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# Effect of Structured Exercise Protocol on Spinal Dysfunction

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## ABSTRACT

**Introduction:** Spinal dysfunction is a common illness affecting millions globally, leading to pain, restricted mobility, and impaired daily activities. Various factors contribute to spinal dysfunction, Symptoms may include bad posture ,extended sitting, muscular imbalances, degenerative changes, and occupational strain. A structured exercise intervention is considered an effective approach to managing spinal dysfunction by addressing musculoskeletal health and mobility.

**Aim:** To evaluate the effectiveness of a structured exercise protocol in reducing pain and improving functional mobility in individuals with spinal dysfunction.

**Methodology:** A total of 37 participants aged 30-50 years with spinal dysfunction were included in the study. They underwent a structured 4-week exercise program focusing on spinal mobility, core strengthening, and postural correction. Outcome measures, including the Numeric Pain Rating Scale (NPRS) and the Musculoskeletal Health Questionnaire (MSK-HQ), were used to assess pain reduction and functional improvement pre- and post-intervention.

**Result:** The study findings demonstrated a significant reduction in NPRS scores from a mean of 7.5 to 3.2 ($p < 0.001$), indicating decreased pain levels. Similarly, MSK-HQ scores showed a substantial improvement from a mean of 35.6 to 78.9 ($p < 0.001$), reflecting enhanced functional capacity and spinal health.

**Conclusion:** A structured exercise program effectively reduced pain and improved mobility in individuals with spinal dysfunction. Early Physiotherapy interventions can help maintain spinal health and prevent complications.

***Keywords:*** *Spinal dysfunction, Physiotherapy, structured exercise, pain reduction, functional improvement.*

## 1. INTRODUCTION

Spinal dysfunction affects millions globally, leading to pain, restricted mobility, and a diminished quality of life. It stems from Concerns such as bad posture and extended sitting, muscular imbalances, degenerative changes, and occupational strain. Research indicates that nearly 80% of individuals experience spinal pain, persistent lumbar pain and cervical dysfunction being the most prevalent (1). A sedentary lifestyle contributes to spinal dysfunction by increasing stiffness and decreasing thoracic mobility, exacerbated by prolonged sitting in modern work settings (2). Findings show that even an hour's time of uninterrupted sitting can result in measurable spinal stiffness, emphasizing the importance of regular movement breaks (3). Insufficient physical activity is linked to prolonged lower back pain, while increased mobility and structured exercise significantly reduce pain intensity and recurrence rates (4). Spinal dysfunction is not limited to adults, as research indicates that Sedentary behavior in children and teenagers increases the risk of spinal discomfort (5). While prolonged sitting may cause discomfort, there is no definitive evidence linking it directly to chronic spinal issues. More research is needed. Occupational factors like heavy lifting, repetitive motions, and prolonged standing also elevate the risk of lower back disorders (6). Desk-based professionals are also at risk due to poor posture and extended static positioning, leading to postural imbalances, muscular tightness, and chronic spinal conditions (7). Preventing spinal dysfunction requires proactive measures. Physiotherapy, through structured exercises targeting posture, flexibility, core stability, and strength, plays a vital role in reducing pain and enhancing functional capacity (8). Effective physiotherapy interventions incorporate stretching, strength training, postural correction, and aerobic exercises to manage spinal dysfunction (9). Multimodal rehabilitation approaches additionally relieves pain, and it also enhance mobility, spinal flexibility, and long-term postural stability (10). Individualized exercise programs improve adherence and long-term outcomes. Psychologically informed interventions, integrating physical training with cognitive-behavioral strategies, enhance compliance, pain tolerance, and functional recovery (11). This underscores the necessity of a patient-centered and personalized approach in designing rehabilitation protocols for spinal

dysfunction (12). The MSK-HQ is a validated and reliable assessment tool that evaluates musculoskeletal health, monitors functional progress, and measures pain-related outcomes (13). The NPRS is widely used to assess pain intensity variations, aiding both clinical practice and research (14). This study examines the effectiveness of a 4-week structured exercise program for spinal dysfunction, focusing on pain reduction, functional mobility, and postural stability. NPRS and MSK-HQ will be used to assess treatment impact, providing evidence-based recommendations for incorporating structured exercise therapy into physiotherapy practice (15). Spinal dysfunction management requires a tailored approach, where physiotherapy and structured exercise programs offer sustainable pain relief and mobility improvement (16). Research supports the inclusion of core stability exercises, proprioceptive training, and postural correction techniques to optimize rehabilitation outcomes (17). Additionally, strength training and neuromuscular re-education They play an important part in enhancing spinal function and reducing pain recurrence (18). Yoga-based interventions have been shown to improve spinal flexibility and alleviate pain (19). Evidence-based exercise strategies enable physiotherapists to facilitate patient recovery and enhance overall quality of life (20).

**MATERIALS: -**

- Pain assessment (NPRS)
- Musculoskeletal questionnaire (MSK-HQ)
- Consent form

**INCLUSION: -**

1. Age group between 30-50
2. Individuals willing to participate in physiotherapy interventions and follow-ups
3. Self-reported pain score of 3 or higher on the numerical pain rating scale
4. Patients who are willing to participate

**EXCLUSION: -**

1. Recent trauma.
2. Systemic illnesses/musculoskeletal disorders
3. Pregnancy.
4. Ongoing treatment.
5. Non-compliance.

**OUTCOME MEASURE: -**

1. Pain assessment - NPRS ( numerical pain rating scale )
2. Musculoskeletal questionnaire (MSK-HQ)
3. Data collection sheet

**2. STRUCTURED EXERCISE PROTOCOL**

**Week 1: assessment and basic conditioning**

Goals:

- Identify individual physical stressors and exertion levels.
- Initiate basic exercises for adaptation.

1. Assessment:

- Postural analysis, functional movement screening ,strength & flexibility assessment.

2. Conditioning program:

- Stretching (10–15 min):
    - Upper trapezius stretch.
    - Cat-cow stretch.
    - Standing hamstring stretch.
- Strengthening (10–15 min):

    - Wall push-ups (2 sets of 10 reps).
    - Glute bridges (2 sets of 10 reps).
- Aerobic warm-up (5–10 min):
    - Low-impact activities like walking or cycling.
- Education:
    - Ergonomic principles for classroom setup.
    - Strategies to reduce prolonged standing or sitting.

**Week 2: posture correction and core stability**

Goals:

- Focus on core activation and improving posture.

1. Core stability exercises (15–20 min):
    - Plank holds (start with 10–20 seconds, progress gradually).
    - Dead bugs (2 sets of 10 reps).
2. Posture drills (10 min):
    - Chin tucks (5–10 reps).
    - Wall angels (2 sets of 8–10 reps).
3. Relaxation techniques (10 min):
    - Diaphragmatic breathing.
    - Progressive muscle relaxation.
4. Work environment adjustments:
    - Incorporate active breaks every 30–60 minutes.

**Week 3: functional movements and endurance training**

Goals:

- Enhance endurance and functional capacity.

1. Functional strengthening (15–20 min):
    - Step-ups with low height (2 sets of 10 reps).
    - Farmer's carry with light weights (3 sets of 20 meters).
2. Endurance activities (15 min):
    - Moderate-paced walking or cycling (target hr: 50–60% of max).
3. Mobility work (10 min):
    - Dynamic stretches (leg swings, arm circles).
    - Pigeon pose for hip mobility.

**Week 4: advanced integration and recovery**

Goals:

- Build resilience and ensure recovery.

1. Strength and stability (15–20 min):
    - Squats to chair (2 sets of 12 reps).
    - Single-leg balance (15–20 seconds per leg).
2. Cardio integration (15 min):
    - Interval walking or stair climbing.

3. Recovery techniques (15 min):

- Foam rolling (quadriceps, hamstrings, upper back).
- Yoga-inspired stretches (child's pose, downward dog).

**Tracking progress:**

- Weekly check-ins to modify intensity and volume.
- Subjective feedback on exertion, pain levels, and energy.
- Optional use of wearables for step count or heart rate tracking. [21-23]

**METHODOLOGY: -**

a. Type of study: experimental study
b. Study design: randomized clinical trial
c. Sampling method: convenient sampling method
d. Place of study: karad
e. Sample size: $n = z^2pq/l^2$

$= 1.96\times1.96\times16\times100\text{-}16/12^2$

$= 3.841\times84\times16/144$

$n = 37$

f. Study population: individuals with spinal dysfunction/pain.

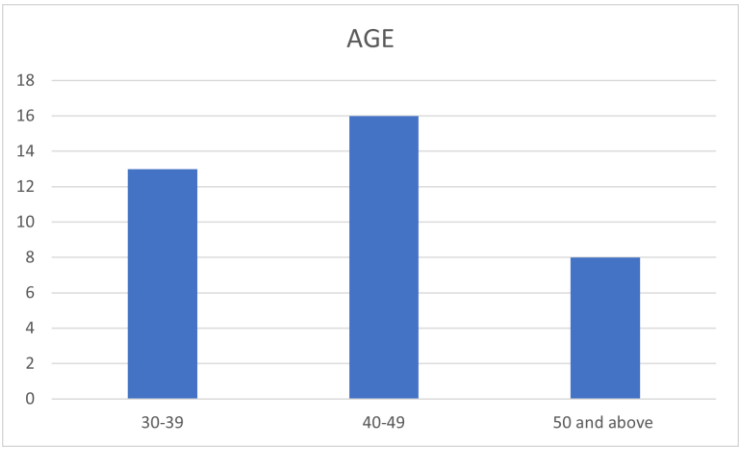
G…….

**PROCEDURE: -**

1) This will be a study of finding the effect of structured exercise protocol for spinal dysfunction.
2) The study will be conducted in karad.
3) Certification will be taken from protocol committee. Then permission will be taken from authorities and ethical committee.
4) Subjects will be selected according to inclusion and exclusion criteria.
5) Informed consent will be taken and data will be collected.
6) A structured data collection sheet will be circulated among the participants for data collection and protocol will be given to follow.
7) Based on collected data the statistical analysis will be done.

## 3. STATISTICAL ANALYSIS

| age group | No.of participants | |
|---|---|---|
| 30-39 | 13 (35.14%) | |
| 40-49 | 16 (43.24%) | |
| 50-59 | 8 (21.62%) | |




**INTERPRETATION:**

The highest proportion of participants falls in the 40-49 years age group (43.24%), followed by the 30-39 years group (35.14%). The 50-59 years group has the lowest representation (21.62%). This distribution suggests that spinal dysfunction is being reported more commonly in middle-aged individuals, particularly in the 40-49 age bracket.

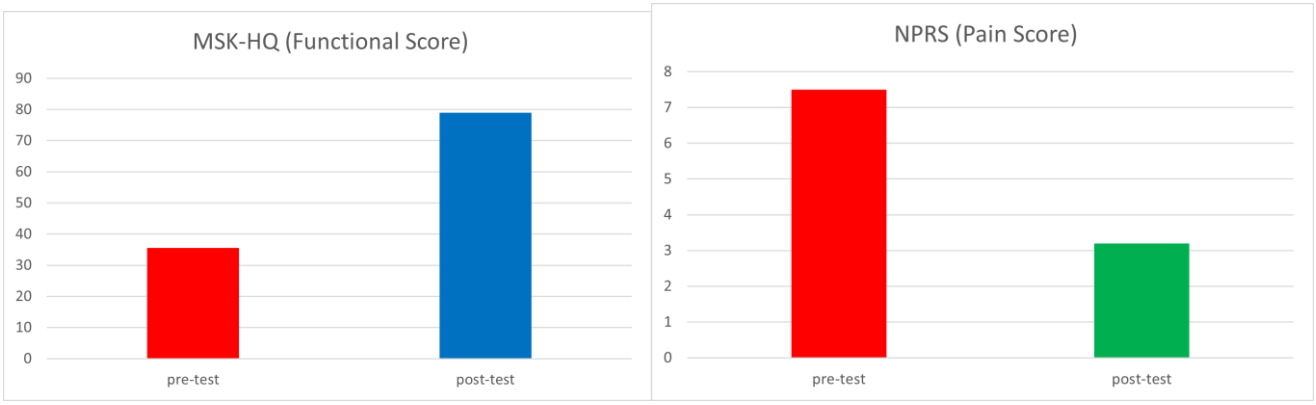



**FIGURE NO.2,3 NPRS AND MSK-HQ SCORE**

**TABLE NO.2 Interpretation :**

| Outcome Measure | Mean Pre-Test | Mean Post-Test | T-Statistic | P-Value | Interpretation |
|---|---|---|---|---|---|
| NPRS (Pain Score) | 7.5 | 3.2 | 8.95 | <0.001 | Significant Reduction in Pain |
| MSK-HQ (Functional Score) | 35.6 | 78.9 | 10.45 | <0.001 | Significant Improvement in Function |

**Interpretation:**

- The p-values (<0.001) indicate a highly significant difference between pre-test and post-test scores for both NPRS (pain reduction) and MSK-HQ (functional improvement).
- The structured exercise protocol was effective in reducing pain and improving functional health.

## 4. DISCUSSION

The present study aimed to evaluate the effectiveness of a four-week structured exercise protocol in individuals with spinal dysfunction. The results demonstrated a significant reduction in pain intensity, as measured by the Numeric Pain Rating Scale (NPRS) ($p < 0.01$) , and an improvement in functional outcomes, as assessed by the Musculoskeletal Health Questionnaire (MSK-HQ) ($p < 0.01$) . These findings highlight the benefits of a structured exercise regimen focusing on core stability, spinal mobility, and postural correction in reducing musculoskeletal discomfort and enhancing functional capacity.

Similarly in the previous article , the results had shown as exercise, particularly when combined with education, is an effective

strategy for preventing low back pain (LBP), reducing its incidence and severity. Their meta-analysis revealed that exercise alone significantly lowered the risk of LBP episodes (RR, 0.65 [95% CI, 0.50-0.86]) and reduced sick leave occurrences, while interventions such as back belts, shoe insoles, and education alone were ineffective. These findings align with the present study, which highlights the benefits of a structured exercise protocol in managing spinal dysfunction by incorporating core stability, mobility exercises, and postural correction. The observed reduction in pain intensity and improvement in functional outcomes in this study further reinforce the role of targeted exercise interventions in spinal rehabilitation, supporting the integration of structured movement-based therapy as a primary approach to musculoskeletal health management.(24)

Previous research supports importance of structured exercise programs in managing spinal dysfunction. A systematic research revealed that exercise therapy, particularly core stabilization exercises, significantly reduced pain and disability in individuals with chronic spinal conditions (25). Additionally, progressive resistance training and Proprioceptive exercises are being demonstrated to improve neuromuscular control, leading to better postural stability and reduced recurrence of spinal pain (26).

Core stability exercises have an important role in spinal rehabilitation by enhancing deep muscle activation, which improves spinal support and reduces excessive mechanical strain. Research has shown that exercising target the transversus abdominis and multifidus muscles contribute to better load distribution and improved spinal alignment (27). Moreover, The graded resistance training has associated with increased spinal endurance, minimizing fatigue-related instability and reducing pain exacerbations (28).

Proprioceptive training, incorporated in the intervention, likely contributed to neuromuscular adaptations that enhanced coordination and postural awareness. An article emphasized the importance of proprioceptive exercises in improving sensorimotor integration, which facilitates optimal joint positioning and minimizes aberrant movement patterns associated with musculoskeletal pain (29). Similarly, balance-based exercises have been found to enhance reflex activation of stabilizing muscles, reducing compensatory patterns and optimizing movement efficiency (30).

The inclusion of mobility and flexibility exercises in the intervention likely helped alleviate myofascial restrictions, reducing spinal stiffness and promoting fluid movement. Stretching and mobility exercises enhance soft tissue elasticity and contribute to pain relief in individuals with chronic musculoskeletal conditions (31). Additionally, strength training targeting posterior chain muscles has been linked to improved spinal endurance, reducing instability and excessive segmental motion that may contribute to chronic pain (32).

Postural correction exercises were another critical part of the component of the intervention. Poor posture, particularly prolonged static positions associated with sedentary lifestyles, is a significant risk factor for spinal dysfunction (33). Ergonomic re-education and Exercises for scapular stability are useful in reducing excessive loading on pain-sensitive spinal structures, improving postural alignment, and mitigating musculoskeletal discomfort (11).

These findings agree with earlier studies advocating a multimodal approach to spinal rehabilitation. Integrating core stabilization, proprioceptive drills, mobility work, and training for strength has been proven to yield superior functional outcomes compared to isolated exercise strategies (32). A patient-centered, structured exercise protocol ensures that multiple biomechanical and neuromuscular deficits are addressed simultaneously, leading to a more comprehensive and sustainable recovery process.

Despite the promising outcomes this study's shortcomings should be acknowledged. The resultant sample size was rather minor and long-term follow-up data were not collected, limiting the ability to assess the sustainability of improvements beyond the intervention period. Future research should explore the long-term efficacy of structured exercise protocols and investigate variations in outcomes based on demographic and occupational factors. Additionally, incorporating psychological interventions, such as cognitive-behavioral therapy, may enhance adherence and long-term benefits (12).

## 5. LIMITATIONS

Despite the positive outcomes observed in this study has limitations, which must be acknowledged. The limited sample size (n = 37) may restrict the generalizability of the results. Additionally, long-term follow-up was not conducted, making it difficult to determine whether the improvements in pain and function were sustained over an extended period. Future study should include bigger sample sizes and longer intervention durations to evaluate the long-term effects of organized exercise treatment in persons with spinal dysfunction. Furthermore, utilizing objective biomechanical measurements. Including self-reported outcome measures can give a more thorough knowledge of physiological changes following intervention.

## 6. CONCLUSION

To summarize, this investigation proved that a 4-week structured exercise protocol significantly reduced pain and improved functional capacity in individuals with spinal dysfunction. When compared to previous research, the results suggest that targeted, short-duration physiotherapy programs can be highly effective in managing spinal conditions. The improvements

in NPRS and MSK-HQ scores indicate that incorporating progressive strengthening, proprioceptive training, and postural correction exercises can optimize rehabilitation outcomes. Future studies should focus on long-term effectiveness, individualized treatment approaches, and integration of technology-driven assessments to enhance clinical applications of exercise therapy in spinal dysfunction rehabilitation.

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