheumatology's clinical diagnosis criteria.

2.4. Exclusion Criteria

1. Pain due to any history of injuries, or trauma
2. Grade 1 and Grade 4 according to the Kellgern Lawrence scale
3. Previous intra joint injection
4. Use of analgesics for the past 3 months
5. PT intervention in the last 6 months
6. Metabolic bone diseases
7. Patients walking with assisted devices

2.5. Sample Selection

About 12 samples were selected by the block randomization sampling method using the computer generalized random allocation software (version 1.0 Sahei 2004). The patients were blinded from knowing the specific effects of the exercises they were performing, and the research assistant who collected the data is blinded from knowing the groups to which the participants belonged. Informed consent was collected from all the participants. The participants have been divided into 2 groups: group A (12 subjects) received functional task training; group B (12 subjects) received conventional exercise therapy and acts as the control group (Figure 1).

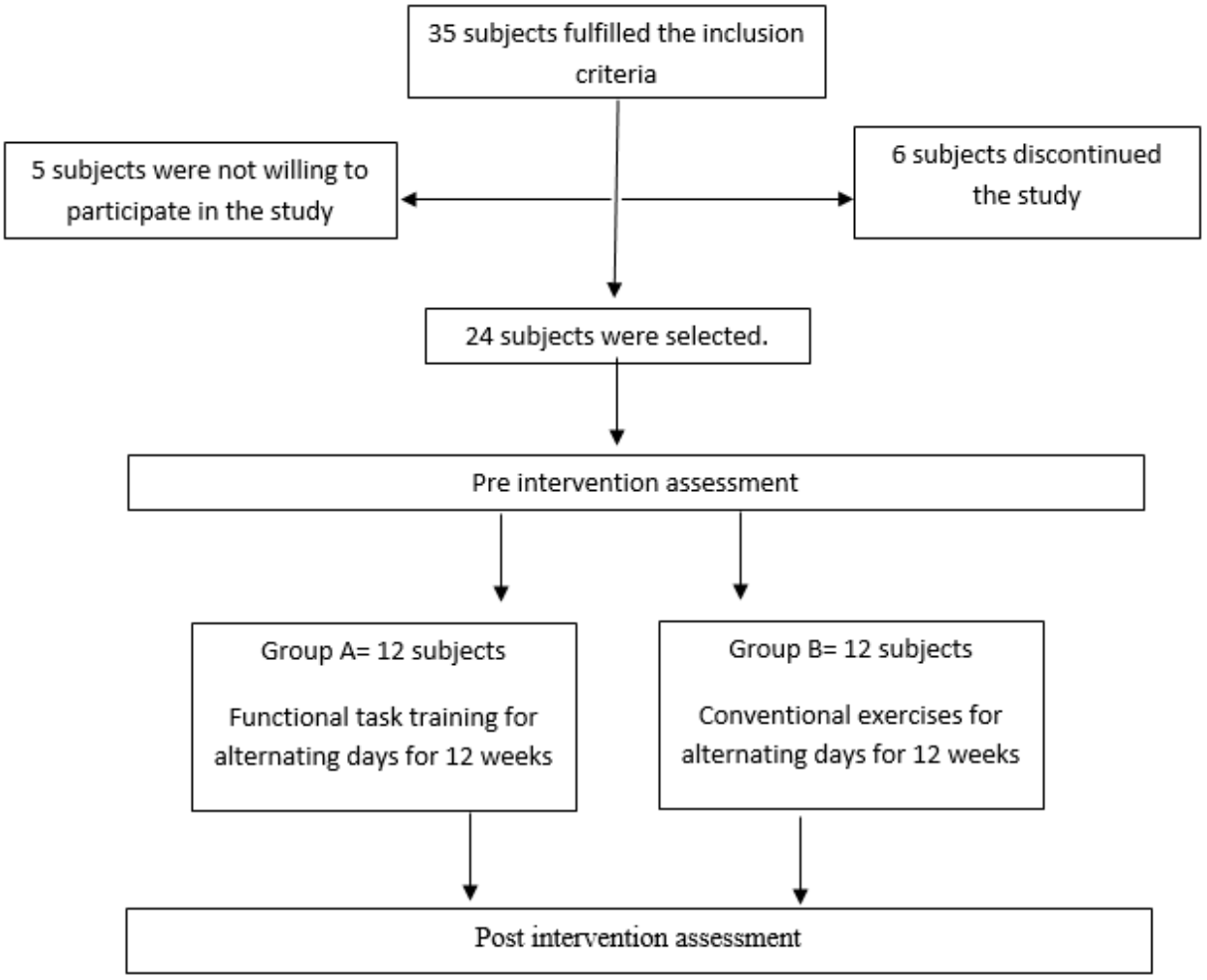

Figure 1. Analogy of the proposal

2.6. Data Collection

WOMAC questionnaires and the walking speed test were used to collect data on the quality of life of patients with grade II and grade III OA knees. These tests are followed by functional task training and traditional workouts.

The 10-meter walking test is a straightforward exercise that evaluates walking speed by having the individual cover a short distance while measuring their pace in meters per second [15].

The Western Ontario and MacMaster Universities (WOMAC) Osteoarthritis Rating is a widely used tool for evaluating individuals with hip or knee OA in terms of pain (5 questions), stiffness (2 questions), and function (17 questions) [16].

2.7. Exercise Protocol

Group A workout regimen includes:

1. Change your position from sitting to standing. First, take a seat in the chair. Take a big breath in and slowly raise yourself off the chair by utilizing your legs. Grab on to the armchair for support as you lean your chest slightly forward. Take another long breath and stand up straight. Lean slightly forward and then, as you breathe out, sit back down again, working to ensure the backs of your legs are in contact with the chair legs. Continue these workouts for a total of 12 weeks on alternate days for one minute each time, four times with a 30-second rest in between [13].
2. Standing with your feet shoulder width apart, take the first step in the star pattern. While extending one leg in front of you on the ground, bending the other knee will aid the foot's advance. Regain your feet, and then proceed similarly. Perform these exercises on alternate days throughout the week for a total of 12 weeks, lasting about a minute each time, four times, with a 30-second break in between.
3. Ascension and descent of a ramp while carrying a 250-gram weight in the hand of choice. For a maximum of 12 weeks, repeat this exercise for one minute four times with a 30-second break on alternating days of the week.
4. Stair climbing and stair lowering while holding a 250-gram weight in the favored hand. For a total of twelve weeks, repeat this exercise for one minute four

times with a 30-second break on alternating days of the week.

5. Walking indoors while transferring a 250-gram weight from hand to hand. Continue this exercise for one minute, four times, with a 30-second break in between. Do this on alternate weekdays for a maximum of 12 weeks [18].

All these exercises are supervised by a physiotherapist. Functional task training is performed for 30 minutes approximately, taking into account the rest period.

Group B's exercise protocol consists of

- Isometric quadriceps exercise [19]
- Knee flexion range of motion
- Knee extension range of motion

All of these exercises were carried out for four repetitions, each followed by a 30-second rest period, on alternate days throughout the week for a duration of 12 weeks.

2.8. Statistical Analysis

The data was collected and analyzed statistically using SPSS version 23 software. The pre- and post-training effects of the functional task-training group and conventional exercises were compared using a paired t-test.

3. Results and Discussion

In order to evaluate the study's hypothesis, "Impact of functional task training on gait parameter of OA knee," statistical analysis was used to compare the significance of the experimental and control group as in (Figure 1). To our knowledge, this is the first study with a wide age range (45 to 60 years) and a 12-week follow-up period. Walking is one of the basic functional tasks that people perform. Stretching and strengthening activities boost walking speed by 10%, according to studies [20]. Similar to this, another article claimed that weight-bearing workouts improve the neuromuscular control of the knee joint, which helps people walk faster on uneven ground and paths. By improving the neuromuscular control of the knee joint, you can speed up walking on uneven surfaces and paths [21]. Another of the most prevalent and incapacitating medical illnesses in the US and around the world is osteoarthritis (OA). Osteoarthritis alteration is more common on the medial versus the ipsilateral side, and similarly, the tibiofemoral region is most often affected [22]. We have benefited from studying the locomotion of individuals with osteoarthritis of the knee, which has helped us understand the role that joint mechanics play in the onset and course of the disease. In addition to those with medial knee arthritis, those with limited knee flexion and excessive knee adduction forces are associated with bow legs and inadequate quads. The accompanying characteristics of muscular function and the deficits that affect movement patterns are far less well understood. It will be easier to create efficient restoration interventions if more is known about how people with OA, as in the shin, move and contract myo propulsive tissues [23]. Weak muscles are linked to reduced knee mobility while walking because the quadriceps' eccentric activity regulates knee flexion during weight acceptance [24]. Leg flexibility could be decreased with significant effects through increased stress on the articular cartilage during impacts [25]. It's possible that this is true in people who frequently exhibit symptoms of joint arthritis. Stiffness of the knees during weight acceptance [25]. Given the high prevalence of weakness in this population, the presence of significant tightness as in the knee mechanism is not surprising; however, the muscle activation mechanisms related to the knee stiffening mechanism are not well described. Intensified compaction of agonist and antagonist surrounding the tibio-femoral joint, which occurs when it becomes stiffer, can raise joint contact pressures [26]. Joint cartilage degradation may become more likely as a result of increased joint stress distribution and impact loads [26].

Table 1 depicts The mean, standard deviation (S.D.), t-test, degree of freedom, and p-value of the difference in walking speed between Groups A and B before and after the experiment. This table demonstrates that there is no difference in pre-test results between Groups A and B that is statistically significant (*P > 0.05). It demonstrates a statistically significant difference between Groups A and B's post test walking speeds (***- P 0.001).

Table 1. Exemplifying noteworthy Values

#WS	#GROUP - A		#GROUP – B		t- TEST	df	SIGNIFI CANCE
	MEAN	S.D	MEAN	S.D			
PRE TEST	1.22	0.06	1.21	0.07	0.091	22	0.927
POST TEST	1.35	0.06	1.22	0.07	4.595	22	0.000***

Figure 2 shows the comparison of scores before and after the examination for walking speed with both groupings A and B, and group A shows significant changes. Table 2 reveals the mean, standard deviation (S.D.), t-test, degree, and p-value of the difference in walking speed between Groups A and B before and after the test. It demonstrates a statistically significant difference between Group A and Group B in post-test walking speed data (***- P 0.001). The post-test Means for both groups indicate a considerable gain, but Group A, with a higher Mean value, is more successful than Group-B. Figure 3 compares the walking speeds of groups A and B, as well as the results of the post-tests, which reveal that group A (1.35) has significant changes over group B (1.22). This could be as a result of the muscles being trained in a certain pattern, which increases the strength of different muscle groups and trains the joints in different planes to increase stability. According to Yang et al. [27], functional task-resistant training will develop muscle strength, which will then be reflected in an improvement in the subjects' physical capability. Studies have shown that as muscle strength grows, so does the speed at which people walk [27]. Functional task training, which develops muscle strength in the participants as previously discussed, causes the subjects' walking speed to increase. Table 3 describes the WOMAC questionnaire results for Groups A & B in the pre test and post test are shown in the table above along with the Mean, Standard Deviation (S.D), t-test, degree of freedom, and p-value. This table demonstrates that there is no significant difference between Group A and Group B's pre-test values (*P > 0.05). It demonstrates a statistically significant difference between Group A and Group B in the post-test results of the WOMAC questionnaire (***- P 0.001).

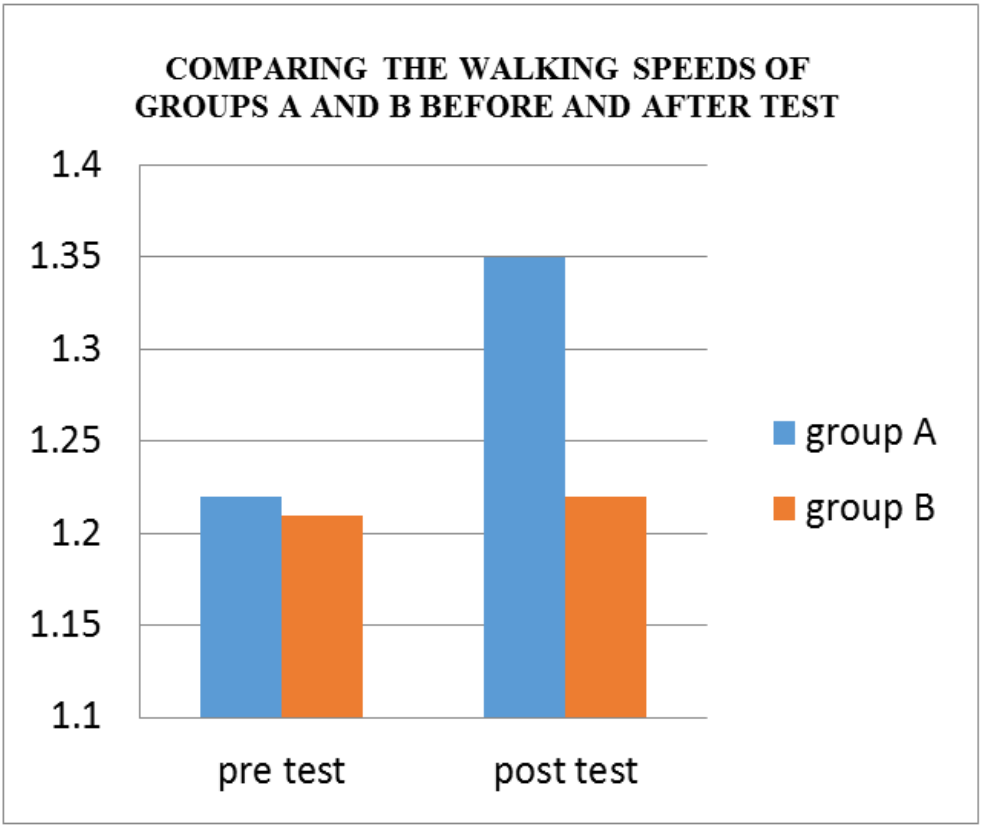

Figure 2. Overview of Reactions

Table 2. Addressing the precise determination

#ws	PRE TEST		POST TEST		t- Test	Sign.
	Mean	S.D	Mean	S.D		
Group- A	1.22	0.06	1.35	0.06	9.078	0.000***
Group- B	1.21	0.07	1.22	0.07	6.166	0.000***

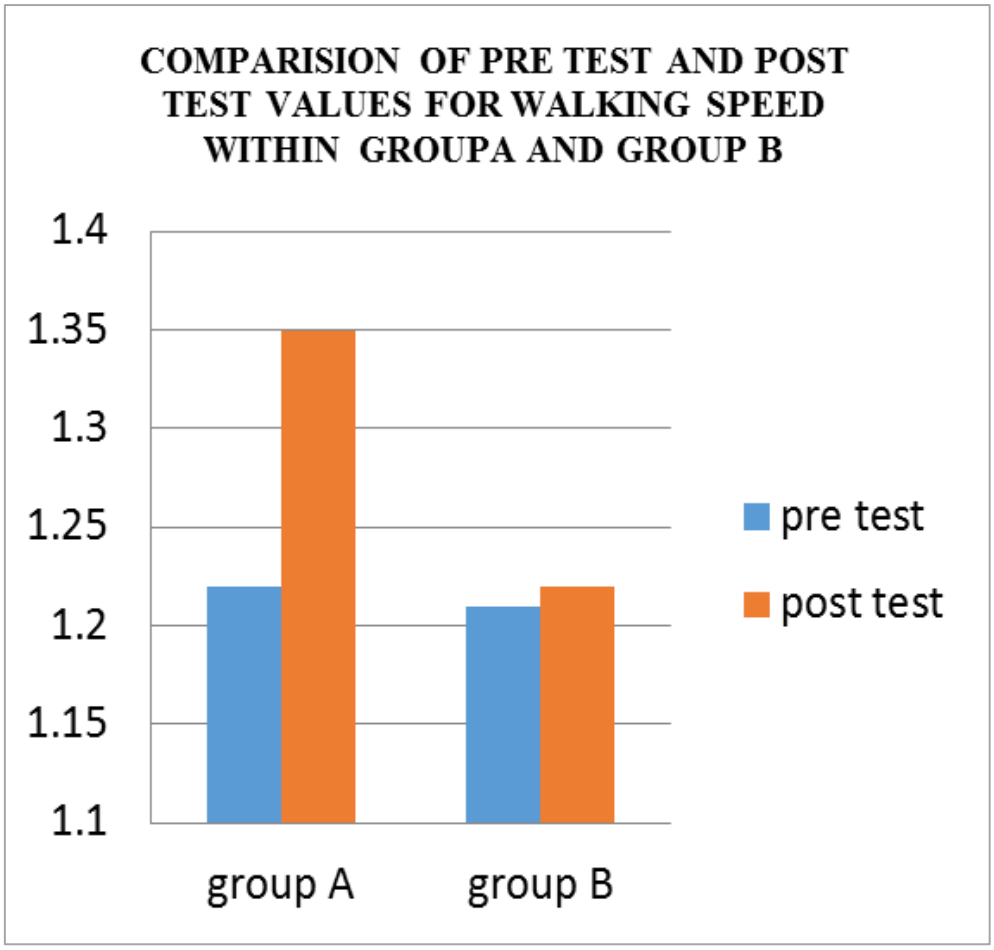

Figure 3. Interpretations of the benefits

Table 3. Substantial correlations

#WQ	PRE TEST		POST TEST		t - TEST	SIGNIFI CANCE
	MEAN	S.D	MEAN	S.D		
GROUP- A	72.0	3.188	65.4	3.50	15.852	0.000***
GROUP- B	72.2	3.724	65.4	3.10	10.457	0.000***

Figure 4 demonstrates how the preliminary testing has not changed significantly. But there is a significant change in posttest values in both groups for the WOMAC questionnaire. In Table 4, the mean, standard deviation (S.D.), t-test, degree of freedom, and p-value of the WOMAC questionnaire between Groups A and B for the pre- and post-test are shown. It demonstrates a statistically significant difference between Group A and Group B in the post-test results of the WOMAC questionnaire (***- P 0.001). The post-test Means for both groups indicate a considerable decline, but Group A, with a lower Mean value, is more successful than Group-B. In Figure 5, comparison has been made between the groups, and statistical data shows that Group A has integer SD values against the control treatment. These results are attributable to the fact that functional task training influences neuromuscular, cognitive, and motor coordination and joint play in addition to reducing pain and improving muscle strength. According to Singh K. K. et al. [13], doing daily activity workouts on a regular basis improves walking ability and stability, as well as reducing discomfort and tightness in degenerative joint disease. According to McGibbons et al. [28], the seat and upright assignment produced more progressive velocities. Greater postural stability (balance) may be needed to allow for bigger changes in center of gravity associated with sit-to-stand activity, as seen by the FTT (functional task training) group's faster rising times. These results raise the prospect of training in functional tasks for functional mobility. Whitehurst et al. [29], discovered similar results in twelve-week studies of cognitive skills exercises involving older people. Earlier studies have shown that

functional task training reduces pain and improves range of motion, so this enhances their quality of life [29]. This study also agrees that functional task training improves pain, walking speed, and range of motion, which helps individuals carry out their daily acts of living with ease.

All these factors contribute to an overall increase in the quality of life of the subjects, which is proved by an increase in the post-test WOMAC SCORE. Functional task training can be used to prevent the complications and even reduce the epidemiology of osteoarthritis of the knee.

The study has a few limitations, including a small sample size and the fact that it did not examine all gait parameters.

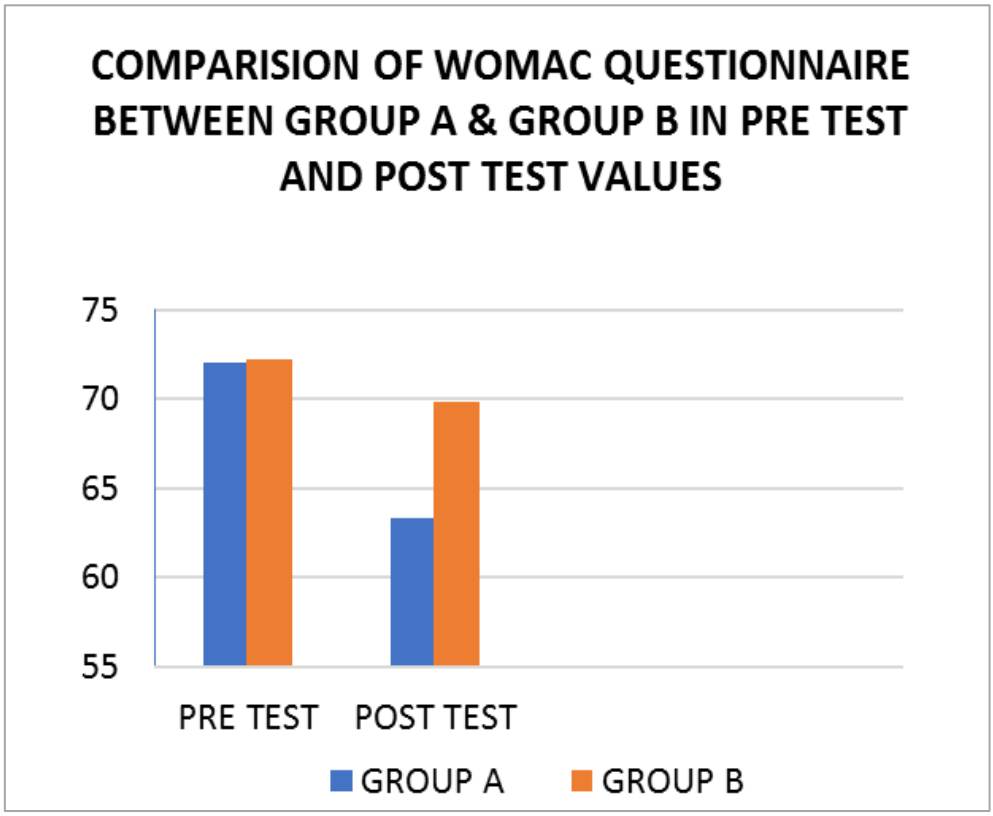

Figure 4. Reviewing the objective measurement.

Table 4. Representating consequences in WOMAC

#WQ	#GROUP - A		#GROUP - B		t – TEST	df	SIGNIFI CANCE
	MEAN	S.D	MEAN	S.D			
PRE TEST	72.0	3.188	72.2	3.724	0.180	22	0.858
POST TEST	63.36	3.89	69.83	3.50	4.094	22	0.009*

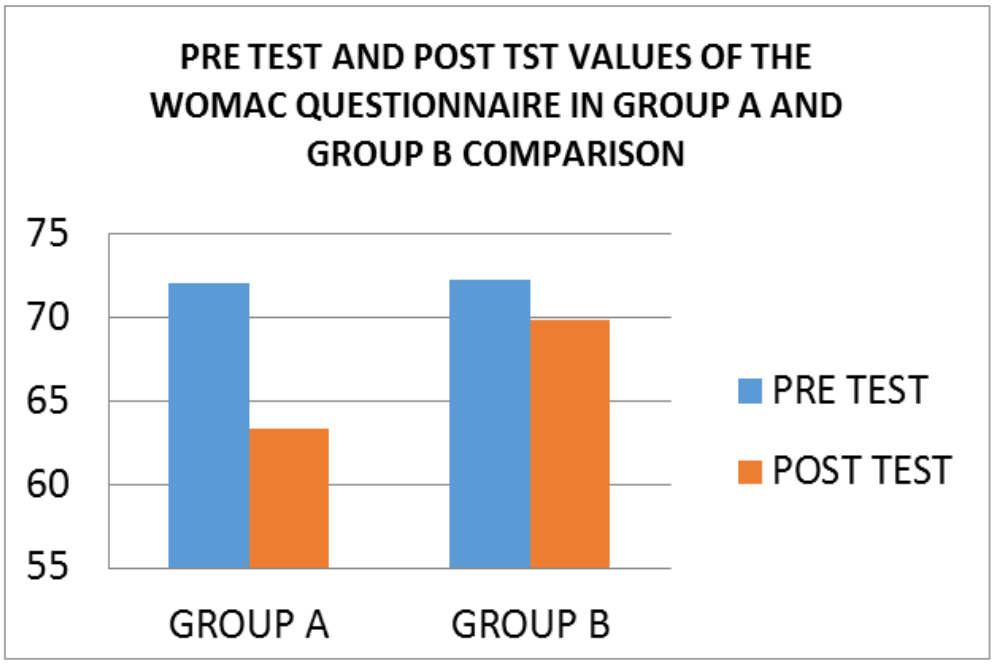

Figure 5. Multifunctional work courses consequences on the Womac Inventory

4. Conclusion

This study found that, compared to the control group performing traditional exercises, functional task guidelines produced noticeably larger increases in walking speed as well as living excellence following the program. The primary goal of physiotherapists in clinical practice is to enhance patients' quality of life, and as walking speed contributes significantly to functional ability, functional task training can be included in their exercise regimen.

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