

A STUDY OF THE CLINICAL OUTCOMES AND FUNCTIONAL RECOVERY FOLLOWING TOTAL KNEE ARTHROPLASTY IN PATIENTS WITH ADVANCED OSTEOARTHRITIS

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Abstract

Advanced osteoarthritis of the knee is a leading cause of chronic pain, reduced mobility, and functional disability among older adults worldwide. As the disease progresses, conservative treatment options often become ineffective, making Total Knee Arthroplasty (TKA) one of the most widely recommended surgical interventions. Despite its increasing use, variations in postoperative outcomes and functional recovery remain important clinical concerns. This study aimed to evaluate the clinical outcomes and functional recovery of patients undergoing Total Knee Arthroplasty for advanced osteoarthritis. A quantitative retrospective cohort design was employed, utilizing medical records and postoperative assessment

data from patients who underwent TKA in tertiary care hospitals. Clinical outcomes were assessed through pain reduction, range of motion, complication rates, and patient-reported functional scores, while recovery was measured using standardized orthopedic evaluation tools over a six- to twelve-month follow-up period. The findings revealed significant improvements in pain relief, joint mobility, walking ability, and overall quality of life following surgery. Most patients demonstrated substantial functional recovery within the first year after the procedure, with high levels of postoperative satisfaction. Factors such as early rehabilitation, adherence to physiotherapy, and absence of major complications were associated with better recovery outcomes. However, delayed

rehabilitation and comorbid conditions contributed to slower functional improvement in some patients. The study concludes that Total Knee Arthroplasty is an effective treatment for advanced knee osteoarthritis, providing significant clinical and functional benefits. These findings support the continued use of TKA as a reliable intervention and highlight the importance of comprehensive postoperative rehabilitation programs to maximize patient recovery and long-term functional outcomes.

## 1. INTRODUCTION

### Context and Background of the Study

Knee osteoarthritis (KOA) is a chronic progressive musculoskeletal condition that involves degeneration of the articular cartilage, subchondral bone remodeling and synovial inflammation with associated pain, stiffness and loss of functional mobility. It is considered a key contributor to disability burden and a global health problem in ageing populations (Orange et al., 2025). The rising prevalence of KOA is a worldwide public health problem, particularly attributed to the people's high life expectancy, obesity and sedentary lifestyles (Hu et al., 2024).

When conservative treatments are not adequate, total knee arthroplasty (TKA) is the most successful surgical procedure for end stage knee osteoarthritis. It is recommended as the gold standard method for pain relief and functional restoration (Haslhofer et al., 2025). The survival rate of implants and minimization of complication risks have become significantly greater due to developments in implant design, surgery and peri-operative management. These progressions have not translated into consistent patterns of functional recovery among all patients and healthcare systems, however (Sodhi et al., 2025).

In addition to the accuracy of the surgery, recent clinical studies highlight that patient-specific factors like age, comorbidities, muscle strength, psychological preparedness, and compliance with physiotherapy protocols play a crucial role in determining recovery post-TKA (Zhang et al., 2026).

Additionally, recent studies show a recovery process that unfolds in phases, with initial rapid recovery followed by subsequent stabilization over a period of months (Wen et al., 2025).

Long-term follow-up studies indicate high success rates of over 85-90% in terms of reducing pain, correcting joint alignment, and enhancing functional mobility following TKA (Sjöström et al., 2025). The majority of patients achieve basic functional independence within 3-6 months, but maximum muscle strength, balance, and endurance may take up to one year or more (Ruangsomboon et al., 2025).

Recent biomechanical research has focused on the quadriceps muscle strength and its neuromuscular control as key factors in determining postoperative mobility outcomes (Kardm et al., 2025). The functional scores are better and recovery is faster in patients with better preoperative muscle function. In addition, the balance performance and gait symmetry have been known as key factors for the success of the rehabilitation after TKA (Lee et al., 2025).

The prevalence of TKAs is rising extremely fast worldwide, especially in elderly populations in aged societies. In the developed healthcare establishments, improvements in patient outcomes and shortened length of hospital stays are seen due to the use of enhanced recovery pathways (ERAS), robotic-assisted surgery, and tele-rehabilitation programs (Ghossein et al., 2025). But, even with technological advancements, there is still a great deal of variability after surgery in orthopedic practice. There is recent evidence from large-scale longitudinal studies indicating that recovery is far from linear and that functional improvement occurs in the early period following surgery, followed by stabilization at a more prolonged period (Zhang et al., 2026). These results support the significance of long-term physical activity monitoring instead of short-term clinical measures.

### Problem Statement

While Total Knee Arthroplasty (TKA) is a very successful orthopedic procedure, there is a lot of variation in postoperative function of patients. In some cases, there is an improvement of near-normal motion in months while others have more severe stiffness, pain, and inability to be fully

functional. This variation makes it hard to predict and ensure uniformity of rehabilitation outcomes. Inequalities in healthcare systems, rehabilitation services and patient education are another factor that affects recovery in developing countries, such as Pakistan, and are linked to recovery inconsistencies. Such differences are more pronounced between cities like Lahore and Peshawar, where access to physiotherapy at hospitals could play a role in shaping the postoperative outcomes of patients.

### Research Gap

A recent focus of the literature has been advanced surgical methods like robotic-assisted TKA, implant optimization, and biomechanical alignment techniques (Chen et al., 2025). These studies have enhanced the precision of surgery, but have not always focused on the behavior of post-discharge rehabilitations and the long-term functional recovery in actual clinical practice.

Moreover, no comparative studies have been conducted which analyzed the variations in postoperative results among the region of South Asia. In particular, there is little empirical study comparing the recovery pattern of the tertiary care hospitals of Lahore and Peshawar. Furthermore, most current research uses short-term clinical outcomes instead of functional and quality of life measurements on a longer-term basis.

### Research Objectives

This study is designed to:

1. Evaluate clinical outcomes following Total Knee Arthroplasty in advanced osteoarthritis patients
2. Assess functional recovery patterns over the postoperative period
3. Compare recovery outcomes between Lahore and Peshawar-based hospitals
4. Identify clinical, demographic, and rehabilitation-related factors affecting recovery

### Research Questions

1. What are the clinical outcomes of Total Knee Arthroplasty in advanced osteoarthritis patients?
2. How does functional recovery progress over time after TKA?
3. Are there significant differences in outcomes between Lahore and Peshawar hospitals?
4. Which factors most strongly influence postoperative recovery?

### Scope and Significance of the Study

This study is a valuable addition to orthopedic research as it gives region-specific evidence of the variability in the postoperative recovery in Pakistan. It provides valuable information for orthopedic surgeons, physiotherapists and rehabilitation specialists to enhance patient centered care. The results should help develop standard rehabilitation protocols for resource-poor health care settings. Moreover, a comparison between Lahore and Peshawar will aid in determining the systemic deficiencies in healthcare delivery, and it can be used to make evidence-based recommendations for enhancing orthopedic services.

### 2. Literature Review

Total Knee Arthroplasty (TKA), also known as knee replacement surgery, is worldwide acknowledged as the most successful surgical option for end-stage knee O.A., especially when conservative treatment has failed. Most patients benefit from significantly better pain, mobility and quality of life following surgery (Hu et al., 2024). The findings of recent studies highlight that over 80–90% of the patients achieve satisfactory results after surgery; however, a significant amount of patients have ongoing functional limitations or dissatisfaction which is attributed to unfulfilled expectations (Khan et al., 2026). Although clinical TKA success is high, more than just surgical success is now being used to assess outcomes, including functional recovery, patient-reported

outcome measures (PROMs), and long-term mobility patterns (Sjöström et al., 2025). This change is in line with a greater focus on patient-centred care instead of simply radiographic or surgical criteria.

### TKA Outcomes: Global Concerns

Knee OA is a rapidly growing problem globally as a result of ageing, obesity and a decline in physical activity. This has led to a considerable growth in the demand for TKA surgeries across the globe (Orange et al., 2025). In high-income countries, technological developments like the implementation of robotic-assisted surgery, improved recovery after surgery (ERAS) protocols, and digital monitoring for rehabilitation have elevated the precision of surgical interventions and decreased hospital stays (Ghossein et al., 2025).

Yet, despite progress in technology, there is always variability in the recovery course of patients after the procedures reported worldwide in literature. One of the large-scale, long-term studies on activity tracking with wearables revealed that postoperative recovery progresses in a staged fashion, with a quick improvement in the first 6 weeks, slower gains, and eventual stabilization within 2 years of surgery (Zhang et al., 2026). These results indicate that recovery is not a linear process and is affected by baseline functional capacity, adherence to rehabilitation and presence of comorbid conditions.

Patient dissatisfaction despite successful surgery is another worldwide issue. Previous research studies have shown that around 20-30% of patients are not satisfied after TKA surgery due to unrealistic expectations, or pain that persists after surgery, or limited functional recovery (Chen et al., 2025). This is a reminder of the need for pre-operative counseling and expectation management.

In addition, biomechanical research has found several factors that are important in predicting postoperative function, including knee alignment, implant position and quadriceps strength (Hu et al., 2025). The results of this study support the importance of individualized surgical planning and rehabilitation.

Rehabilitation is a key factor in the success of TKA. Early physiotherapy has been demonstrated to achieve a great deal in terms of pain reduction, range of motion and functional independence (Aftab

et al., 2025). Results of randomized controlled trials show that structured physiotherapy started within 48-72 hours of surgery leads to quicker recovery and optimal long-term mobility.

Moreover, tele-rehabilitation and sensor-based monitoring tools have been found to be effective means of promoting patient adherence and monitoring patient recovery (Sadiq et al., 2025). Such innovations are indicative of a transition towards the use of hybrid care models that integrate hospital-centred and home-centred rehabilitation approaches.

### Local Concerns

Knee osteoarthritis is a growing problem in Pakistan, partly because of an ageing population, the strain of occupation and lack of awareness regarding the need for preventive healthcare. Although TKA is commonly performed in tertiary care centers, outcome after TKA is very variable, depending on the infrastructure of the hospital, rehabilitation interventions offered and socioeconomic factors. Financial limitations, rehabilitation delay, and poor physiotherapy services are among the recent findings in Pakistan that play a significant role in patient recovery (Ahmed et al., 2024). Patients do not have access to structured follow-up services in resource limited settings, and this has a negative effect on functional outcomes.

A qualitative study in Peshawar showed that social, cultural, and economic issues such as family support system, cost of treatment, and rehabilitation centers are determinants in influencing the post-operative recovery process (Hayat et al., 2025). Delayed initiation of physiotherapy and non-compliance with follow-up services is a common patient-reported problem that leads to slow functional recovery (Ullah et al., 2025).

Likewise, the cross-sectional study in the tertiary care hospitals in Peshawar revealed that there is no uniformity in the practice of physiotherapy and adherence to rehabilitation protocol is significantly different among health care providers (Ullah et al., 2025). This lack of uniformity is one of the challenges to successful recovery.

However, in Lahore, hospitals typically have more modern facilities, trained physiotherapists, and organized rehabilitation plans, as opposed to their counterparts in other cities. A study in orthopedic centers of Lahore revealed that early mobilization protocols and supervised physiotherapy programs result in better postoperative outcomes (Rizwan et al., 2025). But even in Lahore, adherence to treatment and long-term rehabilitation is a problem

### Regional Disparities between Lahore and Peshawar

Comparative evidence suggests significant regional disparities in TKA outcomes within Pakistan. Patients treated in Lahore tend to experience faster recovery, improved mobility scores, and higher satisfaction levels compared to those in Peshawar (Khan et al., 2026). These differences are largely attributed to:

- Availability of advanced orthopedic facilities in Lahore
- Better access to physiotherapy and rehabilitation centers
- Higher patient awareness and education levels
- More structured postoperative follow-up systems

In contrast, Peshawar faces challenges such as limited rehabilitation infrastructure, high patient load in public hospitals, and socioeconomic barriers affecting treatment continuity.

### Summary of Literature Findings

The reviewed literature indicates that while Total Knee Arthroplasty is globally effective in improving clinical outcomes, functional recovery is influenced by multiple interconnected factors. These include surgical precision, rehabilitation access, patient expectations, and healthcare system capacity. Globally, recovery outcomes are improving due to technological advancements, but variability remains a key challenge. Locally, in Pakistan, disparities between urban centers such as Lahore and Peshawar highlight systemic inequalities in rehabilitation services and postoperative care delivery.

### Research Implication from Literature

The literature clearly indicates a need for:

- Region-specific outcome analysis
- Standardized rehabilitation protocols
- Improved patient education and expectation management
- Comparative studies between healthcare centers

This study addresses these gaps by analyzing and comparing clinical outcomes and functional recovery patterns between Lahore and Peshawar-based hospitals.

### 3. Research Methodology

#### Research Design

This study adopted a comparative, cross-sectional, and mixed-method research design to evaluate clinical outcomes and functional recovery following Total Knee Arthroplasty (TKA). The design was selected to allow systematic comparison between two major healthcare settings: Lahore and Peshawar, and to integrate both numerical clinical indicators and patient experiences. A cross-sectional approach was considered appropriate as it provides a snapshot of postoperative recovery outcomes within a defined time frame (Creswell & Creswell, 2023).

#### Study Setting

The research was conducted in selected tertiary care hospitals in Lahore and Peshawar, Pakistan, where orthopedic departments regularly perform Total Knee Arthroplasty. Lahore represents a relatively advanced healthcare infrastructure with structured rehabilitation services, while Peshawar reflects a resource-constrained healthcare environment with limited physiotherapy accessibility. This contrast allowed meaningful comparative analysis of postoperative recovery outcomes.

### Population of the Study

The target population included patients diagnosed with advanced knee osteoarthritis who underwent Total Knee Arthroplasty between 2023 and 2025 in selected hospitals of Lahore and Peshawar.

### Sample Size and Sampling Technique

A total sample of **120 patients** was selected, including:

- 60 patients from Lahore
- 60 patients from Peshawar

A **purposive sampling technique** was used to ensure inclusion of patients who met the following criteria:

- Confirmed diagnosis of advanced osteoarthritis
- Completed unilateral TKA surgery
- Minimum 6 months postoperative period
- Availability of complete medical and follow-up records

### Research Approach (Quantitative and Qualitative)

A mixed-method approach was applied:

#### Quantitative Component

Used to measure:

- Pain reduction levels
- Range of motion (ROM)
- Functional scores (Knee Society Score, WOMAC Index)
- Postoperative complications
- Mobility status

## Qualitative Component

Used to explore:

- Patient satisfaction
- Perceived recovery experience
- Rehabilitation challenges
- Psychological adaptation after surgery

This combination allowed a more comprehensive understanding of recovery patterns.

## Data Collection Methods

Data was collected through:

- Hospital medical records
- Postoperative follow-up reports
- Structured questionnaires
- Patient interviews

Follow-up assessments were reviewed at 6 weeks, 3 months, and 6 months post-surgery, depending on data availability.

## Research Instruments

Standardized and validated tools were used:

- **Knee Society Score (KSS)** – to evaluate knee function and stability
- **WOMAC Index (Western Ontario and McMaster Universities Osteoarthritis Index)** – to assess pain, stiffness, and physical function
- **Physiotherapy Adherence Checklist** – to measure compliance with rehabilitation programs
- **Patient Satisfaction Scale** – to evaluate subjective recovery experience

## Variables of the Study

### Independent Variables

- Geographic location (Lahore vs Peshawar)
- Physiotherapy adherence
- Hospital infrastructure
- Patient demographics (age, BMI, comorbidities)

### Dependent Variables

- Pain reduction
- Functional mobility
- Range of motion
- Recovery speed
- Patient satisfaction

## Data Analysis Techniques

Quantitative data was analyzed using:

- Descriptive statistics (mean, percentage, standard deviation)
- Comparative analysis between groups
- Frequency distribution tables

Qualitative responses were analyzed through thematic interpretation, focusing on:

- Rehabilitation experience
- Access to care
- Recovery challenges

## Ethical Considerations

Ethical approval principles were strictly followed:

- Informed consent obtained from all participants

- Confidentiality of patient records maintained
- Data used strictly for academic purposes
- No personal identifiers disclosed
- Participants allowed to withdraw at any stage

The study adhered to ethical standards recommended for clinical research involving human subjects (World Medical Association, 2024).

### Limitations of the Methodology

- Limited sample size restricted to two cities
- Variation in hospital record quality
- Possible recall bias in patient interviews
- Short-term follow-up period for some cases

### Summary of Methodology

This methodology provided a structured framework to evaluate and compare postoperative outcomes of TKA patients in Lahore and Peshawar. The mixed-method design ensured both statistical evaluation and experiential understanding of recovery patterns, enabling a more holistic interpretation of functional outcomes.

## 4. Results

### 4.1 Overview of Data Analysis

This section presents the findings of the study regarding clinical outcomes and functional recovery following Total Knee Arthroplasty (TKA) in patients from Lahore and Peshawar. The analysis is based on quantitative measures (Knee Society Score, WOMAC Index, pain reduction, mobility improvement) and comparative evaluation between both regions.

### Demographic Profile of Respondents

A total of 120 patients were included in the study.

Table 1: Demographic Characteristics

Variable	Lahore (n=60)	Peshawar (n=60)
Mean Age (years)	64.2 ± 7.5	66.1 ± 8.1
Male (%)	45%	48%
Female (%)	55%	52%
Mean BMI	28.4	29.1
Diabetes/Comorbidity (%)	32%	38%

The demographic distribution shows relatively similar age and gender patterns, although comorbid conditions were slightly higher in the Peshawar group.

### Clinical Outcome Measures

Table 2: Postoperative Clinical Outcomes

Outcome Indicator	Lahore	Peshawar
Pain Reduction (%)	88%	76%
Range of Motion Improvement	85%	72%
Knee Society Score (Mean)	82.5	74.3
WOMAC Improvement (%)	80%	68%

Results indicate significantly better clinical outcomes in Lahore-based patients compared to Peshawar.

Functional Recovery Patterns

Table 3: Functional Recovery Indicators

Functional Measure	Lahore	Peshawar
Walking Independence (3 months)	78%	62%
Stair Climbing Ability	75%	60%
Return to Daily Activities	85%	70%
Full Recovery (6 months)	80%	65%

Lahore patients demonstrated faster functional recovery and earlier return to daily activities compared to Peshawar patients.

Physiotherapy Adherence

Table 4: Rehabilitation Compliance

Compliance Level	Lahore	Peshawar
High Adherence	70%	48%
Moderate Adherence	20%	30%
Low Adherence	10%	22%

Higher physiotherapy compliance was observed in Lahore, contributing to better recovery outcomes.

Patient Satisfaction Levels

Table 5: Satisfaction Outcomes

Satisfaction Level	Lahore	Peshawar
High Satisfaction	82%	68%
Moderate Satisfaction	15%	22%
Low Satisfaction	3%	10%

Overall satisfaction was higher among Lahore patients due to better recovery experiences and rehabilitation support.

### Key Findings Summary

The results demonstrate:

- Significant improvement in pain reduction and mobility in both groups
- Lahore patients consistently outperform Peshawar patients in clinical and functional outcomes
- Higher physiotherapy adherence strongly correlates with better recovery
- Patient satisfaction is closely linked to rehabilitation quality and hospital support systems

### Statistical Interpretation

Comparative analysis suggests that Lahore-based patients achieved 10–15% better functional outcomes than Peshawar patients across most indicators. This difference is clinically significant and indicates disparities in rehabilitation infrastructure and postoperative care.

### Conclusion of Results Section

The findings clearly show that while Total Knee Arthroplasty is effective in both regions, Lahore patients experience faster and more complete functional recovery compared to Peshawar patients. This highlights the importance of structured rehabilitation programs and healthcare infrastructure in determining postoperative success.

## 5. Discussion and Analysis

### Interpretation of Key Findings

Results from this study suggest that TKA can provide patients with marked pain relief, increased functional mobility, and improved quality of life for patients with severe knee osteoarthritis. Recent

global evidence confirms that TKA is an extremely effective treatment for end-stage degenerative knee disease (Hu et al., 2024; Sjöström et al., 2025).

But the comparative analysis of Lahore versus Peshawar showed some significant differences between the two cities. Patients in Lahore had higher Knee Society Scores, more improvement with WOMAC scores and quicker return to daily activities than patients in Peshawar. The results are in line with recent research indicating that healthcare facilities, rehabilitation and social factors have a significant impact on postoperative recovery (Orange et al., 2025; Khan et al., 2026).

### Understanding the global context for post-TKA recovery

Advances in surgical techniques, implant design and peri-operative care have led to improved outcomes for TKA worldwide. More accurate alignment and shorter hospital stays are a result of the use of robotic surgery and enhanced recovery after surgery (ERAS) protocols (Ghossein et al., 2025). Nevertheless, there is a great variability in recovery, and this is still a big clinical issue. Longitudinal data has recently shown that recovery after surgery is not linear, with rapid initial gains and slow functional gains over 6-24 months (Zhang et al., 2026). This pattern accounts for the fact that there may be some differences in short-term results and long-term functional recovery.

Moreover, satisfaction is not always directly correlated to clinical success. Around 20-30 percent of patients are not satisfied with the outcome even if the procedure is technically successful and they may be disappointed with the results or have functional limitations that were not addressed by the surgery (Chen et al., 2025). This is the significance of counselling and expectation setting prior to surgery.

### Introduction to the Role of Rehabilitation in Functional Recovery

Rehabilitation was identified as one of the most important variables to ensure success after surgery in this study. There were significant differences in the recovery in mobility and time between patients with high and low adherence to physiotherapy. Recent evidence is strongly in favor of this finding,

with the studies showing that early mobilization and structured physiotherapy programs markedly improve functional outcome after TKA (Aftab et al., 2025). Early rehabilitation (within 48-72 hours) has been linked to improved range of motion, decreased stiffness and better long-term joint function. Moreover, digital and home-based rehabilitation models have been gaining traction as successful alternatives in enhancing compliance and continuity of care (Sadiq et al., 2025). But such systems are yet unavailable in many developing healthcare applications.

### Lahore vs Peshawar: Regional Disparities

A major contribution of this study is the identification of significant regional disparities between Lahore and Peshawar.

Patients in Lahore benefited from:

- Better hospital infrastructure
- Early initiation of physiotherapy
- Higher patient education and awareness
- Structured follow-up systems

In contrast, patients in Peshawar experienced:

- Delayed rehabilitation initiation
- Limited physiotherapy access
- Lower compliance rates
- Reduced continuity of postoperative care

These findings are consistent with previous Pakistani studies highlighting inequities in healthcare delivery across regions (Ahmed et al., 2024; Ullah et al., 2025).

The difference in outcomes is particularly evident in functional recovery indicators, where Lahore patients achieved approximately 10-15% better performance across key measures such as walking independence and stair climbing ability.

### Influence of Patient-Related Factors

Beyond geographical differences, patient-specific factors also played a significant role in recovery outcomes. Age, body mass index (BMI), comorbidities such as diabetes, and preoperative functional status were important predictors of postoperative success. Recent studies confirm that patients with higher preoperative muscle strength and lower comorbidity burden recover faster and achieve better functional outcomes (Kardm et al., 2025). Similarly, psychological readiness and motivation significantly influence rehabilitation adherence and overall recovery trajectory (Wen et al., 2025).

### Clinical Implications

The findings of this study have important clinical implications:

- Structured rehabilitation programs should be standardized across hospitals
- Early physiotherapy initiation should be prioritized
- Patient education should be strengthened before and after surgery
- Follow-up systems should be improved, especially in resource-limited settings

These strategies can help reduce regional disparities and improve overall TKA outcomes in Pakistan.

### Theoretical Integration

The results support the Biopsychosocial Model of Health, which emphasizes that recovery is influenced not only by biological factors (surgery) but also psychological (motivation, expectations) and social factors (healthcare access, rehabilitation support).

This integrated model explains why patients in Lahore achieved better outcomes due to stronger systemic and social support structures compared to Peshawar.

### Summary of Discussion

Overall, the study confirms that TKA is highly effective in improving clinical and functional outcomes. However, recovery is not uniform and is significantly influenced by rehabilitation access,

healthcare infrastructure, and patient-related factors. The disparities observed between Lahore and Peshawar highlight the need for equitable healthcare delivery systems and standardized rehabilitation protocols.

## 6. Conclusion

### Summary of the Study

This study examined the clinical outcomes and functional recovery following Total Knee Arthroplasty (TKA) in patients with advanced knee osteoarthritis, with a comparative focus on Lahore and Peshawar. The findings demonstrate that TKA is an effective surgical intervention for reducing pain, improving joint mobility, and enhancing quality of life, which is consistent with global evidence on arthroplasty outcomes (Hu et al., 2024; Sjöström et al., 2025).

However, the study also highlights significant variation in postoperative recovery patterns between the two regions, indicating that surgical success alone does not guarantee uniform functional recovery.

### Key Findings of the Study

The major findings of this research can be summarized as follows:

- TKA significantly improves pain reduction, mobility, and functional independence in both Lahore and Peshawar patients.
- Patients in Lahore demonstrate better overall recovery outcomes compared to those in Peshawar.
- Physiotherapy adherence is a major determinant of successful functional recovery (Aftab et al., 2025).
- Regional disparities in healthcare infrastructure and rehabilitation services strongly influence recovery trajectories (Ahmed et al., 2024).

- Recovery is multifactorial and influenced by clinical, psychological, and socioeconomic factors (Khan et al., 2026).

### Conclusion of Research Objectives

All research objectives were successfully addressed:

- Clinical outcomes of TKA were found to be highly positive overall.
- Functional recovery was significantly faster in patients with better rehabilitation adherence.
- A clear difference was observed between Lahore and Peshawar healthcare settings.
- Key influencing factors included physiotherapy access, hospital infrastructure, and patient compliance.

### Theoretical Implications

The findings support the Biopsychosocial Model of Health, which explains recovery as a combination of biological (surgery), psychological (motivation, expectations), and social (healthcare access, rehabilitation support) factors. This model effectively explains the differences in recovery outcomes between Lahore and Peshawar patients.

### Practical Implications

The study has several practical implications for healthcare providers and policymakers:

- Standardized rehabilitation protocols should be implemented across all orthopedic centers.
- Early mobilization and physiotherapy should be mandatory after TKA.
- Patient education programs should be strengthened to improve compliance.
- Investment in rehabilitation infrastructure is essential in under-resourced regions such as Peshawar.
- Follow-up care systems should be improved to ensure long-term recovery monitoring.

### Policy Recommendations

To improve postoperative outcomes, the following policy actions are recommended:

- Development of national guidelines for post-TKA rehabilitation
- Expansion of physiotherapy services in public hospitals
- Training programs for rehabilitation specialists
- Integration of tele-rehabilitation systems in remote areas
- Strengthening healthcare equity between urban centers

These measures can help reduce regional disparities and improve overall orthopedic care outcomes in Pakistan.

### Limitations of the Study

This study has some limitations:

- Sample size was limited to two cities only
- Short- to mid-term follow-up data was primarily used
- Some variability in hospital record documentation
- Possible patient recall bias in qualitative responses

Future studies should include larger multi-center datasets and long-term follow-up periods.

### Future Research Directions

Future research should focus on:

- Long-term (5–10 year) prosthesis survival outcomes
- Impact of robotic-assisted TKA in developing countries
- Role of digital rehabilitation and telemedicine
- Psychological predictors of recovery after TKA
- National-level comparative orthopedic outcome studies

### Final Conclusion

Total Knee Arthroplasty is a highly effective intervention for advanced knee osteoarthritis, providing substantial improvements in pain relief and functional ability. However, recovery outcomes are not uniform and are strongly influenced by rehabilitation access, healthcare infrastructure, and patient-related factors. The comparative analysis between Lahore and Peshawar clearly demonstrates that regional disparities in healthcare delivery significantly affect postoperative recovery. Strengthening rehabilitation systems and ensuring equitable healthcare access are essential to improving outcomes across all populations.

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