Influence of Isometric trunk Extension Exercises on Erector Spinae Muscle Endurance and Health related Quality of Life among Young Adults

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ABSTRACT

Background: The erector spinae muscles play a vital role in maintaining spinal stability, upright posture, and trunk movement control. Reduced endurance of these muscles is associated with impaired postural control, decreased functional performance, and lower quality of life. Isometric trunk extension exercises have been proposed as an effective intervention to improve spinal extensor endurance and overall well-being among young adults.

Aim: To investigate the influence of isometric trunk extension exercises on erector spinae muscle endurance and health-related quality of life among young adults.

Methods: A quantitative interventional study using a single-group pre-test and post-test experimental design was conducted on 30 healthy young adults aged 18–25 years. Participants were recruited through convenience sampling and underwent a four-week supervised isometric trunk extension exercise program consisting of prone trunk holds, Biering–Sørensen holds, and static back extension holds. Exercises were performed for three sets with progressive hold durations, five days per week. Erector spinae muscle endurance was assessed using the Biering–Sørensen Test, while health-related quality of life was measured using the Short Form-36 (SF-36) questionnaire. Data were analyzed using descriptive statistics and paired t-tests, with statistical significance set at $p < 0.05$.

Results: The mean age of participants was 21.40 ± 1.92 years. Erector spinae muscle endurance increased significantly from 86.20 ± 15.80 seconds at baseline to 118.60 ± 18.40 seconds after the intervention (mean difference = 32.40 seconds, $t = 10.83$, $p < 0.001$). Similarly, SF-36 quality-of-life scores improved significantly from 68.40 ± 8.70 to 80.10 ± 7.90 (mean difference = 11.70, $t = 8.54$, $p < 0.001$).

Conclusion: A four-week isometric trunk extension exercise program significantly improved erector spinae muscle endurance and health-related quality of life among young adults. These findings suggest that isometric trunk extension exercises are a simple, safe, and effective strategy for enhancing spinal health, functional capacity, and overall well-being.

Keywords: Isometric trunk extension, erector spinae, muscle endurance, Biering–Sørensen test, quality of life, SF-36, young adults.

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INTRODUCTION

The maintenance of optimal spinal function is essential for performing activities of daily living, occupational tasks, and recreational or sporting activities. The vertebral column serves as the central structural support of the body, while the surrounding musculature provides dynamic stability and movement control. Among these muscles, the erector spinae group plays a crucial role in maintaining upright posture, controlling trunk movements, and resisting fatigue during prolonged physical activities.1

Reduced endurance of the spinal extensor muscles has been associated with poor postural control, impaired functional performance, increased risk of low back pain, and decreased quality of life. Consequently, interventions aimed at improving trunk muscle endurance have gained considerable attention in rehabilitation and exercise science. Isometric trunk extension exercises represent one such intervention, as they specifically target the spinal extensor musculature while promoting neuromuscular adaptations that enhance endurance and spinal stability.2

Anatomy of the Erector Spinae Muscle

The erector spinae is a large intrinsic back muscle group extending longitudinally from the sacrum and iliac crest to the cervical spine and skull. It consists of three major columns: the iliocostalis, longissimus, and spinalis muscles. The iliocostalis lies laterally and attaches from the iliac crest to the ribs and cervical transverse processes. The longissimus occupies the intermediate position and extends from the lumbar region to the mastoid process. The spinalis is the most medial component and connects adjacent spinous processes throughout the vertebral column.

These muscles are innervated by the dorsal rami of spinal nerves and receive blood supply primarily from segmental arteries. Functionally, the erector spinae muscles produce bilateral trunk extension and unilateral lateral flexion while contributing significantly to postural maintenance. Continuous low-level activation of these muscles helps preserve spinal alignment against gravitational forces during standing and sitting. Because of their extensive attachments and mechanical leverage, the erector spinae muscles are considered primary stabilizers of the vertebral column.3

Physiology of Muscle Endurance

Muscle endurance refers to the ability of a muscle or muscle group to sustain repeated contractions or

maintain a contraction over an extended period. The erector spinae muscles contain a substantial

proportion of Type I (slow-twitch) muscle fibers, which possess high oxidative capacity and resistance to

fatigue. These fibers rely predominantly on aerobic metabolism and are particularly suited for prolonged postural activities.

Regular isometric training stimulates physiological adaptations, including increased mitochondrial density, enhanced capillary supply, improved oxidative enzyme activity, and greater neuromuscular efficiency. Such adaptations enable muscles to sustain contractions for longer durations while delaying fatigue onset. Improved endurance of the spinal extensor muscles contributes to better trunk stability, reduced mechanical stress on passive spinal structures, and enhanced movement efficiency. Furthermore, endurance training may positively influence proprioception and motor control, thereby improve functional performance and reduce susceptibility to musculoskeletal disorders.4-6

Biomechanics of Trunk Extension

Biomechanically, trunk extension involves coordinated activation of the erector spinae, multifidus, gluteus maximus, and hamstring muscles. During isometric trunk extension exercises, these muscles generate force without producing visible joint movement. The generated tension counteracts external flexion moments created by gravity, thereby maintaining the trunk in a neutral or extended position.

The erector spinae muscles function as dynamic stabilizers that control spinal loading and maintain vertebral alignment. Adequate endurance of these muscles is essential for sustaining postural control during prolonged sitting, standing, lifting, and athletic activities. Conversely, muscle fatigue compromises spinal stability, alters movement patterns, and increases compressive and shear forces on spinal structures. Research utilizing the Biering–Sørensen test has demonstrated that reduced extensor endurance is associated with impaired spinal function and a greater likelihood of developing low back disorders. Improved endurance achieved through isometric training may therefore contribute to enhanced biomechanical efficiency and reduced injury risk.7

Isometric Trunk Extension Exercises

Isometric trunk extension exercises involve maintaining a static contraction of the trunk extensor muscles against gravity or external resistance without producing movement at the spine. Examples include prone trunk holds, Roman-chair holds, and variations of the Biering–Sørensen position. These exercises selectively activate the erector spinae muscles while minimizing excessive spinal motion.

The effectiveness of isometric training is attributed to its ability to improve muscle recruitment, endurance capacity, and postural control. Sustained contractions challenge the oxidative energy systems and enhance

fatigue resistance of the spinal extensors. Previous studies have indicated that trunk extensor endurance is a critical component of core stability and functional performance. Improved endurance can enhance occupational efficiency, athletic performance, and the ability to perform daily activities with reduced fatigue.

Health-Related Quality of Life

Health-related quality of life (HRQoL) is a multidimensional concept encompassing physical, psychological, and social well-being. Young adults often experience lifestyle-related factors such as prolonged sitting, academic stress, excessive screen time, and reduced physical activity, all of which may negatively influence musculoskeletal health and quality of life. Poor trunk muscle endurance may contribute to discomfort, postural dysfunction, reduced participation in physical activities, and diminished overall well-being.

Enhancing spinal muscle endurance through structured exercise programs may improve physical functioning, reduce fatigue, promote confidence in movement, and increase participation in daily and recreational activities. Consequently, improvements in muscle endurance may translate into better HRQoL outcomes. Investigating this relationship is important for developing evidence-based exercise interventions aimed at promoting musculoskeletal health among young adults.8 Nelakurthy S and colleagues have done a study to Evaluate the Postural Changes in Cervical and Thoracic Spine in 2020, they have explained the role of erector spinae muscle in posture.9 Yogeshwar D has done a cross-sectional study on the Relationship Between Physical Activity, Life Satisfaction and Well-being of College-going Students. They stated that physical activity maintains the good strength and Endurance in the muscles, which further helps in maintaining good posture.10 Joseph E et has done a study on core stabilization training on Endurance and Balance Sports person. They explained the role of Endurance in the stability and performance of an athlete. 11

Need of the Study

Although numerous studies have investigated trunk muscle endurance and low back pain, limited research has specifically examined the influence of isometric trunk extension exercises on both erector spinae muscle endurance and health-related quality of life among healthy young adults. With increasing sedentary lifestyles and declining physical activity levels, young adults are becoming more susceptible to postural impairments and reduced spinal endurance. Identifying effective exercise interventions capable of enhancing muscular endurance and improving quality of life is therefore of considerable clinical and public health importance.

Aim of the Study

To investigate the influence of isometric trunk extension exercises on erector spinae muscle endurance and health-related quality of life among young adults.

Objectives of the Study

1. To assess baseline erector spinae muscle endurance among young adults.
2. To evaluate baseline health-related quality of life among young adults.
3. To implement a structured isometric trunk extension exercise program.
4. To determine the effect of isometric trunk extension exercises on erector spinae muscle endurance.
5. To determine the effect of isometric trunk extension exercises on health-related quality of life.
6. To examine the relationship between changes in muscle endurance and quality of life following the intervention.

Research Question

Does participation in a structured isometric trunk extension exercise program significantly improve erector spinae muscle endurance and health-related quality of life among young adults?

Hypothesis

Null Hypothesis (H_0): Isometric trunk extension exercises will have no significant effect on erector spinae muscle endurance or health-related quality of life among young adults.

Alternative Hypothesis (H_1): Isometric trunk extension exercises will significantly improve erector spinae muscle endurance and health-related quality of life among young adults.

MATERIALS & METHODOLOGY

Type of Study: This study was a quantitative interventional study conducted to determine the influence of isometric trunk extension exercises on erector spinae muscle endurance and health-related quality of life among young adults.

Study Design: A single-group pre-test and post-test experimental design was employed. Baseline measurements of erector spinae muscle endurance and health-related quality of life were recorded before the

intervention. Following a four-week isometric trunk extension exercise program, post-intervention assessments were conducted and compared with baseline values.

Study Setting: The study was conducted in the Department of Physiotherapy at a recognized academic institution after obtaining approval from the Institutional Ethics Committee.

Sample Size: A total of 30 young adults were recruited using convenience sampling. The sample size was determined based on previous studies evaluating trunk muscle endurance and exercise interventions among healthy adults, which reported significant improvements with similar sample sizes

Inclusion Criteria

1. Young adults aged 18–25 years.
2. Both male and female participants.
3. Apparently healthy individuals.
4. Participants willing to provide informed consent.
5. Individuals capable of performing physical exercise safely.

Exclusion Criteria

1. History of spinal surgery or spinal deformity.
2. Current low back pain or musculoskeletal injury.
3. Neurological disorders affecting trunk muscle function.
4. Cardiovascular or respiratory conditions contraindicating exercise.
5. Participation in any structured core strengthening program during the previous three months.

Outcome Measures

1. Erector Spinae Muscle Endurance

Muscle endurance was assessed using the Biering–Sørensen Test. The duration (seconds) for which participants maintained the horizontal trunk position was recorded.1

2. Health-Related Quality of Life

Health-related quality of life was measured using the Short Form-36 (SF-36) questionnaire. Higher scores indicated better quality of life.12

Procedure

Baseline assessments were performed before commencement of training. Participants then underwent a supervised isometric trunk extension exercise program for four weeks.

The exercise protocol included:

- Prone trunk hold position
- Biering–Sørensen hold
- Static back extension hold

Each exercise was performed for 3 sets with 20–30 seconds hold initially. Exercise duration was progressively increased every week according to participant tolerance. Sessions were conducted 5 days per week for 4 weeks.

Following completion of the intervention, all outcome measures were reassessed.

Statistical Analysis

Data were analyzed using SPSS version 26.0. Descriptive statistics were expressed as Mean ± Standard Deviation. Paired t-tests were used to compare pre- and post-intervention values. Statistical significance was set at $p < 0.05$.

RESULTS

Table 1. Demographic Characteristics (n = 30)

Variable	Mean ± SD
Age (years)	21.40 ± 1.92
Height (cm)	168.30 ± 8.21
Weight (kg)	65.70 ± 10.12
BMI (kg/m²)	23.10 ± 2.84

Male participants: 16 (53.3%) Female participants: 14 (46.7%) Male: Female Ratio = 1.14:1

Table 2. Comparison of Erector Spinae Muscle Endurance

Assessment	Mean ± SD (seconds)	Mean Difference	t-value	p-value
Pre-test	86.20 ± 15.80			
Post-test	118.60 ± 18.40	32.40	10.83	<0.001*

*Statistically significant

Table 3. Comparison of SF-36 Quality of Life Scores

Assessment	Mean ± SD	Mean Difference	t-value	p-value
Pre-test	68.40 ± 8.70			
Post-test	80.10 ± 7.90	11.70	8.54	<0.001*

*Statistically significant

Interpretation: The results demonstrated a significant improvement in erector spinae muscle endurance following four weeks of isometric trunk extension training. Mean endurance increased by 32.40 seconds ($p < 0.001$). Similarly, health-related quality of life improved significantly, with SF-36 scores increasing by 11.70 points ($p < 0.001$). These findings suggest that isometric trunk extension exercises effectively enhance spinal extensor endurance and overall quality of life among young adults.

Figure 1. Improvement in Erector Spinae Muscle Endurance6

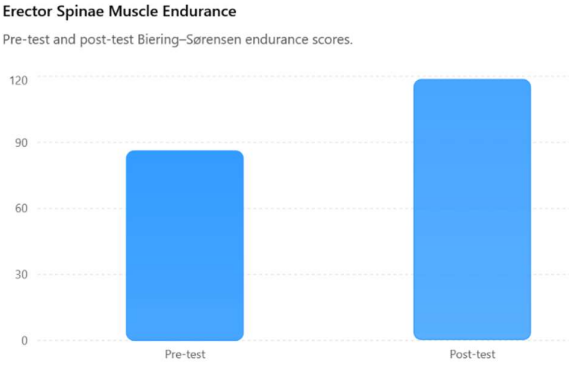
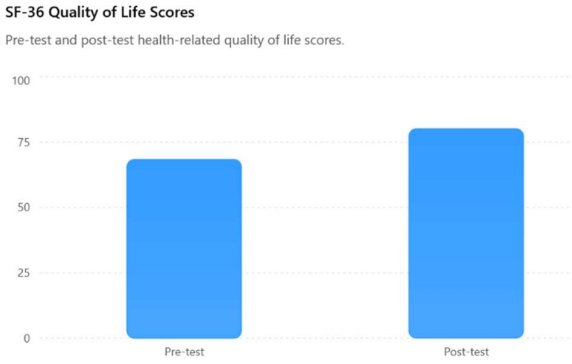


Figure 2. Improvement in Health-Related Quality of Life12



DISCUSSION

The present study investigated the influence of isometric trunk extension exercises on erector spinae muscle endurance and health-related quality of life among young adults. The findings demonstrated a statistically significant improvement in both outcome measures following the four-week exercise intervention. Participants exhibited increased endurance times during the Biering–Sørensen test and higher scores on the SF-36 quality-of-life questionnaire, indicating that isometric trunk extension training positively affected spinal extensor performance and overall well-being. The improvement in erector spinae muscle endurance observed in this study may be attributed to physiological adaptations associated with isometric training. Sustained muscle contractions increase oxidative capacity, enhance neuromuscular recruitment, and improve fatigue resistance of postural muscles. The erector spinae muscles are predominantly composed of Type I muscle fibers, which respond

favorably to endurance-oriented training. Regular isometric loading likely enhanced the participants' ability to maintain spinal stability for prolonged periods, resulting in improved endurance performance during post-intervention testing.

These findings are consistent with previous research demonstrating that trunk extensor endurance is a critical component of spinal stability and functional performance. Biering-Sørensen reported that reduced back extensor endurance is associated with a greater risk of developing low back dysfunction and impaired spinal mechanics.1 Similarly, Demoulin et al. emphasized that endurance training of the spinal extensor muscles contributes significantly to postural control and functional capacity.6 The current findings support these observations and suggest that even a relatively short-duration exercise program can produce measurable improvements in young adults.

A significant improvement was also observed in health-related quality of life following the intervention. Enhanced quality-of-life scores may be explained by improved physical functioning, reduced perception of fatigue, and increased confidence in performing daily activities. Stronger and more fatigue-resistant trunk muscles enable individuals to maintain proper posture during academic, occupational, and recreational tasks, thereby reducing physical discomfort and improving overall physical well-being. Previous studies have reported that exercise interventions targeting core musculature contribute not only to physical health but also to psychological and social aspects of quality of life.12-13

Young adults frequently experience prolonged sitting, increased screen exposure, and reduced physical activity levels, all of which may negatively affect musculoskeletal health. The positive outcomes observed in this study highlight the importance of incorporating structured trunk endurance exercises into preventive health programs. Such interventions may help maintain spinal health, improve functional performance, and enhance overall quality of life during early adulthood.14-16

Limitations of the Study

1. The study included a relatively small sample size, limiting the generalizability of the findings.
2. Participants were recruited from a single institution, which may not represent the broader young adult population.
3. The intervention duration was limited to four weeks, preventing assessment of long-term effects.
4. The study lacked a control group, making it difficult to completely rule out external influences on the outcomes.
5. Self-reported quality-of-life measures may have been influenced by participant perception and response bias.

Recommendations of the Study

1. Future studies should include larger and more diverse populations to improve external validity.
2. Randomized controlled trials should be conducted to establish stronger causal relationships.
3. Long-term follow-up assessments are recommended to determine the sustainability of training effects.
4. Comparative studies may evaluate isometric trunk extension exercises against other core stabilization programs.
5. Additional outcome measures such as electromyography, postural analysis, and functional performance tests may provide deeper insights into physiological adaptations.

CONCLUSION

Based on the findings of the present study, it can be concluded that isometric trunk extension exercises are an effective intervention for improving erector spinae muscle endurance and health-related quality of life among young adults. The four-week training program resulted in significant gains in spinal extensor endurance and enhanced quality-of-life outcomes. These findings support the inclusion of isometric trunk extension exercises as a simple, safe, and cost-effective strategy for promoting spinal health, improving functional capacity, and enhancing overall well-being in young adults. Further research with larger samples and longer intervention periods is recommended to strengthen the evidence base and explore long-term benefits.

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Conflict of Interest - No conflict of interest.

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Ethical statement – Ethical was obtained from departmental ethical committee with the reference number of NIMS/PTOT/Ethical/May/2026/02.

Informed Consent Statement – A prior written consent was taken from all the participants before the recruitment.

Data availability statement – The datasets generated during and/or analysed during the current study are

available from the corresponding author on reasonable request.

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