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Impact of Structured Physiotherapy Rehabilitation on Muscle Strength and Functional Capacity in Children with Acute Malnutrition Admitted to a Nutrition Rehabilitation Centre

Dr. Anjali Mehta (PT)[1], Dr. Reshma Khurana (PT)[2]

[1]Research Scholar, Index Department of Physiotherapy and Paramedical Sciences, Malwanchal University, Indore, Madhya Pradesh, India

[2]Principal at Index Department of Physiotherapy and Paramedical Sciences, Malwanchal University, Indore, Madhya Pradesh, India

Abstract: ***Background: Acute malnutrition during the preschool years is associated with significant skeletal muscle wasting, reduced neuromuscular activation, and delayed gross motor function. While nutritional rehabilitation restores metabolic balance and body weight, recovery of muscle strength and functional motor performance may remain incomplete without structured physical rehabilitation. Objective: To evaluate the effectiveness of a six-week structured physiotherapy rehabilitation program on muscle strength and gross motor function in children aged 3–5 years diagnosed with acute malnutrition and admitted to a Nutrition Rehabilitation Centre (NRC). Methods: A randomized controlled trial was conducted on 100 children aged 3–5 years with moderate or severe acute malnutrition according to WHO criteria. Participants were randomly allocated into intervention The intervention group received structured physiotherapy sessions for 35 minutes per day, five days per week, for six weeks. Outcome measures included Manual Muscle Testing (MMT) and Gross Motor Function Measure (GMFM). Statistical analysis was performed using paired and independent t-tests with significance set at $p < 0.05$. Results: Post-intervention findings demonstrated statistically significant improvements in muscle strength and gross motor function in the Malnourished children. MMT scores improved by 72% from baseline, while GMFM scores increased by 54% following six weeks of rehabilitation. Conclusion: Structured physiotherapy integrated into NRC care significantly enhances muscle strength and gross motor function in malnourished preschool children. Incorporating rehabilitation strategies into routine nutritional management protocols may accelerate physical recovery and promote functional independence.***

Keywords: Acute malnutrition, Physiotherapy rehabilitation, GMFM, Muscle strength, Preschool children, Nutrition Rehabilitation Centre

1. Introduction

Malnutrition remains a significant global health burden, particularly in low- and middle-income countries. Acute malnutrition, characterized by wasting and rapid weight loss, disproportionately affects children under five years of age. In preschool children aged 3–5 years, malnutrition interferes with rapid growth phases and neuromuscular development, resulting in long-term functional deficits.[1]

The musculoskeletal system is profoundly affected by inadequate nutritional intake. Protein-energy deficiency leads to muscle fibre atrophy, decreased cross-sectional area, reduced force generation capacity, and impaired motor coordination. In addition to muscular weakness, children often present with poor balance, reduced endurance, delayed locomotor skills, and limited participation in age-appropriate play activities.[2,5]

Nutrition Rehabilitation Centres (NRCs) provide structured medical and dietary management for children with moderate and severe acute malnutrition. Although therapeutic feeding improves anthropometric parameters, restoration of muscle strength and gross motor function requires active neuromuscular stimulation. [7]Research in paediatric rehabilitation suggests that structured physiotherapy enhances motor learning, improves neuromuscular recruitment, and stimulates muscle hypertrophy through repetitive task-oriented practice.[3]

Despite these benefits, physiotherapy services are not consistently incorporated into NRC management protocols. There remains limited empirical evidence evaluating the direct impact of structured physiotherapy interventions on muscle strength and gross motor function in malnourished preschool children.

This study aims to determine whether a six-week structured physiotherapy rehabilitation program can significantly improve muscle strength and gross motor function in children aged 3–5 years admitted to an NRC for acute malnutrition.

2. Materials and Methods

Study Design
A prospective randomized controlled trial (RCT) with a pre-test and post-test experimental design was conducted to evaluate the effectiveness of a structured physiotherapy rehabilitation program on muscle strength and gross motor function in children with acute malnutrition.

Participants were randomly allocated into:
- Intervention Group (n = 50) – Received structured physiotherapy along with standard nutritional rehabilitation
- Control Group (n = 50) – Received standard nutritional rehabilitation only

Randomization was performed using computer-generated random numbers in SPSS.

Study Setting
The study was conducted at Nutrition Rehabilitation Centre (NRC), Kilkari – Amaltas Hospital, Banger, Dewas, Madhya Pradesh, India.

The NRC provides inpatient nutritional management for children diagnosed with Moderate Acute Malnutrition (MAM) and Severe Acute Malnutrition (SAM) according to WHO criteria.

Sample Size
Total Sample Size = 100 children
Sample size was calculated using power analysis in SPSS with:
- Power $(1 - \beta) = 0.80$
- Alpha $(\alpha) = 0.05$
- Expected large effect size $(d \geq 0.8)$

The calculated minimum sample required per group was 45. Considering 10% attrition, 50 children were recruited per group.
Participants

Inclusion Criteria
- Children aged 3–5 years
- Diagnosed with Moderate or Severe Acute Malnutrition (WHO growth standards)
- Medically stable for participation in exercise
- Written informed consent from parent/guardian

Exclusion Criteria
- Diagnosed neuromuscular disorders
- Congenital musculoskeletal anomalies affecting motor function
- Severe cardiopulmonary instability
- Acute medical conditions contraindicating exercise

Outcome Measures
a) Manual Muscle Testing (MMT)

Muscle strength was assessed using standardized paediatric Manual Muscle Testing (0–5 grading scale).

b) Gross Motor Function Measure (GMFM-88)

Gross motor function was assessed using the GMFM-88 scale, evaluating five domains:
- Lying & Rolling
- Sitting
- Crawling & Kneeling
- Standing
- Walking, Running & Jumping

Scores were converted into percentage totals.

Higher scores indicated better functional performance. [4]

Intervention Protocol
Duration -6 weeks
Frequency- 5 sessions per week

Session Duration- 30–35 minutes

Phase 1: Neuromuscular Activation (Week 1–2)
- Assisted active range movements
- Trunk stabilization exercises
- Postural correction activities
- Sensory-motor facilitation

Phase 2: Progressive Strengthening (Week 3–4)
- Sit-to-stand repetitions
- Squat-to-stand exercises
- Step-up activities
- Play-based resistance tasks
- Functional weight-bearing exercises

Phase 3: Functional Gross Motor Training (Week 5–6)
- Gait training
- Balance beam walking
- Obstacle negotiation
- Running drills
- Jump training

Caregiver Education

Parents were educated regarding:
- Home-based strengthening exercises
- Safe activity progression
- Importance of early motor stimulation

Compliance was monitored weekly.

3. Statistical Analysis

Data were analysed using SPSS Version 25.0.
Step 1: Data Entry in SPSS
Variables created:
- Group (1 = Intervention, 2 = Control)
- MMT_Pre
- MMT_Post
- GMFM_Pre
- GMFM_Post

Step 2: Descriptive Statistics
Mean ± Standard Deviation calculated for:
- Age
- MMT scores
- GMFM scores

Step 4: Within-Group Comparison
Paired t-test used to compare pre vs post scores within groups.

Command:
Analyse → Compare Means → Paired-Samples T Test

Step 5: Between-Group Comparison
Independent t-test used to compare post-test scores between groups.

Command:
Analyse → Compare Means → Independent-Samples T Test

Grouping variable: Group (1,2)

Step 6: Effect Size
Cohen's d calculated using formula:
d = \frac{Mean_1 - Mean_2}{Pooled\ SD}

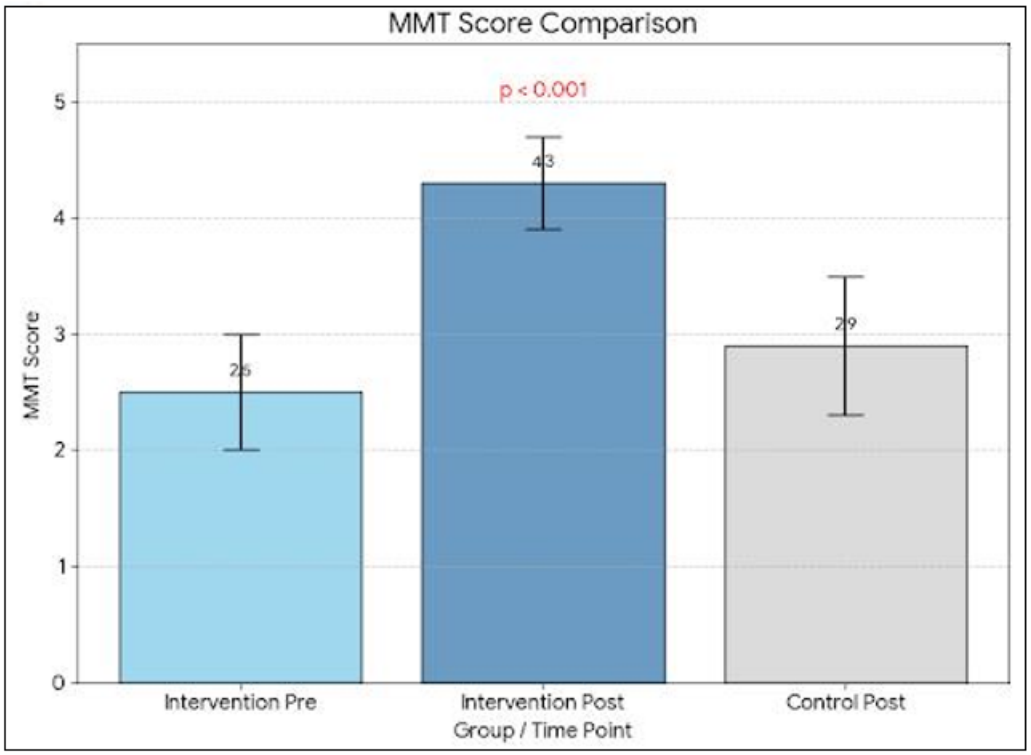
Interpretation:
- 0.2 = Small
- 0.5 = Medium
- 0.8 = Large
- 1.2 = Very Large

4. Results

Muscle Strength Outcomes (MMT - Muscle Strength Outcomes)

Variable	Intervention Pre	Intervention Post	Control Post	p-value
MMT Score	2.5 ± 0.5	4.3 ± 0.4	2.9 ± 0.6	<0.001

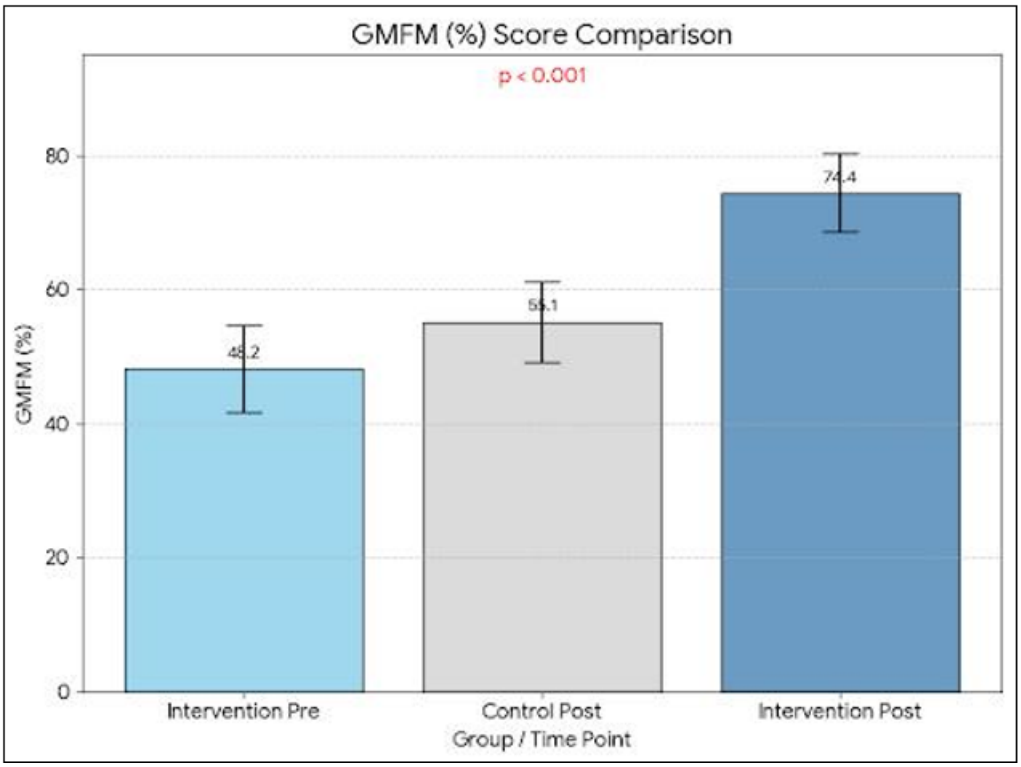
Effect Size (Cohen's d) = 1.8 (Large)
Interpretation- highly significant improvement in muscle strength in the intervention group compared to control.



Gross Motor Function Outcomes

Variable	Intervention Pre	Intervention Post	Control Post	p-value
GMFM (%)	48.2 ± 6.5	74.4 ± 5.8	55.1 ± 6.0	<0.001

Percentage Improvement = 54%
Effect Size (Cohen's d) = 2.1 (Very Large)
Interpretation- structured physiotherapy produced clinically meaningful improvement in gross motor function.



5. Discussion

The present randomized controlled trial demonstrates that a structured six-week physiotherapy rehabilitation program significantly improves muscle strength and gross motor function in preschool children with acute malnutrition.

The substantial increase in MMT scores indicates enhanced neuromuscular activation and improved muscle recruitment patterns. Progressive loading and task-oriented functional exercises likely contributed to muscle fibre hypertrophy and improved motor unit synchronization.

The 54% improvement in GMFM scores reflects meaningful functional gains, particularly in standing, walking, and balance domains. The very large effect size (d = 2.1) suggests that physiotherapy intervention is not merely adjunctive but essential in comprehensive malnutrition rehabilitation.

Nutritional recovery alone showed limited functional improvement in the control group, reinforcing the necessity of structured motor rehabilitation within NRC protocols.

Early physiotherapy intervention may prevent persistent developmental delays and improve long-term participation outcomes in this vulnerable population

6. Clinical Implications

- Physiotherapy should be incorporated into standard NRC treatment protocols.
- Early neuromuscular activation accelerates functional recovery.
- Caregiver education enhances sustainability of outcomes.
- Multidisciplinary management improves holistic rehabilitation.

7. Limitations

- Single-centre study
- Limited follow-up duration
- No long-term functional tracking
- Environmental influences not controlled

8. Future Recommendations

- Multi-centre randomized trials
- Longitudinal follow-up studies
- Inclusion of cognitive and psychosocial outcome measures
- Cost-effectiveness analysis of rehabilitation integration

9. Conclusion

A structured six-week physiotherapy rehabilitation program significantly improves muscle strength and gross motor function in children aged 3–5 years with acute malnutrition. These findings emphasize the need for integrating physiotherapy services into routine care at Nutrition Rehabilitation Centres to optimize functional recovery and developmental outcomes.

Conflict of Interest: None

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