Effect of Inpatient Physiotherapy Reconditioning Program on Pain, Functional Mobility and Spinal Muscle Performance in Prolonged Bedridden Patients : A Comparative Study

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KEYWORDS

Activities of daily living, Atrophy, Functional mobility, Muscle weakness, Pressure ulcer.

ABSTRACT

Background: Immobilization for prolonged duration can cause severe complications. The study evaluates the impact of reconditioning program on pain levels, functional mobility and spinal muscle performance in prolonged bedridden patients.**Objective:** The study aimed to evaluate the impact of a reconditioning program on pain, functional mobility and spinal muscle performance in patients with immobilization for long time.**Methods**: The study included one hundred and six participants of 35-55 age group with lower limb injuries, such as fractures of the femur, tibia, and fibula. Subjects were randomly assigned to either a conventional treatment group (Group A) or an experimental exercise program group (Group B). Both groups underwent treatment for four weeks, and data analysis utilized a paired t-test for within group analysis and unpaired t-test for between group analysis.**Results:** Both groups A and B showed significant difference in all the three outcome measures but group B showed extremely significant improvement (<0.0001) in the outcome measures taken i.e. pain, lumbar strength by manual muscle testing, functional mobility by Functional Independence Measure Scale than group A. **Conclusion:** Both conventional and experimental reconditioning programs effectively enhanced muscle strength, functional mobility and reduced pain levels in prolonged bedridden patients. However, the experimental group (Group B) showed a more pronounced impact on pain reduction and improvement in lumbar flexor, rotator and extensor muscle strength, functional mobility compared to the conventional treatment group (Group A).

INTRODUCTION

In a hospital setting, deconditioning is characterized by inactivity stemming from prolonged bedrest and extended periods of sitting. Among the elderly population, this deconditioning results in a discernible decline in functional abilities due to physiological changes across various body systems. One previous study stated that patients discharged from hospitals frequently depend on continuous medication and may experience limitations in independent walking or driving, leading to reliance on others.[1]

Acute hospitalization occured due to accidents, traumas can exert significant stress on older adults, resulting in prolonged bedrest, nutritional deficits, and sleep disturbances. Extended hospital stays may lead to a decline in muscle mass, cognitive function, muscle strength, and activities of daily living.[2] Immobilization for prolonged periods is associated with detrimental physiological changes across various body systems, disrupting the body's mechanisms and resulting in severe consequences. Notably, bedrest or immobilization can contribute to spinal muscular atrophy, contractures, muscle loss, and pressure sores. Extended periods of

immobility can also cause alterations in trunk and spinal structures, affecting spinal stability.[3,4]

Prolonged immobility during bedrest has significant effects on the musculoskeletal system. Firstly, it leads to rapid reductions in skeletal muscle mass, emphasizing the importance of maintaining muscle function during immobilization. Low-load endurance training is ineffective for preserving muscle mass; higher resistance training is recommended.[4]

In an adult population, extended bedrest leads to a significant decline in functional status. Between 30% and 55% of older patients experience a decline in daily living activities, and up to 65% show decreased ambulatory function during hospitalization. Physical inactivity or bedrest is a major contributor to functional impairment in older hospitalized patients, often leading to transfer difficulties, including challenges with getting in and out of bed and chairs. Acute illness or hospitalization exacerbates these difficulties. Bed mobility exercises can facilitate transfer activities, thereby reducing complications like muscle atrophy and wasting.[5]

Ambulation of a bedridden patient is always an important concern, as it involves the prevention of many future complications. Task-specific training will improve mobility and thereby reduce pain. Specifically, bed-to-chair transfer tasks will help the patient get up from bed or chair, improving various outcomes such as pain, range of motion, balance, and muscle strength. This will help prevent further complications.[6]

Reduced mobility range, low manual muscle testing (MMT) grades, and environmental factors stemming from substandard infrastructure contribute significantly to falls, resulting in injuries, fractures, muscle pain, and prolonged bedrest. Core muscular strength is an important factor for individuals who are bedridden for extended periods. The lumbar spine muscles, including the quadratus lumborum, erector spinae, hip musculature, diaphragm, and pelvic floor muscles, collectively form the core. Prolonged bedrest can lead to atrophy of spinal extensor muscles, such as the multifidus, and hypertrophy of flexor muscles, like the abdominal muscles and psoas. Postural muscles, including the latissimus dorsi and abdominal muscles, often undergo atrophy during bedrest, and these effects can last for a long time, increasing the risk of complications.[7]

Complications due to immobilization include pressure sores, deep vein thrombosis, pneumonia, urinary tract infections, muscle weakness, and wasting. Research has demonstrated that immobility-related issues contribute to increased morbidity, mortality, extended hospital stays, and higher healthcare costs.[8]

Purpose :

A specific core strengthening program can enhance dynamic postural control, optimize muscle balance, and improve joint arthrokinematics in the lumbopelvic hip complex.[8,9] Consistent exercise has been scientifically proven to reduce hospital stays, enhance overall fitness, and improve the quality of life for patients. Individualized care, close monitoring, and consultation with healthcare professionals are essential to tailor rehabilitation programs based on each patient's specific needs and medical condition.[10,11]

The central research question revolves around assessing the impact of this exercise regimen on pain levels, functional mobility, and spinal muscle performance in patients who have been bedridden for an extended period. Addressing this gap in the literature could provide valuable insights for improving rehabilitation strategies for these individuals.

MATERIALS AND METHODS

Ethics statement

The study received approval from the Institutional ethical committee of XXX (Ref. No. 03/2015-2016).

Study design and setting

This was a comparative study that included a pre- and post-test design. One hundred and six hospitalized patients were included in this study. Out of 106, six participants were dropped out

of the study for some reasons. So, out of 100, Group A was considered as a conventional group who were given regular hospital-acquired treatment protocol (Bed mobility exercise group) to 50 participants while Group B was considered as an experimental group (Reconditioning program) to 50 participants. Written consent was obtained before the start of study and the procedure of the study was explained to each group, respectively. A pre-test assessment as per the outcomes was done. An exercise program was implemented to both groups and then outcome assessment was done to record the post-test values.

Sample size calculation was done by using this formula : $4pq/L^2$ (p=positive factor/prevalence/proportion , q=100-p , L= Allowable error)

Participants

Patients who were immobilized for long time because of traumatic injuries for more than 2 weeks were screened according to criteria for inclusion and exclusion. Participants were informed about the aim and procedure of research study and included the subjects who have undergone road traffic accidents had lower limb injuries because of trauma such as tibia, fibula, and femur fractures aged 35 to 55 years of males and females, were categorized as overweight and obese. Subjects with comorbidities like hypertension, diabetes or both. Subjects with any form of chronic disease, any psychological illness previously, cardiovascular disease, respiratory failure, unconsciousness, severe comminuted fractures, or numerous fractures were not included as a part of study. The study included 100 participants. Allocation of the groups was done using the lottery method. The subject randomly picked up a chit with each number corresponding to the group. The individuals were subsequently allotted into 2 groups, viz. Group A (Bed Mobility exercises) and group B (Reconditioning program) with 50 participants in each group. The study duration was 4 weeks for this research.

Data collection tools:

The Visual Analog Scale (VAS) for pain and Manual Muscle Testing (MMT) were utilized to evaluate the strength of spinal flexors, extensors, and rotators, as well as back extensor.

Outcome Measures

Visual Analog Scale (VAS): The Visual Analog Scale is a simple and effective tool for assessing pain. It consists of a straight horizontal line, typically 10 cm in length. The scale ranges from 0 (no pain) on the left end to 10 (severe pain) on the right end, representing the extreme limits of pain perception.[11]

Manual Muscle Testing (MMT): MMT is widely used for documenting muscle strength impairments. During MMT, the examiner applies force against the subject's resistance to evaluate the strength of various muscle groups. Muscle strength is subjectively graded on a 5-point scale ranging from "weak" to "strong".[12]

Functional Independence Measure Scale: This scale consists of measures of independence in self-care (activities like eating, grooming, bathing, dressing), sphincter control (bladder and bowel management), transfers (from bed, chair, wheelchair, toilet, tub, shower), locomotion (walking or wheelchair use, stair climbing), communication (comprehension and expression), and social cognition (social interaction, problem-solving, memory). It comprises a total of 18 items. Each item is scored on a scale of 7 points. A higher score indicates greater independence, while a lower score indicates the need for more assistance. According to the score, there are three levels of categorization: complete dependence, modified dependence, and independence.[13]

Procedure :

The total duration of the exercise program was 4 weeks. The exercise program for Group A started with basic bed mobility exercises, which included breathing exercises. Two different types of breathing exercises were included: diaphragmatic breathing and pursed lip breathing,

performed five times before and at the end of the session. Following this, participants engaged in arms crossed sitting for five repetitions a day, five times a week, promoting upper body stability. Next, supine chest stretches with elbows bent were performed five times daily across the week. Transitioning to the supine-to-sit task, participants executed ten repetitions each day, five days a week, focusing on core and lower body strength.The supine alternating shoulder flexion followed, with ten repetitions per day for five days, fostering shoulder mobility and stability. Ankle toe movements further improved lower body mobility and circulation, executed with twenty-five repetitions three times a day. Finally, static abdominals, performed five times daily across the week, enhanced core stability.[14,15]

Group B included a regimen consisting of a range of exercises aimed at enhancing both physical and respiratory function. Starting with fundamental breathing exercises such as diaphragmatic breathing and pursed lip breathing, individuals engaged in these techniques five times at the start and end of each session, promoting relaxation.[15] The Active Cycle of Breathing Technique (ACBT) was then employed to aid in loosening and clearing secretions from the lungs, thereby reducing the risk of chest infections. This technique involves three key phases: breathing control, deep breathing exercises or thoracic expansion exercises, and huffing or forced expiratory technique.[16] Exercises designed to improve spinal mobility included abdominal curl-ups and core stability exercises such as tummy tucks and the drawing-in manoeuvre, performed five times per day, five times a week. Additionally, lifting one arm and lifting one leg while in a supine position were performed five times per day, five times a week.[17] Modified bed aerobics, postural training, and activity pacing further contributed to comprehensive rehabilitation. Chair-based activities such as sit-to-stand manoeuvres and leg lifts were incorporated to enhance strength and mobility, performed five times a day, five times a week. Together, these exercises formed a structured regimen tailored to promote respiratory health, spinal mobility, and overall functional capacity.

Statistical analysis

The data were entered into an excel sheet and paired t-test was used to analyse the data for pre and post assessment of the group. Unpaired t-test was used for between group analysis. Continuous data were expressed as mean with standard deviation or median, and differences between the two groups were compared. Statistical analysis of recorded data was done using software SPSS version 26.

RESULTS

Table 1 demonstrates all the demographic data consists of age, gender, working status, habits, obesity, population, comorbidities associated with the patients. The study includes age group of 35-45 years (55 %) and 46-55 years (45.0%). The study includes both males (61%) and females (39%). It consists of both working (65 %) and non-working population (35%). Also while noting the history, number of habits included were, Masheri (25%), tobacco(16%) and smoking(13%) and patients with no habits were (46%). Obesity was considered as one of the important demographic variable. Overweight patients (38 %) and Obese (62%). Two groups were included, urban (46.0%) and rural(54%). Patients included with various comorbidities like hypertension (30%), diabetes (22%), both of them(16%) and none of them (32%)

Table 2 states about pre and post values of visual analogue scale for group A and B. For group A, VAS (at rest) post p value was <0.0032 and VAS (On activity) post p value was 0.0014. For group B, VAS (at rest) and VAS (On activity) post p value was <0.0001 which is considered as extremely significant.

Table 3 states the muscle strength of lumbar flexors and rotators. Post treatment p value of group A were 0.0240 and 0.0214 for lumbar flexors and rotators. Post treatment p value of group B were <0.0001 for both lumbar flexors and rotators.

Table 4 demonstrates about the assessment regarding activities of daily living by functional independence measure scale. It interpreted that both the groups had improvement in the post

phase of assessment but the mean difference of group B (39.48) was higher than group A (22.12).

Table 5 demonstrates the between group analysis (post-test values) for the 3 outcome measures taken. P value for pain (at rest) and (on activity) was <0.0001. For lumbar flexors strength, p value was 0.0004. For rotators, p value was 0.0188 and for lumbar extensors, it was <0.0001. As per the analysis, it was evident that there was a significant difference between post assessment values of both the groups.

DISCUSSION

The objective of the research study was to evaluate the impact of a reconditioning program on pain, functional mobility, and spinal muscle performance in patients experiencing prolonged immobilization. A total of one hundred subjects were divided into two groups: Group A underwent bed mobility exercises, while Group B participated in a comprehensive reconditioning program. There was extremely significant improvement in Group B compared to Group A.

Extended periods of bed rest, which can last from days to months, are often necessary after major medical procedures, particularly However, prolonged immobilization can lead to significant changes in postural stability and trunk strength, affecting daily activities during the post-hospitalization period. Core stabilization plays an important role in maintaining spinal integrity and facilitating efficient lower limb movement. Additionally, extended bed rest contributes to overall muscular weakness and reduced physical activity levels. Previous research by SR Jagdish Bhai et al. highlighted the importance of physiotherapy in promoting early ambulation and enhancing muscle strength among postoperative patients recovering from proximal femur fractures with dynamic hip screw and plate fixation. These findings underscore the significance of tailored rehabilitation programs for patients experiencing prolonged bed rest.[18]

Muscular weakness, particularly in the spinal extensors, significantly increases the risk of spinal deformities and fractures, especially among postmenopausal women with osteoporosis.[19] Research studies conducted by Sarabon N; Rosker J have underscored the detrimental effects of prolonged bed rest on trunk stability. These studies emphasize the critical role of dynamic trunk-stabilizing exercises in mitigating these adverse effects.[20]

As per the previous study, it was stated that in-hospital mobility is important for bedridden patients. It not only recovers the patient but also it will help the patient to return to the baseline functional status which was present previously. So, it will help the patient to improve in activities of daily living.[21]

Furthermore, a systematic review focused on physical rehabilitation programs for bedridden patients undergoing extended immobilization revealed a range of exercise interventions. These interventions targeted musculoskeletal, neurological, and cardiovascular domains, all aimed at enhancing the overall quality of life for these individuals.[22]

Elderly populations are particularly vulnerable to muscle function loss due to age-related declines in strength. Research advocating for strength training programs administered over a 12-week period, three times weekly, has demonstrated their effectiveness in facilitating recovery among bedridden patients.[23] Additionally, Kortebein P et al. research highlighted significant declines in muscle function, strength, and aerobic capacity after just 10 days of bed rest among healthy older adults. These findings underscore the urgency of mobility-promoting interventions in maintaining overall health and muscle function.[24]

Another study conducted by Yen-Huey Chen et al. investigated the impact of exercise intervention on patients with prolonged mechanical ventilation, focusing on functional status and pulmonary mechanics. The study population consisted of 27 subjects, divided into two groups. The training group underwent muscle stretching, strengthening, and cardiopulmonary endurance training, while the control group received treatment without exercise training. The

results indicated that exercise training led to improved hospital outcomes and enhanced overall quality of life.[25]

The present study acknowledges certain limitations, including a relatively small sample size and limited geographic diversity. As a result, there are opportunities for broader research that includes diverse populations, varied outcome measures, and broader geographical representation to enhance the generalizability of findings.

Conclusion:

Based on the interpretation of the results, both bed mobility exercises and the reconditioning program demonstrated improvements in all four outcome measures. Notably, the reconditioning program was more effective, with the mean difference being higher than Group A in all outcomes. It was more effective in reducing pain during activity ($p < 0.0001$) compared to bed mobility exercises. Group B exhibited extremely significant improvement in lumbar flexor and rotator muscle strength as well as lumbar extensor strength ($p < 0.0001$) when compared to Group A. For the FIMS assessment, both Group A and Group B exhibited significant improvement ($p < 0.0001$). Consequently, while both groups showed positive outcomes, Group B demonstrated more substantial improvement in prolonged bedridden patients than Group A.

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TABLES

Table 1. Demographic variables

DEMOGRAPHIC VARIABLES	CATEGORY	PERCENTAGE	NO. OF PARTICIPANTS
Age	35-45 yrs	55%	55
	46-55 yrs	45%	45
Gender	Male	61%	61
	Female	39%	39
Working status	Workers	65%	65
	Non workers	35%	35
Habits	Masheri	25%	25
	Tobacco	16%	16
	Smoking	13%	13
	None	46%	46
Obesity	Overweight	38%	38
	Grade 1 Obese	62%	62
Population	Urban	46%	46
	Rural	54%	54
Comorbidities	Hypertension	50%	50
	Diabetes	32%	32
	Both of these	18%	18

Table 2. Visual Analogue Scale

VAS (at rest)	Pre test	Post test	P value
Group A	3.19 ±0.3943	2.67 ± 0.8535	0.0001
Group B	3.04 ± 1.310	2.29 ± 0.4560	<0.0001
VAS (on activity)	Pre test	Post-test	p-value
Group A	7.72±0.1279	3.78±0.1379	0.0014
Group B	7.66 ± 1.196	2.155 ± 0.839	<0.0001

VAS,Visual Analogue Scale ;Values are presented as mean ± standard deviation

Table 3. Manual Muscle Strength testing of lumbar flexors and rotators

MMT (Lumbar)	Pre -test	Post – test	p-value
Flexors : Group A	3.11 ± 0.8633	3.46 ± 1.534	0.0240
Group B	3.01 ± 1.159	4.08 ± 0.8000	<0.0001
Extensors : Group A	2.92±0.6952	3.32±0.8437	0.0007
Group B	2.96±0.7273	4.58±0.4986	<0.0001
Rotators : Group A	3.14 ± 0.4025	3.29 ± 0.4560	0.0214
Group B	3.08 ± 0.4645	3.56 ± 0.6563	0.0001

MMT, Manual Muscle Testing

Table 4. Functional Independence Measure Scale Assessment

FIMS assessment	PRE (MEAN±SD)	POST (MEAN±SD)	P -value
Group A	78.26 ± 2.473	100.38± 2.276	<0.0001
Group B	77.94 ± 2.436	117.78 ± 1.877	<0.0001

FIMS, Functional Independence Measure Scale

Table 5. Between group analysis (post- values) for all the 4 outcome measures

Post-test values	Group A	Group B	P value
Pain (at rest)	2.67 ± 0.8535	2.29 ± 0.4560	<0.0001
Pain (On activity)	3.78±0.1379	2.155 ± 0.839	<0.0001
Lumbar strength (Flexors)	3.46 ± 1.534	4.08 ± 0.8000	0.0004
(Rotators)	3.29 ± 0.4560	3.56 ± 0.6563	0.0188
Lumbar extensor strength	3.32±0.8437	4.58±0.4986	<0.0001
FIMS assessment	100.38± 2.276	117.78 ± 1.877	<0.0001