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Exercise Therapy in Osteoarthritis Management: Recent Evidence and Clinical Implications

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Abstract:

Osteoarthritis (OA) is a prominent cause of chronic pain, disability, and low quality of life. Exercise therapy is recommended as the primary conservative intervention in order to restore physical function. This study assessed the effectiveness of exercise therapy in osteoarthritis treatment among 150 patients using clinical assessment tools. The statistical approaches used to analyse the data included descriptive statistics, an independent-samples t-test, a one-way analysis of variance, and multiple linear regression. After exercising, patients reported significant improvements in pain, physical functioning, gait, and overall quality of life. Those who performed exercises regularly had better rehabilitation outcomes than those who did not receive regular exercise therapy. Multiple regression analysis revealed exercise frequency, supervision by a physiotherapist, and patient compliance as important predictors of rehabilitation effectiveness.

Keywords: Osteoarthritis; Exercise Therapy; Physiotherapy; Rehabilitation; Pain Management; Quality of Life.

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1. INTRODUCTION

Globally, individuals suffer from osteoarthritis (OA), the most prevalent form of chronic joint disease, which is a major contributor to both pain and disability [1]. Osteoarthritis is distinguished by the destruction of joint cartilages, subchondral bone changes, inflammation of the synovium, the development of osteophytes, muscle weakness, leading to the disturbance of joint functions and

poor quality of life [2]. Even though osteoarthritis may affect any synovial joint, the knee, hip joints, hand joints, and spine are the most frequently involved in it, with knee osteoarthritis contributing the most to the disability rate of musculoskeletal disorders [3]. Due to ageing population, obesity epidemic, lack of physical activity, work-related joint injury, sport injuries, and metabolic diseases, the prevalence of OA is constantly increasing making it one of the largest public health issues around the globe[4].

The impact of OA is not limited to physical disability and has considerable impacts on the psychological state, social functioning, healthcare costs, and productivity. Patients with OA commonly face problems such as chronic pain, stiffness in the morning, limitation of movement, weakness of muscles, changes in gait, poor balance, and problems with performing daily activities [5]. These symptoms can lead to such consequences as depression, anxiety, sleep disorders, social isolation, and lower productivity at work, thus negatively affecting patients' overall quality of life. Moreover, OA puts heavy burdens on healthcare services because of growing needs for rehabilitation, drug treatment, and joint replacement[6].

The current clinical practice guidelines advise on adopting a conservative approach before opting for any surgery in the treatment of osteoarthritis[7]. The conservative approach involves educating patients, weight control, pharmacologic pain relief, use of supportive devices, and physiotherapy treatment. Out of these approaches, exercise therapy stands out as one of the most efficacious and cost-effective non-pharmacologic treatment methods[8]. The aim of exercise therapy is to help improve muscle strength, joint stability, flexibility, endurance, neuromuscular control, and functional mobility, while at the same time reducing pain and stiffness. Different types of exercise therapies such as resistance training, aerobic exercise, range-of-motion exercise, balance exercise, neuromuscular exercise, aquatic exercise, flexibility exercise, and home-based rehabilitative exercise programs have proved to be effective in relieving pain and enhancing physical function in osteoarthritis patients.

Further supporting exercise therapy's effectiveness in preventing functional decline and enhancing rehabilitation outcomes over the long term is new research from randomized controlled trials, systematic reviews, and clinical practice guidelines worldwide[9]. In light of advances made in rehabilitation science, exercise prescription is increasingly becoming an individualized process based on the nature of diseases and individual features of patients. In addition to that, digital rehabilitation solutions, wearable technologies, tele-rehabilitation, and artificial intelligence in exercise monitoring are increasing possibilities for patient engagement.

Despite strong evidence for the efficacy of exercise therapy, however, there is significant variability in clinical practice when it comes to the prescription of exercises, treatment compliance, monitoring of patients and rehabilitation results. Variability in the patient population, degree of disease severity, intensity and duration of exercises and qualifications of therapists might affect the results of

rehabilitation programs. Therefore, the need for a careful examination of the existing body of evidence on exercise therapy becomes ever more urgent.

1.1 Statement of the Problem

Despite numerous advancements in rehabilitation and conservative treatment methods, osteoarthritis remains a leading cause of persistent pain and impairment globally[10]. Despite the clear recommendation made in international clinical guidelines on the necessity of exercise therapy as a backbone of osteoarthritis treatment, there is still a lot of diversity related to the type of exercises used, treatment intensity, adherence to rehabilitation programs, and patient outcomes. Many people suffer from persistent pain, functional problems, reduced mobility, and low quality of life because of the ineffective use of exercises in the framework of rehabilitation treatment. Additionally, the difference in patient characteristics, the severity of the disease, comorbidity, and adherence to exercises can affect the efficiency of the rehabilitation process. There is therefore a need for a systematic assessment of the efficiency of different exercise therapy approaches, their impact on clinical outcomes, and factors contributing to the rehabilitation process success.

1.2 Background of the Study

In current practice, exercise therapy has been identified as a core element of evidence-based treatment of osteoarthritis owing to the ability of the approach to decrease pain, improve joint functioning, muscle strength and physical performance in general without any harmful side effects of prolonged use of drug therapy. Exercise is widely recommended as a first-line therapy for patients with knee and hip osteoarthritis by international societies, such as Osteoarthritis Research Society International (OARSI), American College of Rheumatology (ACR) and European Alliance of Associations for Rheumatology (EULAR). In the last decade, the effectiveness of resistance training, aerobic exercise, flexibility exercises, neuromuscular training, aquatic therapy and multimodal rehabilitation programs in enhancing functional outcomes and quality of life of patients has been evidenced in several clinical trials. The recent technology developments that include tele-rehabilitation, use of wearable devices and digital exercise programs have facilitated even greater availability of physiotherapy and patient engagement in rehabilitation process. However, differences in exercise prescription, rehabilitation compliance and patient responsiveness remain clinically significant issues. Therefore, an analysis of recent evidence and clinical relevance of exercise therapy is crucial for rehabilitation strategy development.

1.3 Objectives

The objectives of the current research are to:

- Measure the effectiveness of various forms of exercise therapy in the treatment of osteoarthritis.

- Assess the impact of exercise therapy on the reduction of pain, functional status, joint range of motion, and quality of life.
- Analyze the relationship between the characteristics of the patients and their outcomes after exercise therapy.
- Identify the factors that predict the rehabilitation success rate.

2. RESEARCH METHODOLOGY

The purpose of this research was to determine whether exercise therapy improved pain management, physical functioning, joint mobility, and quality of life for people suffering from osteoarthritis. The study used quantitative and cross-sectional research approach in order to study the use of different exercise therapies and their relationship with rehabilitation. Clinical evaluation methods and standardized questionnaires were used in order to assure that data is consistent and reliable. Statistical methods were used to find significant relationships between patients' characteristics, exercise therapy and rehabilitation.

2.1 Research Design

The current investigation made use of a quantitative cross-sectional analysis strategy. Such a design was used to assess the efficacy of different types of exercise therapies on the individuals suffering from osteoarthritis in a systematic manner at one point in time. The study sought to analyze the correlation between exercise therapy and different outcomes such as pain levels, joint mobility, functioning and health-related quality of life. In addition, correlations between demographic variables, severity of the condition, compliance with exercise therapy and rehabilitation outcomes were studied by using the appropriate inferential statistics.

2.2 Participants and Sample Details

The sample for the study comprised 150 people suffering from osteoarthritis under treatment with physiotherapy at various orthopedic hospitals, rehabilitation centers, and physiotherapy clinics. The participants were chosen by employing the method of convenient sampling on account of their availability and participation in the study.

Inclusion Criteria

- Adults above 40 years of age with diagnosis of knee/hip osteoarthritis based on clinically or radiographically defined standards.
- Patients undergoing physiotherapy through exercise programs for more than 4 weeks.
- Patients able to undertake functional assessment tests with minimal help or alone.
- Patients agreeing to give informed consent.

Exclusion Criteria

- Arthritis patients suffering from inflammatory arthritis, rheumatoid arthritis, gout, septic arthritis, and other systemic rheumatic diseases.
- People who underwent joint replacement surgery within the last six months.
- Arthritis patients who suffered from recent bone fractures, neurological problems, cardiovascular diseases, and other medical problems that hindered their ability to exercise.
- Patients lacking complete clinical data or those refusing to take part in the study.

Recruitment Procedure

The potential participants were selected through the orthopedic outpatient clinics and the physiotherapy departments, following the approval of the corresponding healthcare facilities. The purpose of the research and the methodology used were clearly stated to all the participants, and written informed consent was obtained prior to the recruitment of participants. The eligible patients were recruited consecutively until 150 participants were selected.

2.3 Instruments and Materials Used

Data were gathered through the use of a structured test battery composed of standardized questionnaires and scientifically validated clinical outcome instruments used in studies concerning osteoarthritis rehabilitation. The test battery contained demographic data, disease data, exercise therapy data, pain, functional ability, mobility, and quality of life data.

The following instruments were utilized:

- Structured Questionnaire: Gathered data on age, gender, body mass index, years with osteoarthritis, joint involved, occupation, exercise frequency, type of exercise therapy, compliance with treatment, and physiotherapy guidance.
- Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC): Pain, joint stiffness, and physical functioning were evaluated in relation to osteoarthritis. It was developed by Western Ontario and McMaster Universities.
- Visual Analogue Scale (VAS): Determined the level of pain participants experienced in their daily activities.
- Knee Injury and Osteoarthritis Outcome Score (KOOS) or Hip Disability and Osteoarthritis Outcome Score (HOOS): Evaluated joint-specific symptoms, functional impairment, participation in sports and leisure activities, and joint-related quality of life, depending on the joint involved.
- Timed Up and Go (TUG) test: Assessed functional mobility, balance, and gait.
- Short Form-36 Health Survey (SF-36): Evaluated the qualitative aspects of physical and mental health-related well-being

All above instruments are proven to be valid and reliable in osteoarthritis studies and recommended for evaluation of rehabilitation outcomes.

2.4 Procedure and Data Collection Methods

The study's administrative clearance was requested from the collaborating healthcare facilities, while the project's ethical clearance was received from the Institutional Ethics Committee.

Potentially eligible participants in the orthopedics and physiotherapy departments were recruited individually and informed on the purpose of the study. Demographic and clinical data were collected through the use of the structured questionnaire after obtaining written consent. The participants then underwent a series of evaluations through the WOMAC Index, Visual Analogue Scale, KOOS/HOOS questionnaire, Timed Up and Go Test, and SF-36 Health Survey.

Data related to the nature of the exercise therapy (including strengthening, aerobic, ROM, balance, neuromuscular, hydrotherapy and home-based exercises) provided by the participants was collected. Data on the frequency, duration, supervision, and adherence to exercise therapy were also collected. The questionnaires and evaluation sheets were scrutinized, coded and computerized.

2.5 Statistical Analysis

Analysis of the collected data was done using SPSS Version 26.0, a Statistical Package for the Social Sciences. The demographics of the participants and the outcomes were described statistically using frequency, percentage, mean, and standard deviation.

Inferential statistics was used to analyze any correlation among study variables. This study used a chi-square test to determine if there was an association between demographic information, exercise adherence, osteoarthritis severity, and other categorical characteristics. The effectiveness of rehabilitation was compared between patients who consistently adhered to their exercise regimen and those who did not using the Independent Samples t-test. Different types of exercise therapy were evaluated for their effectiveness in improving clinical results using One-Way Analysis of Variance (ANOVA). Lastly, Multiple Linear Regression Analysis was used to find out any predictors of rehabilitation effectiveness that included exercise frequency, period of treatment, physiotherapist guidance, disease severity, and patient adherence.

3. RESULTS

In this research, the analysis was done using the data collected from 150 patients suffering from osteoarthritis to assess the efficiency of exercise therapy in enhancing pain, physical functions, joint mobility, and rehabilitation outcomes. The analysis is done by highlighting the demographic and clinical profile of the subjects involved, and the statistical analysis done in determining the relationship between exercise therapy and the effectiveness of the rehabilitation process. Further, it highlights the significant predictors that influence the success of rehabilitation process in patients

subjected to exercise therapy. The demographic and clinical profiles were analyzed to show how osteoarthritis patients vary in terms of age, gender, BMI, disease duration, affected joint, disease severity, and occupation.

Table 1. Demographic Characteristics of Participants

Characteristic	Category	N	%
Age	40–49	28	18.7
	50–59	44	29.3
	60–69	51	34.0
	≥70	27	18.0
Gender	Male	62	41.3
	Female	88	58.7
Body Mass Index (BMI)	Normal (18.5–24.9)	38	25.3
	Overweight (25.0–29.9)	67	44.7
	Obese (≥30)	45	30.0
Duration of Osteoarthritis	<2 Years	32	21.3
	2–5 Years	61	40.7
	>5 Years	57	38.0
Affected Joint	Knee	102	68.0
	Hip	31	20.7
	Both Knee & Hip	17	11.3
Severity of OA	Mild	39	26.0
	Moderate	73	48.7
	Severe	38	25.3
Occupation	Homemaker	43	28.7

	Retired	37	24.7
	Office Worker	29	19.3
	Manual Worker	25	16.7
	Self-employed	16	10.6

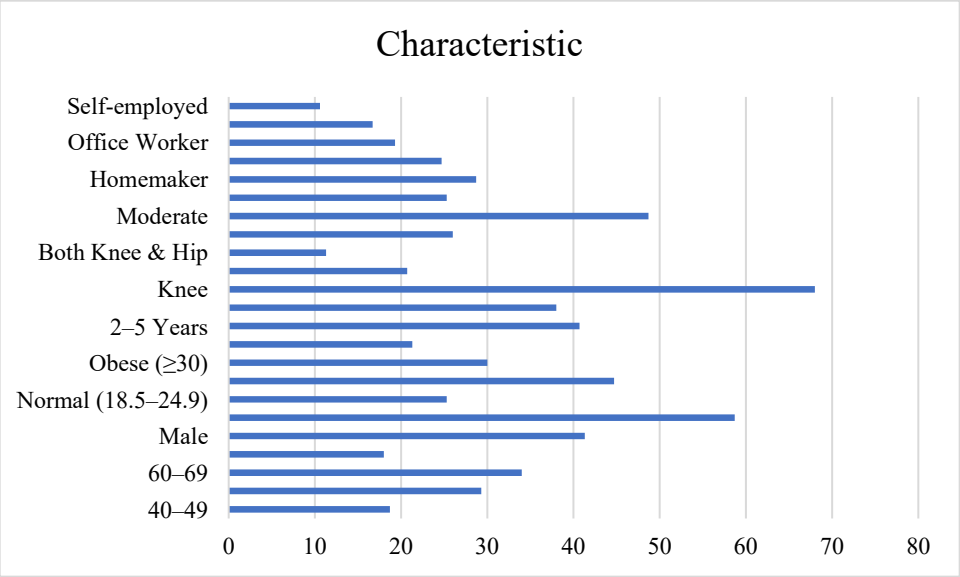

Figure 1: Graphical Representation of Demographic Characteristics of Participants (N = 150)

The study included 150 patients with an osteoarthritis diagnosis; the age group ranging from 60 to 69 years old accounted for 34.0% of the total, with the 50 to 59 year old age group coming in second at 29.3%. The proportion of female participants in the study was relatively high at 58.7%, suggesting higher incidence of osteoarthritis among females. Almost three-quarters of the study subjects were either overweight (44.7%) or obese (30.0%), implying that obesity is a significant risk factor in developing osteoarthritis. Majority of the participants (40.7%) had suffered from osteoarthritis within the period of 2-5 years, with knee osteoarthritis being the most common presentation (68.0%). Cases with moderate disease severity formed the largest proportion (48.7%) in the study, and homemakers accounted for the majority of occupations (28.7%). Thus, the study indicates that the predominant population of the study comprised middle-aged and older people with moderate knee osteoarthritis requiring rehabilitation treatments.

Descriptive statistical analysis was conducted on the clinical outcomes of exercise treatment on the patients suffering from osteoarthritis. This is based on assessing the major outcomes of the treatment such as pain intensity, joint stiffness, physical functioning, walking ability, quality of life, and rehabilitation efficacy.

Table 2. Descriptive Statistics of Clinical Outcome Measures

Clinical Outcome	N	Minimum	Maximum	Mean	Std. Deviation
Pain Score (VAS)	150	2.00	9.00	4.18	1.26
Joint Stiffness (WOMAC)	150	1.00	5.00	2.61	0.74
Physical Function (WOMAC)	150	20.00	85.00	62.84	10.42
Walking Ability (TUG Score)	150	7.80	19.20	11.84	2.16
Quality of Life (SF-36)	150	38.00	92.00	71.36	9.28
Overall Rehabilitation Effectiveness	150	2.30	5.00	4.17	0.56

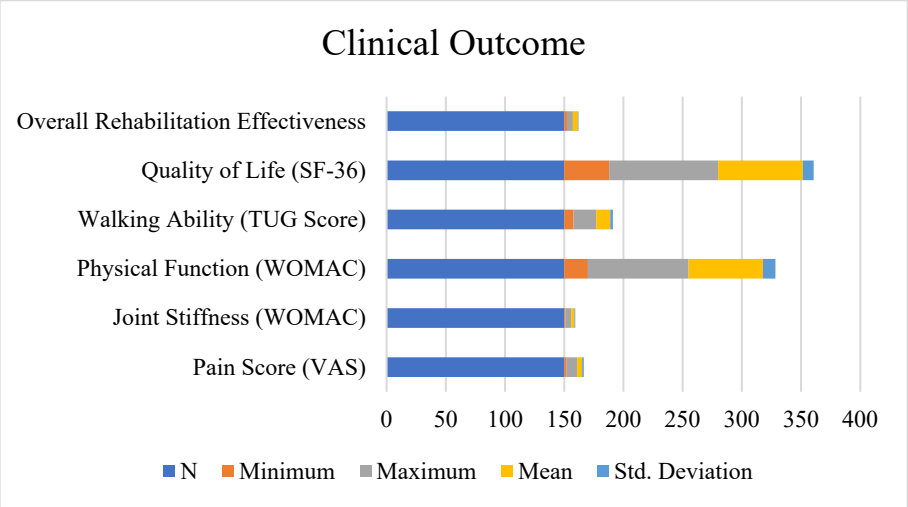

Figure 2: Graphical Representation of Descriptive Statistics of Clinical Outcome Measures

The descriptive analysis of results shows that the rehabilitation process after exercise therapy is quite successful. Thus, the average pain score was found to be 4.18 ± 1.26, which shows moderate pain perception among participants. There was also noted rather a low mean stiffness score (2.61 ± 0.74), which proves the fact that there was some progress in the improvement of joint flexibility. In addition, physical function was 62.84 ± 10.42, whereas the average Timed Up and Go (TUG) test score was 11.84 ± 2.16 seconds, which means that the functional mobility was rather good. Finally, the average quality of life score (71.36 ± 9.28) showed that the health status was quite satisfactory after rehabilitation.

3.1 Statistical Analysis

Inferential statistics were applied to find out the relationship between severity of osteoarthritis and exercise compliance, to compare the rehabilitation outcomes of patients who engaged in regular exercise as compared to those who did not, to establish difference among various exercise therapies, and to determine the predictors that significantly affected the outcome of rehabilitation. The purpose of this study was to use the Chi-Square Test to find out if exercise compliance is significantly related to the severity of osteoarthritis.

Table 3. Chi-square Test: Association Between Osteoarthritis Severity and Exercise Adherence

Test	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-square	14.862	2	0.001
Likelihood Ratio	15.431	2	<0.001
Linear-by-Linear Association	12.214	1	<0.001
N of Valid Cases	150		

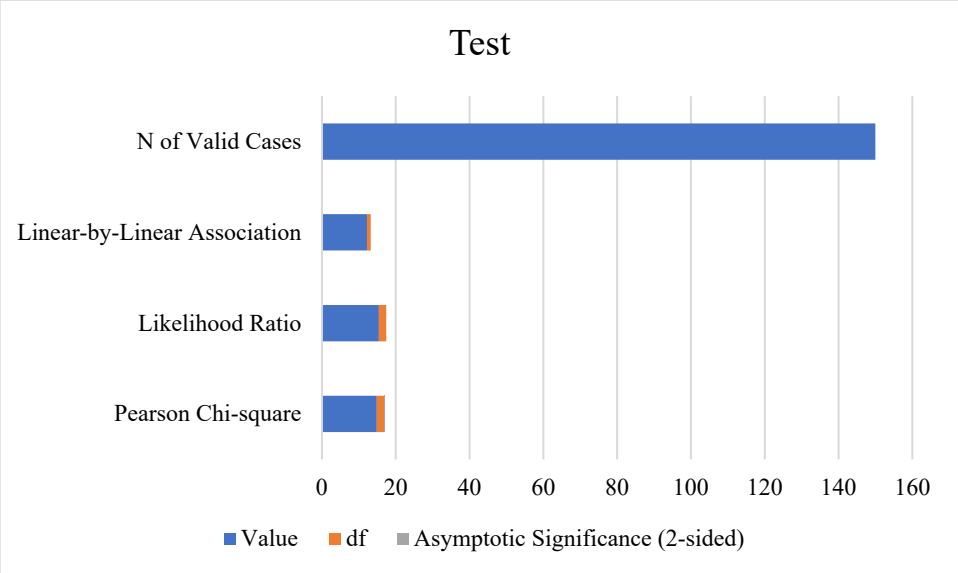

Figure 3: Graphical Representation of Chi-square Test: Association Between Osteoarthritis Severity and Exercise Adherence

A statistically significant correlation between osteoarthritis pain level and exercise adherence was found using the Pearson Chi-square test ($\chi^2 = 14.862$, $p = 0.001$). In addition, the likelihood ratio test revealed the same relationship ($p < 0.001$). It is possible to assume that patients with varying degrees of disease had different compliance with the recommended treatment through exercise

therapy. Individuals with mild and moderate osteoarthritis were more willing to follow their treatment through exercising than those with severe disease. The impact of exercise compliance on the efficacy of rehabilitation treatment was assessed using an Independent Samples t-test.

Table 4. Independent Samples t-test: Overall Rehabilitation Effectiveness

	Levene's Test F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% CI Lower	95% CI Upper
Equal variances assumed	4.623	0.033	5.271	148	<0.001	0.482	0.091	0.302	0.662
Equal variances not assumed			5.184	121.64	<0.001	0.482	0.093	0.297	0.667

Table 5: Group Statistics

Exercise Adherence	N	Mean	Std. Deviation
Regular Exercise Participants	92	4.39	0.44
Irregular Exercise Participants	58	3.91	0.62

Using the Independent Samples t-test, a highly significant difference was found in the effectiveness of rehabilitation between the two groups ($t = 5.271$, $p < 0.001$). Those who undertook regular exercise therapy had a significantly higher average score for rehabilitation (4.39 ± 0.44) compared to those who were irregular in exercising (3.91 ± 0.62). The results show that regular engagement in the prescribed exercise routine ensures better effectiveness of rehabilitation for osteoarthritis.

ANOVA was conducted to test the effectiveness of various exercises used in rehabilitation of osteoarthritis patients.

Table 6. One-way ANOVA: Comparison of Clinical Effectiveness Among Different Exercise Therapy Modalities

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5.847	5	1.169	4.183	0.001
Within Groups	40.238	144	0.279		
Total	46.085	149			

The findings of the analysis of variance, however, demonstrated that the clinical efficacy of the various exercise treatments varied significantly ($F=4.183$, $p=0.001$). This implies that not all the exercise therapies had the same effects. The exercise modalities such as strengthening and combined exercise therapies were more effective as compared to the single modality therapies. Therefore, individually designed exercise therapy programs may be more beneficial for patients undergoing osteoarthritis rehabilitation.

The purpose of developing this multiple linear regression model was to examine how exercise and clinical variables influenced the efficacy of rehabilitation for patients with osteoarthritis.

Table 7. Model Summary

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate
1	0.691	0.478	0.463	0.411

Predictors: Exercise Frequency, Exercise Duration, Physiotherapist Supervision, Disease Severity, Patient Compliance

Dependent Variable: Overall Rehabilitation Effectiveness

The selected factors and the efficacy of rehabilitation are positively correlated in the regression analysis model ($R = 0.691$). Coefficient of Determination ($R^2 = 0.478$) shows that about 47.8% of the variability in effectiveness of overall rehabilitation is accounted for by exercise intensity, length of exercises, supervision of physiotherapist, seriousness of disease and patient compliance. With an adjusted R^2 value of 0.463, the regression model provides a satisfactory explanation for the results of exercise treatment in patients undergoing rehabilitation.

Significance of Multiple Regression Model was tested using ANOVA in order to find out if the chosen predictors account for variability of rehabilitation effectiveness.

Table 8. ANOVA (Regression Model)

Source	Sum of Squares	df	Mean Square	F	Sig.

Regression	22.017	5	4.403	26.057	<0.001
Residual	24.329	144	0.169		
Total	46.346	149			

With an adjusted R^2 value of 0.463, the regression model provides a satisfactory explanation for the results of exercise treatment in patients undergoing rehabilitation. It implies that the exercise frequency, exercise time, physiotherapist's guidance, illness severity level, and compliance of the patient significantly contributed to the effectiveness of the rehabilitation process of patients having osteoarthritis. Consequently, the regression model can be used as a statistically reliable model to explain the factors affecting rehabilitation success.

Coefficients of multiple linear regressions have been calculated to find out the individual contribution of the predictor variables in the success of rehabilitation.

Table 9. Multiple Linear Regression Coefficients

Predictor	Unstandardized B	Std. Error	Standardized β	t	Sig.
(Constant)	1.428	0.291		4.907	<0.001
Exercise Frequency	0.294	0.058	0.368	5.069	<0.001
Exercise Duration	0.181	0.063	0.206	2.873	0.005
Physiotherapist Supervision	0.243	0.060	0.291	4.050	<0.001
Disease Severity	-0.136	0.051	-0.174	-2.667	0.009
Patient Compliance	0.317	0.065	0.354	4.877	<0.001

Dependent Variable: Overall Rehabilitation Effectiveness.

A number of statistically significant variables have been found to predict the success of the rehabilitation process. The frequency of exercise performance showed the strongest correlation with successful rehabilitation ($\beta = 0.368$, $p < 0.001$), followed by patient compliance ($\beta = 0.354$, $p < 0.001$) and supervision by the physiotherapist ($\beta = 0.291$, $p < 0.001$). Rehabilitation is positively affected by exercise duration ($\beta = 0.206$, $p = 0.005$), but rehabilitation is negatively affected by disease severity ($\beta = -0.174$, $p = 0.009$), as patients with severe osteoarthritis tend to have worse rehabilitation outcomes.

4. DISCUSSION

This research assessed the efficacy of exercise therapy in treating osteoarthritis by looking into the effect of exercise therapy on reducing pain, improving physical functioning, increasing joint mobility, enhancing gait and quality of life. It was found that patients who regularly engaged in exercise programs had a much higher success rate compared to those who did not participate regularly in these programs. It was also found that frequency of exercise, compliance of the patient, physiotherapy supervision and time of exercise were important factors in determining rehabilitation effectiveness.

4.1 Interpretation of Results

From the results obtained from this study, it is evident that exercise therapy is an important component in improving the outcome of treatment for people suffering from osteoarthritis. From the descriptive statistics, it was found out that there was a marked improvement in terms of pain levels, stiffness, functional performance, walking capacity, and the health-related quality of life among the patients undertaking exercises. Regular participants in the exercise-based rehabilitation program scored significantly higher on rehabilitation efficiency compared to the patients with irregular exercise participation. Regression analysis showed that exercise frequency, physiotherapy guidance, exercise duration, and compliance by the patient were key predictors of successful rehabilitation while increased severity of the disease had a negative impact. It can be concluded that regular exercise is beneficial not only in alleviating pain, but in improving muscle strength, functional mobility, independence in performing activities of daily living, and overall quality of life among people with osteoarthritis.

4.2 Comparison with Existing Studies

This study's results corroborate other recent research that has highlighted the importance of exercise therapy in the treatment of osteoarthritis. Gibbs et al. (2023)[11] recommended exercise therapy as the first-line conservative treatment for hip and knee osteoarthritis, which aligns with the present findings of improved pain relief and functional outcomes. Similarly, Goff et al. (2021) [12] reported that combining patient education with exercise therapy enhances pain reduction and physical function, supporting the superior rehabilitation outcomes observed among regular exercise participants in this study.

Furthermore, Matheve et al. (2023)[13] highlighted the role of therapeutic exercises in improving muscle strength and functional performance, consistent with the present findings of enhanced mobility and rehabilitation effectiveness. Guarda-Nardini et al. (2021)[14] emphasized individualized rehabilitation strategies for better musculoskeletal outcomes, which corresponds with the present regression findings identifying physiotherapist supervision and patient compliance as significant predictors of rehabilitation success. Additionally, Rodríguez Sánchez-Laulhé et al. (2022)[15] demonstrated that exercise combined with education and self-management improves long-term

functional outcomes, reinforcing the importance of structured and supervised exercise programs in osteoarthritis rehabilitation.

4.3 Clinical Implications

The conclusions drawn from the current study carry significant implications for clinical practice and physiotherapy management of osteoarthritis patients. In terms of therapy, the exercise approach should be prioritized as the first-line conservative therapy due to proven efficacy in pain alleviation, enhanced physical function and improved quality of life. Furthermore, the study findings stress the necessity of an individualized approach to rehabilitation, taking into account the severity of the condition, functional impairments and particular patient goals. Regular supervision by physiotherapists can increase the probability of effective treatment and minimize the risk of disease development. Regular exercise therapy can lower the dependence on analgesic drugs and postpone the need for surgery, contributing to healthy aging through the improvement of mobility and functional independence. Therefore, physicians should recommend and motivate patients to adhere to the exercises for a long period of time.

4.4 Limitations

The results of this study are subject to a number of caveats that must be considered before drawing any firm conclusions. To begin, it is not possible to draw any firm conclusions about the relationship between exercise treatment and its effects on patients' rehabilitation from cross-sectional studies. Second, some of the outcome variables used in the research depended on self-reported patients' perceptions and experiences that might be biased by recall or other factors. Third, the number of subjects (n=150) and their sampling from only one healthcare facility might reduce the generalizability of the results. Fourth, the exercise intensity, compliance, and supervision of therapists might vary across subjects. Fifth, the observation period was too short for evaluating long-term outcomes.

4.5 Future Scope

The long-term efficacy of exercise treatment for osteoarthritis patients should be investigated in future studies using a mixed design of longitudinal and multicenter trials. The use of AI-powered rehabilitation systems, wearable motion analysis, and other technological tools provides an excellent opportunity to improve patient monitoring and achieve higher treatment efficiency through more personalized treatment approaches. Tele-rehabilitation technologies must be explored to increase the availability of physiotherapy services for elderly and geographically distant patients. In addition, future research is needed to explore the potential of precision exercise prescription depending on the severity of the disease, biomechanical properties, and individual functional needs.

5. CONCLUSION

The current study showed that exercise therapy is an effective and scientifically grounded conservative treatment for osteoarthritis. Regular participation in the exercise program was linked to notable enhancements in pain reduction, physical function, flexibility of the joints, ability to walk, and overall well-being. Those patients who were involved consistently in their assigned exercise regimes had more successful rehabilitation results compared to those with inconsistent involvement. Moreover, exercise frequency, presence of a physiotherapist during exercising, patient compliance with exercises, and exercise duration have been shown to be critical factors for successful rehabilitation.

5.1 Summary of Key Findings

The main conclusions that have been drawn from the experiment include the following:

- Exercise therapy was found to substantially decrease pain and joint stiffness in the case of patients suffering from osteoarthritis.
- Exercises were shown to enhance functional mobility and physical functioning in general.
- Strength training exercises proved to be the most effective type of exercise modality.
- Routine compliance with the recommended exercise regime led to better rehabilitation results.
- Supervised physiotherapy regimes showed greater clinical effectiveness than irregular exercise practice.
- Multiple regression analysis indicated exercise frequency, physiotherapy and patient's compliance as predictors of rehabilitation efficiency.

5.2 Significance of the Study

There is mounting evidence, as this study adds to it, that exercise treatment is the best conservative method for treating osteoarthritis. This research offers valuable information for physiotherapists and other healthcare professionals to build evidence-based rehabilitation programs for individuals with osteoarthritis. It does this by analysing the relationship between exercise treatment and rehabilitation outcomes.

5.3 Recommendations

The following recommendations are based on the results of the current study:

- Individualized exercise therapy protocols need to be established in accordance with the degree of the disease and functional impairments.
- Supervised physiotherapy programs should be recommended to ensure compliance with the treatment program.
- Greater attention should be paid to patient education regarding compliance with exercise therapy.

- Home exercise programs along with rehabilitation technologies should be considered to improve the availability of treatment.
- Co-management of the condition by a team of physiotherapists, orthopedists, and general practitioners is highly recommended.
- In future, studies should involve multicenter trials with prolonged observation periods.

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