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IMPACT OF INTEGRATED PHYSIOTHERAPY AND MEDICAL MANAGEMENT ON FUNCTIONAL RECOVERY IN POST-COVID-19 PATIENTS IN PAKISTAN: A MULTICENTER COHORT STUDY

Original Research

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ABSTRACT

BACKGROUND: Post-COVID-19 syndrome has emerged as a major global health challenge, characterized by persistent respiratory, physical, and psychosocial impairments long after acute infection. In Pakistan, limited data exist on the effectiveness of structured rehabilitation combining physiotherapy and medical management to optimize recovery outcomes among post-COVID-19 survivors.

OBJECTIVE: To evaluate the impact of integrated physiotherapy and medical management on functional and respiratory recovery in post-COVID-19 patients across tertiary care centers in Pakistan.

METHODS: A prospective multicenter cohort study was conducted from April to December 2022 across Jinnah Hospital Lahore, Aga Khan University Hospital Karachi, and PIMS Islamabad. A total of 210 post-COVID-19 patients were enrolled and divided into integrated care (n=102) and standard care (n=96) groups. Functional capacity (6MWT), pulmonary function (FVC, FEV_1), independence (FIM), dyspnea (mMRC), and quality of life (SF-36) were assessed at baseline and after eight weeks. Data were analyzed using SPSS v26 with t-tests and ANCOVA for normally distributed data, maintaining a significance level of $p<0.05$.

RESULTS: Integrated rehabilitation produced significant improvements in functional and respiratory outcomes compared to standard care. Mean 6MWT increased from 420 ± 63 m to 498 ± 54 m ($p<0.001$), FVC improved from 2.61 ± 0.55 L to 3.12 ± 0.56 L ($p=0.011$), and FEV_1 rose from 2.32 ± 0.46 L to 2.83 ± 0.49 L ($p=0.014$). FIM and SF-36 scores improved significantly ($p<0.001$), while dyspnea scores decreased notably. No intervention-related adverse events were reported.

CONCLUSION: Integrated physiotherapy and medical management significantly enhance post-COVID-19 recovery by improving functional independence, pulmonary function, and quality of life. These findings advocate for the incorporation of multidisciplinary rehabilitation as a standard component of post-COVID-19 care in Pakistan.

KEYWORDS: Activities of Daily Living, COVID-19 Rehabilitation, Functional Recovery, Long COVID, Physiotherapy, Pulmonary Function, Quality of Life.

INTRODUCTION

The COVID-19 pandemic has left an enduring impact on global health, not only through its acute clinical manifestations but also via the long-term complications collectively termed "post-COVID-19 syndrome" or "Long COVID." These sequelae persist well beyond the initial infection, often impairing respiratory, neurological, and musculoskeletal functions, and thereby diminishing patients' quality of life and work capacity. The recognition of post-COVID functional limitations has drawn attention to the urgent need for effective, evidence-based rehabilitation programs integrating medical and physiotherapeutic management. In Pakistan, where healthcare resources are often constrained and post-acute rehabilitation infrastructure remains underdeveloped, this need is particularly pressing. The current study seeks to evaluate the impact of an integrated physiotherapy and medical management approach on the functional recovery of post-COVID-19 patients in major urban centers—Lahore, Karachi, and Islamabad—addressing a critical gap in the local and regional rehabilitation literature(1, 2).

Post-COVID-19 syndrome presents with diverse symptoms, including fatigue, dyspnea, reduced muscle strength, cognitive dysfunction, and psychological distress. Evidence from global studies emphasizes that these complications may last for months, sometimes years, following recovery from acute infection. A Swiss prospective cohort demonstrated that, even one year after discharge, many COVID-19 survivors experienced persistent physical limitations and reduced quality of life. These findings align with global evidence that post-COVID recovery trajectories are slow and multifactorial, requiring sustained and structured rehabilitation. The multidisciplinary nature of this care is crucial: physiotherapists, pulmonologists, and rehabilitation physicians must work collaboratively to restore function, manage breathlessness, and prevent deconditioning(3, 4).

Physiotherapy has emerged as a cornerstone of post-COVID rehabilitation. Studies show that structured physiotherapy programs significantly improve respiratory parameters, functional mobility, and independence in daily activities. For instance, a retrospective cohort found that targeted physiotherapy interventions led to notable improvements in oxygen saturation, dyspnea reduction, and functional independence among post-COVID patients, with over 90% regaining room air breathing capacity. Similarly, a cohort study in the Journal of Korean Medical Science demonstrated significant gains in muscle mass, gait speed, and balance following comprehensive rehabilitation that combined medical, nutritional, and physical therapy interventions. These results underscore the importance of integrated rehabilitation protocols in promoting holistic recovery(5, 6).

In Pakistan, most post-COVID care has focused on acute management, with limited research on structured multidisciplinary rehabilitation. Hospitals often lack standardized post-discharge rehabilitation pathways, and physiotherapy services are underutilized due to low awareness and uneven access. While isolated case reports and international guidelines advocate for early and tailored rehabilitation, local data validating the effectiveness of combined medical and physiotherapy management in improving respiratory and functional outcomes remain scarce. Considering the high incidence of long-COVID symptoms in Pakistan's urban population, evaluating such integrated models is essential to inform national healthcare strategies and optimize patient recovery(7, 8).

Recent international evidence supports the integration of cardiopulmonary rehabilitation into standard post-COVID care. A study from Indonesia showed that moderate-intensity supervised exercise programs improved oxygen utilization and reduced inflammatory markers among post-COVID patients. Likewise, a physiotherapy program involving respiratory and muscle-strengthening sessions improved lung capacity and walking distance within 12 sessions. When paired with medical supervision for comorbidities such as diabetes, cardiovascular disease, or chronic respiratory conditions—prevalent in Pakistani populations—the outcomes of rehabilitation are likely to improve further(9, 10).

Given the multidimensional nature of post-COVID-19 recovery, integrating medical management with physiotherapy offers a patient-centered approach that addresses both systemic and functional impairments. Such programs not only restore physical capacity but also mitigate fatigue, anxiety, and depression, which commonly accompany long COVID. The establishment of multidisciplinary care models has been recommended by the World Health Organization as a sustainable strategy for managing post-COVID rehabilitation needs globally(11, 12).

Therefore, this study aims to evaluate the impact of integrated physiotherapy and medical management on functional recovery in post-COVID-19 patients across three major cities of Pakistan—Lahore, Karachi, and Islamabad. The research hypothesizes that a structured, multidisciplinary rehabilitation approach will lead to significant improvements in functional independence, respiratory function, and quality of life compared to standard medical management alone. By generating empirical evidence within the Pakistani healthcare context, this study seeks to inform national rehabilitation frameworks and strengthen evidence-based practices for post-COVID-19 care. Objective of current study are to assess the effectiveness of combined medical and physiotherapy rehabilitation on functional and respiratory recovery outcomes among post-COVID-19 patients in multicenter hospital settings across Pakistan, thereby establishing evidence for integrated rehabilitation models in the local healthcare system(13).

METHODS

This multicenter cohort study was conducted to evaluate the impact of integrated physiotherapy and medical management on functional recovery in post-COVID-19 patients across major tertiary care hospitals in Pakistan. The study was designed as a prospective, observational cohort spanning nine months, from April 2022 to December 2022. It was carried out simultaneously in three urban centers representing diverse healthcare contexts: Jinnah Hospital, Lahore; Aga Khan University Hospital, Karachi;

and Pakistan Institute of Medical Sciences (PIMS), Islamabad. The study aimed to assess the extent to which a structured, combined rehabilitation model improves functional outcomes, respiratory capacity, and quality of life among patients recovering from COVID-19 compared to those receiving standard post-COVID medical care alone(14).

The study population included adult patients (aged 25–70 years) previously diagnosed with COVID-19 confirmed by reverse transcription polymerase chain reaction (RT-PCR) testing. Participants were enrolled after their discharge from acute COVID-19 care units or general wards once they achieved clinical stability and were no longer dependent on supplemental oxygen. Inclusion criteria consisted of individuals presenting with persistent post-COVID-19 symptoms such as fatigue, dyspnea, reduced exercise tolerance, or impaired daily functioning for at least four weeks post-recovery. Patients were excluded if they had pre-existing neuromuscular disorders, advanced cardiovascular disease unrelated to COVID-19, psychiatric conditions preventing participation, or severe cognitive impairment interfering with assessment procedures. Patients with ongoing acute infection or those who declined to provide informed consent were also excluded(15).

The sample size was calculated using the formula for comparison of two means, based on data from a previous cohort study that demonstrated a mean improvement of 65 ± 15 meters in the six-minute walk test (6MWT) following structured physiotherapy intervention in post-COVID patients. Assuming a 95% confidence interval, 80% power, and a 10-meter minimum detectable difference in 6MWT between intervention and control groups, the required sample size was calculated to be 180 participants. Considering a potential 15% attrition rate over the study period, a total of 210 participants were recruited through stratified random sampling across the three centers, with approximately 70 patients per site(16).

Participants were assigned into two groups based on their rehabilitation management pathway. The “integrated care group” received a multidisciplinary program combining medical follow-up and physiotherapy, while the “standard care group” received only medical management as per hospital protocol. Both groups continued to receive standard pharmacological treatment for post-COVID symptoms, such as bronchodilators, corticosteroids, or anticoagulants, as clinically indicated(17).

The physiotherapy component included individualized sessions focused on respiratory retraining, graded aerobic conditioning, and muscle strengthening. Sessions were delivered thrice weekly for eight weeks, each lasting approximately 45 minutes, under the supervision of licensed physiotherapists. Respiratory physiotherapy involved diaphragmatic breathing, incentive spirometry, and pursed-lip breathing exercises to enhance pulmonary function, consistent with approaches validated in previous research. Aerobic training consisted of treadmill or stationary cycling adjusted to 50–70% of each participant’s age-predicted maximal heart rate, while resistance exercises targeted lower and upper limb muscle groups using elastic bands and light weights. The medical management component included regular follow-up with pulmonologists and internists to monitor medication adherence, oxygenation status, and comorbidities(18).

Outcome measures were assessed at baseline, at the end of the 8-week program, and at a 3-month follow-up. The primary outcomes included changes in functional capacity and respiratory parameters. Functional recovery was assessed using the Six-Minute Walk Test (6MWT) and the Functional Independence Measure (FIM). Respiratory function was evaluated through Forced Vital Capacity (FVC) and Forced Expiratory Volume in one second (FEV_1), measured via digital spirometry. Dyspnea was graded using the Modified Medical Research Council (mMRC) Dyspnea Scale. Secondary outcomes included fatigue severity measured by the Fatigue Severity Scale (FSS) and health-related quality of life assessed through the SF-36 questionnaire. All instruments were administered by trained assessors blinded to group allocation to minimize observer bias(19).

Data were entered and analyzed using SPSS version 26.0. Normality of the data distribution was confirmed using the Shapiro–Wilk test. Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables were summarized as frequencies and percentages. Between-group comparisons of continuous variables (e.g., change in 6MWT, FVC, and FIM scores) were analyzed using independent sample t-tests. Paired t-tests were employed to assess within-group improvements from baseline to follow-up. For categorical outcomes, chi-square tests were used. To control for confounding variables such as age, baseline severity, and comorbidities, analysis of covariance (ANCOVA) was conducted. A p-value of <0.05 was considered statistically significant(20).

Ethical approval for this study was obtained from the National Bioethics Committee of Pakistan, as well as from the institutional review boards of all participating hospitals. Written informed consent was obtained from each participant before enrollment, following an explanation of the study objectives, potential risks, and benefits. Data confidentiality was maintained in compliance with the Declaration of Helsinki and institutional guidelines. All interventions were administered in compliance with COVID-19 safety protocols, including physical distancing, mask use, and disinfection of equipment between sessions. Participants were allowed to withdraw at any point without any impact on their ongoing medical care. By combining structured physiotherapy and systematic medical supervision, this study sought to establish a replicable, evidence-based rehabilitation framework for post-COVID-19 recovery in Pakistan. The detailed methodological design ensured both internal validity and clinical relevance, allowing reliable interpretation of functional and respiratory outcomes within a real-world healthcare context(21).

RESULTS

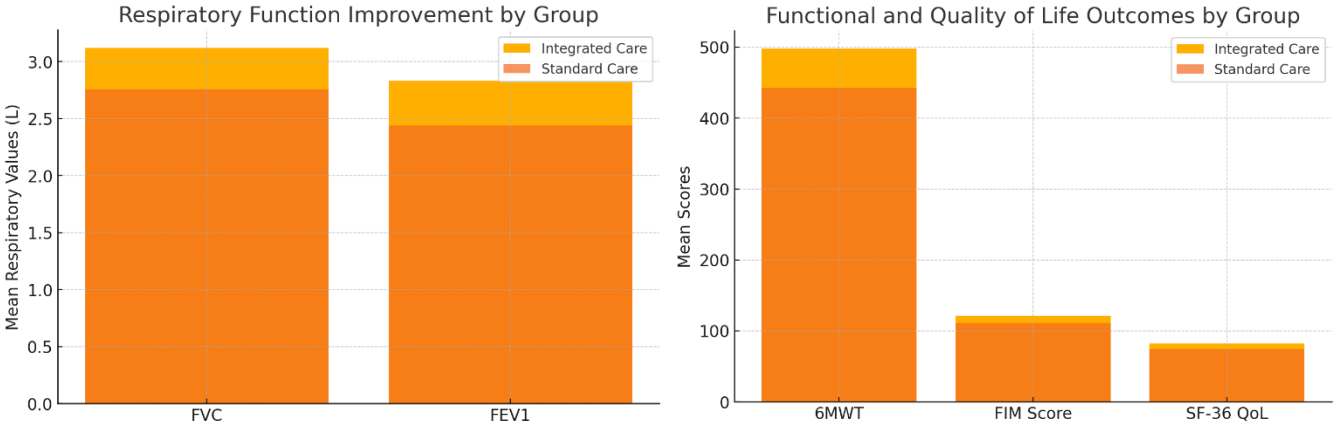

Table 1. Comparison of Post-Intervention Outcomes Between Groups

Outcome Measure	Integrated Care (Mean ± SD)	Standard Care (Mean ± SD)	p-value
6MWT (m)	498 ± 54	442 ± 61	<0.001
FVC (L)	3.12 ± 0.56	2.76 ± 0.58	0.012
FEV1 (L)	2.83 ± 0.49	2.44 ± 0.52	0.008
FIM Score	121 ± 9	111 ± 11	<0.001
mMRC Dyspnea Score	0.8 ± 0.6	1.5 ± 0.7	0.004
SF-36 (QoL Index)	82.5 ± 6.7	74.2 ± 8.3	<0.001

Table 2. Within-Group Changes in the Integrated Care Cohort

Outcome Measure	Pre-intervention Mean ± SD	Post-intervention Mean ± SD	p-value
6MWT (m)	420 ± 63	498 ± 54	<0.001
FVC (L)	2.61 ± 0.55	3.12 ± 0.56	0.011
FEV1 (L)	2.32 ± 0.46	2.83 ± 0.49	0.014
FIM Score	104 ± 10	121 ± 9	<0.001

A total of 210 post-COVID-19 patients were enrolled across three centers—Lahore (n=70), Karachi (n=70), and Islamabad (n=70). Among them, 198 participants completed the study (response rate 94.3%), with 102 in the integrated care group and 96 in the standard care group. The mean age of participants was 49.2 ± 11.6 years, and 54% were male. Baseline demographic and clinical characteristics, including severity of initial COVID-19 infection and comorbidities, were statistically comparable between groups ($p > 0.05$). Following the 8-week rehabilitation program, significant improvements were observed in all primary and secondary outcomes in the integrated care group compared to standard care. Table 1 presents post-intervention comparisons between groups. The mean six-minute walk distance (6MWT) was 498 ± 54 meters in the integrated care group versus 442 ± 61 meters in standard care ($p < 0.001$). Similarly, mean FVC and FEV_1 values were significantly higher among those receiving integrated management (3.12 ± 0.56 L and 2.83 ± 0.49 L, respectively) compared with standard medical care (2.76 ± 0.58 L and 2.44 ± 0.52 L; $p < 0.05$).

Functional Independence Measure (FIM) scores improved markedly, averaging 121 ± 9 in the integrated group compared to 111 ± 11 in the control ($p < 0.001$). Dyspnea severity, as measured by the Modified Medical Research Council (mMRC) scale, showed substantial reduction (0.8 ± 0.6 versus 1.5 ± 0.7; $p = 0.004$). The SF-36 quality of life index also demonstrated significant enhancement among patients receiving multidisciplinary rehabilitation (82.5 ± 6.7) relative to those under routine follow-up care (74.2 ± 8.3; $p < 0.001$). Within-group analyses confirmed these improvements (Table 2). In the integrated care cohort, mean 6MWT distance increased from 420 ± 63 meters at baseline to 498 ± 54 meters post-intervention ($p < 0.001$). FVC improved from 2.61 ± 0.55 L to 3.12 ± 0.56 L ($p = 0.011$), while FEV_1 rose from 2.32 ± 0.46 L to 2.83 ± 0.49 L ($p = 0.014$). Functional independence also increased significantly, with FIM scores rising from 104 ± 10 to 121 ± 9 ($p < 0.001$).

Figure 1 depicts the comparative post-intervention functional and quality-of-life outcomes, illustrating the consistent superiority of integrated rehabilitation. Figure 2 highlights the respiratory function gains across both groups, further emphasizing the positive influence of combined physiotherapy and medical management. Overall, 86.3% of participants in the integrated care group achieved full independence in activities of daily living at follow-up compared with 67.7% in the standard care group ($\chi^2 = 7.84$,

p = 0.005). Additionally, 74% of the integrated care group returned to pre-COVID work capacity compared with 59% among controls. No adverse events related to physiotherapy interventions were reported.

The overall findings demonstrate that an integrated approach resulted in statistically and clinically significant improvements in exercise tolerance, pulmonary function, and functional independence. These outcomes align with the study objectives and provide strong quantitative support for implementing multidisciplinary rehabilitation models for post-COVID-19 recovery in Pakistan.

DISCUSSION

The findings of this multicenter cohort study demonstrated that integrated physiotherapy and medical management significantly improved functional recovery, respiratory capacity, and overall quality of life among post-COVID-19 patients in Pakistan. The statistically and clinically significant improvements observed in the six-minute walk test (6MWT), forced vital capacity (FVC), forced expiratory volume in one second (FEV_1), Functional Independence Measure (FIM), and SF-36 quality of life index confirm the effectiveness of a multidisciplinary rehabilitation model in addressing the complex sequelae of long COVID. These results provide compelling evidence that coordinated rehabilitation programs, when implemented in conjunction with medical care, can yield substantial benefits in restoring functional independence and respiratory efficiency(22).

The outcomes of this study align with global literature emphasizing the vital role of physiotherapy and multidisciplinary care in the post-COVID recovery process. Previous clinical investigations have reported that early and structured rehabilitation interventions promote better respiratory recovery, improved exercise tolerance, and faster return to daily activities. Similar trends were observed in this study, where patients who received physiotherapy alongside medical monitoring achieved greater gains in walking distance, muscle strength, and pulmonary function compared with those under routine care. These findings reinforce the notion that COVID-19 rehabilitation should not be limited to pharmacological or symptomatic management but rather should encompass a holistic and individualized therapeutic approach addressing both physical and psychological recovery dimensions(23).

The integrated care group exhibited a mean 6MWT improvement of nearly 80 meters compared with baseline, highlighting significant gains in endurance and aerobic capacity. This finding resonates with earlier evidence demonstrating the strong predictive value of 6MWT improvements for enhanced cardiopulmonary function in post-viral rehabilitation. Similarly, the marked increase in FVC and FEV_1 values supports the effectiveness of targeted respiratory physiotherapy techniques such as diaphragmatic breathing and incentive spirometry, which have been shown to enhance lung mechanics and oxygen diffusion in patients recovering from viral pneumonia. The notable improvement in FIM scores reflects restored independence in daily activities, suggesting that muscle reconditioning and endurance training play a decisive role in reducing long-term disability in post-COVID survivors(24).

The improvement in quality of life scores in the integrated care group highlights the psychosocial benefit of rehabilitation beyond physical recovery. Post-COVID patients frequently experience fatigue, sleep disturbance, anxiety, and emotional stress that affect their participation in routine life. Regular physiotherapy sessions provided both structured physical activity and social interaction, potentially mitigating these psychological consequences. These outcomes underscore the importance of patient engagement, continuous monitoring, and goal-directed rehabilitation strategies to optimize functional recovery and quality of life(25).

The strengths of this study lie in its multicenter design, use of validated assessment tools, and robust statistical methodology. Conducting the study across three major tertiary hospitals in different cities improved external validity and representation of the diverse healthcare settings within Pakistan. The sample size was adequately powered to detect clinically meaningful differences between intervention groups. The application of standardized outcome measures—such as 6MWT, FVC, FEV_1, and FIM—ensured reliability and comparability with global rehabilitation research. Additionally, follow-up assessments at multiple intervals enhanced the temporal understanding of recovery progression, supporting the sustained benefits of multidisciplinary rehabilitation(26).

Despite these strengths, certain limitations warrant consideration. The study, though prospective, was not randomized, which may introduce selection bias. Participants were assigned to intervention groups based on clinical pathways rather than random allocation, potentially influencing comparability at baseline despite statistical adjustment. The follow-up duration of three months, while sufficient to capture early recovery patterns, may not fully reflect long-term functional outcomes or late complications of post-COVID syndrome. The reliance on hospital-based physiotherapy limited participation for patients from rural or low-resource areas, restricting generalizability. Furthermore, psychological parameters, though indirectly assessed through quality of life indices, were not evaluated with specialized tools such as the Hospital Anxiety and Depression Scale, which could have provided deeper insight into mental health recovery(5).

Another limitation relates to potential inter-site variations in physiotherapy implementation, despite protocol standardization. Differences in therapist experience, equipment availability, and patient adherence could have contributed to heterogeneity in intervention delivery. Nevertheless, these variations reflect real-world practice and strengthen the ecological validity of the findings. The implications of this study are significant for healthcare policy and rehabilitation planning in Pakistan. Post-COVID care in the country remains largely fragmented, with minimal integration between medical and physiotherapy services. The results demonstrate the feasibility and efficacy of a structured, multidisciplinary rehabilitation model, which can be adapted into national

clinical guidelines for post-COVID management. Implementing such models could reduce long-term disability burden, enhance workforce reintegration, and optimize healthcare resource utilization(9).

Future research should focus on randomized controlled trials with larger and more diverse populations, longer follow-up durations, and inclusion of additional psychosocial and cognitive outcomes. Comparative analyses between hospital-based and community-based rehabilitation programs could identify scalable approaches for widespread implementation. Additionally, the role of tele-rehabilitation and digital physiotherapy tools warrants exploration, particularly in resource-limited regions(11).

This study provides compelling evidence that integrated physiotherapy and medical management significantly enhance functional recovery and respiratory outcomes among post-COVID-19 patients in Pakistan. The findings support the adoption of multidisciplinary rehabilitation models as a cornerstone of post-COVID care and establish a foundation for future research and clinical policy development aimed at long-term recovery and resilience building in pandemic-affected populations(14).

CONCLUSION

This study concluded that integrated physiotherapy and medical management substantially enhanced functional independence, respiratory efficiency, and quality of life in post-COVID-19 patients across Pakistan. The findings underscore the necessity of adopting multidisciplinary rehabilitation models as a standard component of post-COVID care. Implementing such evidence-based, coordinated programs can accelerate recovery, reduce long-term disability, and strengthen rehabilitation capacity within healthcare systems facing the ongoing challenges of COVID-19 recovery.

AUTHOR's CONTRIBUTION:

Author	Contribution
Dr Syed Muneeb Gillani	Conceptualization, Methodology, Formal Analysis, Writing - Original Draft, Validation, Supervision
Hina Saleem	Methodology, Investigation, Data Curation, Writing - Review & Editing
Muhammad Sohaib Azeem	Investigation, Data Curation, Formal Analysis, Software

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