

## **A Literature Review of Effectiveness of Core Muscle Training on Improving Endurance in Healthy Adults**

**Ravina Parmar<sup>1</sup>, R. Sedhunivas<sup>2</sup>, Natasha Verma<sup>3</sup>**

<sup>1</sup>Post Graduate Student M.P.T. Cardio-Pulmonary Sciences, Garden City University, Bangalore, India.

<sup>2,3</sup>Assistant Professor, Department of Physiotherapy, Garden City University, Bangalore, India.

\*Corresponding Author: Ravina Parmar

Email ID: raveena.parmar2000@gmail.com

### **Abstract**

**Background:** Core endurance is essential for spinal stability, posture, and injury prevention. Modern sedentary lifestyles have led to reduced core strength and endurance, even in healthy individuals. Various training programs target core improvement; however, evidence on their effectiveness remains limited. This literature review explores the impact of core muscle training on core endurance in healthy adults.

**Objective:** This literature review aims to analyse and evaluate the existing evidence on the effectiveness of core muscle training in improving core endurance among healthy adults.

**Methods:** Relevant studies were searched in PubMed and Google Scholar using keywords “core muscle training,” “core endurance,” and “healthy adults.” Research published between 2015 and 2025 was reviewed, and 10 eligible studies were systematically analyzed.

**Results:** Core muscle training significantly improved core endurance, trunk stability, and posture in healthy adults. Combined exercise programs produced greater benefits than single- method training, with most studies showing positive outcomes within 4–12 weeks.

**Conclusion:** Core muscle training significantly enhances core endurance, trunk stability, and postural control in healthy adults. Programs utilizing a multi-modal approach (e.g., resistance, balance, and stabilization exercises) are most effective, yielding superior benefits compared to single-method interventions.

**Key Words:** Core muscle training, Core endurance, Healthy adults, Exercise intervention, Functional performance.

### **Introduction:**

The core muscles form the foundation of proximal stability that enables efficient distal mobility, facilitating the transfer of energy from larger to smaller muscle groups during daily activities. Functioning as a dynamic muscular corset, the core stabilizes the spine and body both during static postures and limb movements. In essence, the core acts as the central hub of the

body’s functional kinetic chain often described as the body’s “powerhouse,” “foundation,” or “engine” for all limb movements.<sup>1</sup> And the human body’s capacity to produce, transmit, and absorb forces effectively depends primarily on the stability provided by its central structure is the core. The core muscles, which play a key role in maintaining spinal stability, are functionally categorized into two groups. The first group,

known as the deep core or local stabilizing muscles, includes the transversus abdominis, lumbar multifidus, internal oblique, and quadratus lumborum. These muscles are responsible for fine motor control and provide segmental stabilization of the spine. The second group, referred to as the superficial core or global stabilizing muscles, consists of the rectus abdominis, external and internal obliques, erector spinae, quadratus lumborum, and hip muscle groups. These muscles contribute to overall trunk movement and support dynamic stability during functional activities.<sup>1,2</sup>

Core weakness refers to the reduced strength or dysfunction of the body's central musculature, particularly the abdominal and back muscles. It often results from physical inactivity, poor exercise habits, and the prolonged adoption of faulty postures.<sup>3</sup> Core muscles training is widely utilized in both rehabilitation and fitness programs. The key components of core function stability, strength, and endurance are essential for maintaining spinal stability, enabling efficient force generation, and preventing injuries. Core stability specifically pertains to the ability of the spine to remain stable and supported during movement and load-bearing activities.<sup>4</sup>

Core stability training is believed to be effective in preventing low back pain, enhancing overall physical fitness, and improving functional and athletic performance<sup>5</sup> and the core endurance is the ability of the trunk and pelvic stabilizing muscles to maintain submaximal contractions over an extended period. It differs conceptually from maximal core strength and is particularly important for activities that demand sustained postural control and stability.<sup>6</sup>

Multiple studies have shown that consistent endurance training across the lifespan can reduce the decline in maximal aerobic capacity by nearly half compared to sedentary individuals.<sup>7</sup>

Recent cross-sectional studies involving young healthy adults, including medical college students aged 18–25, have shown a notably high prevalence of core muscle weakness. Over 92% of participants demonstrated low endurance on the 60° Spinal Flexion Test, and more than 96% performed poorly on the Side Plank Tests. Similarly, research on bodybuilders indicated that many exhibited insufficient core strength and

stability based on objective assessments, highlighting that general strength training alone does not necessarily enhance core functional performance.<sup>2,8</sup>

A study on office workers reported that individuals who did not engage in regular exercise demonstrated significantly lower core endurance levels. This finding suggests that even in otherwise healthy adults, insufficient physical activity and lack of targeted core training can contribute to reduced endurance capacity. Prolonged sitting further diminishes the activation demands on trunk and pelvic stabilizers, leading to gradual weakening over time. Additionally, maintaining poor postures such as slouched or forward-leaning positions can result in under activation of the deep local stabilizing muscles, including the transversus abdominis and lumbar multifidus.<sup>9</sup>

#### **Need of the Study:**

Modern lifestyles characterized by sedentary behavior and low levels of physical activity have contributed to reduced core muscle endurance, negatively impacting posture, stability, and overall functional performance. Core endurance plays a crucial role in maintaining spinal alignment, preventing musculoskeletal disorders, and optimizing physical efficiency in both daily life and athletic activities. Despite the widespread use of various core training programs, there remains limited comprehensive evidence on their effectiveness in enhancing core endurance among healthy adults. Hence, a literature review is warranted to critically evaluate existing research and determine the true impact of core muscle training on core endurance.

#### **Objective of the Study:**

The literature review examines the evidence about effectiveness of core muscle training in enhancing core endurance among healthy adults.

#### **Materials and Methods:**

##### **Methodology:**

The data evidence was collected from online publications/sources retrieved from various search engines, including PubMed, Google Scholar. Using keywords such as 'core muscle training,' 'core endurance,' and 'healthy

adults,' a thorough search was conducted to obtain applicable publications. The filter criteria were restricted to the 2015 to 2025, in order to get precise and recent data from throughout the world over the course of the last decade. A total of 10 articles identified which satisfied the specific selection requirements for inclusion and exclusion criteria. All the 10 articles were retrieved entirely to facilitate a detailed evaluation and analysis. A systematic approach was used to derive results from all the articles. For the enhanced comprehension and clearer interpretation, the outcomes are presented in a tabular format.

### Inclusion Criteria

1. This study concentrates on experimental data derived from randomized controlled trials to investigate the effects of various types of core muscle training to enhance core muscle endurance.
2. The articles are published in the English language.
3. The articles are published between 2015 and 2025.
4. The age range is from 19 to 60 years.
5. Individuals of both genders are included.

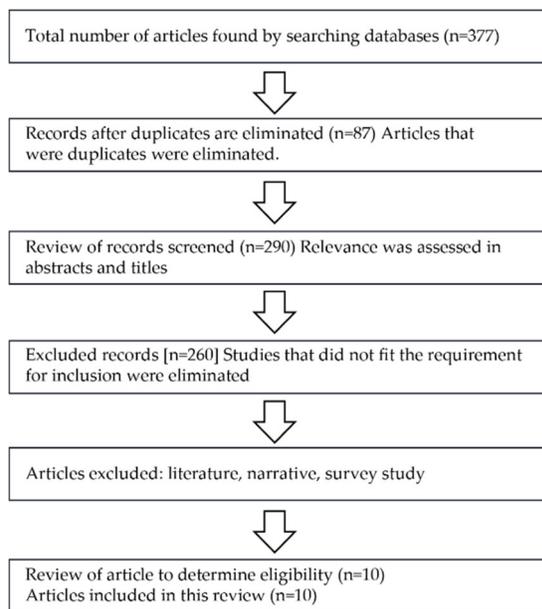
### Exclusion Criteria

1. Articles published in languages other than the English language are excluded.
2. Narrative review and literature apart from RCT articles are excluded.
3. Articles published before 2014 are excluded.

### Results:

Findings from the reviewed studies indicate that core muscle training effectively enhances core endurance in healthy adults. Participants demonstrated notable improvements in trunk stability, posture, and muscular endurance after structured training interventions. Programs incorporating a combination of exercises such as resistance, balance, and stabilization yielded superior outcomes compared to single-method approaches. Most interventions, lasting between 4 and 12 weeks, showed significant progress in endurance assessments like plank and trunk flexor tests. Overall, the evidence confirms that core muscle training plays a key role in improving core endurance and functional stability in healthy individuals.

### Flow Chat:



### Discussion:

The aim of this literature review was to systematically evaluate and synthesize the findings from Randomized Controlled Trials (RCTs) published between 2015 and 2025 to determine the effectiveness and optimal characteristics of core muscle training interventions for improving core endurance in healthy adult populations.

We identified several relevant articles from reputed journals that matched our selected keywords. Based on the defined inclusion and exclusion criteria, a total of 10 randomized controlled trials (RCTs) published in the time frame of 2015 to 2025 were included for analysis. Although numerous studies have explored interventions such as Pilates and core stabilization exercises for improving core strength, the present review specifically focuses on enhancing core endurance. The selected RCTs were chosen because they provided detailed exercise protocols and direct evidence from the authors' findings, offering stronger and more reliable data compared to review-based studies. These articles will be further analyzed to examine the effectiveness of core muscle training on core endurance in healthy adults.

After analyzing the 10 selected studies, it was observed that all demonstrated a positive effect of core muscle training on core endurance. Moreover, the outcomes were more pronounced

when participants engaged in combination interventions rather than single-mode training. The duration of the interventions varied between 3 and 12 weeks, which was generally sufficient to produce measurable improvements in core

endurance. However, evidence suggests that extending the training period beyond this range may lead to even greater and more sustained benefits for participants.

**Literature Review Table:**

Author, year	Total no. of samples	Duration of the study	Intervention	Outcome measures	Significant Findings
Sinemsuner keklik, et al. 2022	33	6 weeks	Pilates exercise	Inclinometer, MC Gill & prone bridge tests.	Improvement observed in PG in trunk proprioception & all of the core muscle endurance tests.
Namkuk Son, et al.2023	60	12 weeks	Isometric core exercise [ICE], dynamic core exercise [DCE],	Functional movement screen, Y- Balance test (upper & lower), and core endurance tests (flexor, extensor, and lateral flexor of the trunk).	Both forms of online-based core exercise Programs have demonstrate effectiveness in enhancing functional movement, dynamic postural control, an core endurance among young adults.
Carrie w hopes, et al.2016	33	8 weeks	Core stabilization exercise	US, imaging & flexor, extensor endurance test.	Increase in core muscle activation while wearing body armor & limited increase i core muscle endurance.
Chioma Nneka Ikele et al.2020	29	6 weeks	Abdominal crunch exercises, Dead bug exercise.	Timed sit up test, flexion endurance test, Trunk flexibility test (Extension).	The dead bug exercise was found to b more effective in enhancing core strength endurance, and flexibility, and can serv as an alternative to the abdominal crunch exercise.
John m mayer et al.2016	582	11 weeks	Lumbar extensor, HIPRE training & core stabilization ex training.	Core muscle endurance test.	The Lumbar extensor HIPRE is effective t improve isometric lumbar extension.
Rajesh kumar et al.2022	90	12 weeks	Core strengthening & weight training	Sit-ups test, cooper, 12 min run test, sit & reach test.	Abdominal strength & endurance improv slightly more in weight training than

					cor strengthening training. Flexibility increases more in core strength than W. Training group. This finding indicates that both cor training & weight training are effective i improving physical fitness in school-ag athletes.
Elliott et al.2016	90	8 weeks	Stability balls	ODI, NPRS, 4 core muscle endurance test.	Ball sitting had no significant effect on LB or associated disability but did improv core endurance in the sagittal plane.
Gihan s mousa et al 2024	26	6 weeks	Core stability exercise, & balance exercise.	Sit to stand, prone bridge, biode balance system.	A 6 weeks core stability exercises an balance training had a positive impact o balance, trunk endurance and lower limb strength in physiotherapy students.
Seyda toprak celenary et al.2017	53	8 weeks	Thoracic stabilization exercise	VAS, MC Gill, spinal mouse, biodex balance system.	Decrease postural pain, spinal curvature posture sway, & increase core muscle endurance in students.
Nikola stojanovic et al.2023	606	12 weeks	Circuit training, involve-total body workout, medicine ball, resistance band.	Sit-ups, dynamic trunk extensor, push- ups.	A 12 week circuit training involves bod workout, resistance band, medicine ba exercise suits school base program & ca improve local muscle endurance in norma weighted Primary school boys.

The reviewed literature collectively supports the effectiveness of core muscle training in improving core endurance among healthy adults. Most studies demonstrated significant improvements in endurance following structured core training programs, including Pilates-based exercises, plank variations, stability ball training, and functional movement routines. These interventions were shown to enhance trunk

stability, postural control, and neuromuscular coordination, contributing to better performance in both daily and athletic activities.

The prevalent outcome measures consist of Oswestry disability index (ODI), Visual Analogue Scale (VAS), Inclinator, MC Gill test, Prone Bridge test, Trunk Flexors-Trunk Extensors test, Bilateral side bridge test, Imaging, Flexor-Extensor endurance test, core muscle endurance

test, Sit -ups test, Cooper test, 12-min run test, Numerical Pain Rating Scale (NPRS), Sit and reach test, Push-ups.

Physiotherapy interventions were used like Core strengthening exercises, Isometric Exercise, Pilates exercise, Intensive dynamic back exercises, Dead-bug exercise, Core stabilization exercise, Core stability exercises, Balance exercise, Etc.

In a research study, Sinem suner keklik et al.2022 "An online pilates exercise program is effective on proprioception and core muscle endurance in a randomized controlled trial", The trial lasted for 6 weeks and the involved interventions were Pilates exercise. This study concluded that Improvement observed in PG in trunk proprioception & all of the core muscle endurance tests.

A study conducted by Son N et al.2023 was the "effects of 12-week online- delivered isometric and dynamic core stability exercises on functional movement, dynamic postural control, and core endurance in healthy young adults". The trial lasted for 12 weeks and the involved interventions were isometric core exercises, and dynamic core exercises. The Study proved which exercise is effective and the Study concluded that Both forms of online-based core exercise programs have demonstrated effectiveness in enhancing functional movement, dynamic postural control, and core endurance among young adults.

In 2016, Carrie w hoppes et .al did research Study on "The efficacy of an eight- week core stabilization program on core muscle function and endurance: A randomized trial". The trial lasted for 8 weeks and the involved interventions were core stabilization exercises. It is concluded that performing an eight-week core stabilization exercise program significantly improves transversus abdominis muscle activation in standing and standing with body armor. When compliant with the exercises, such a program may increase trunk strength and muscle endurance.

In a research Study Ikele CN et.al in 2020 was the "Comparative analysis of the effects of abdominal crunch exercise and dead bug exercise on core stability of young adults". The trial lasted for 6 weeks and the involved interventions were abdominal crunch exercise and dead bug exercise. The abdominal crunch exercise is not more effective than dead bug exercise.

In a research Study John m mayer et.al in 2016 was the "Effect of lumbar progressive resistance exercise on lumbar muscular strength and core muscular endurance in soldiers". The trial lasted for 11 weeks and the involved interventions were lumbar Extensor, HIPRE training and core stabilization exercise training. Lumbar Extensor and HIPRE are effective to improve Isometric lumbar extension.

A study conducted by Rajesh Kumar et .al 2022 was the "effect of 12-week core strengthening and weight training on muscle strength, endurance and flexibility in school-aged athletes". The trial lasted for 12 weeks and the involved interventions were core strengthening and weight training. This study concluded that abdominal strength and endurance showed slightly greater improvement in the weight training group compared to the core strength training group, whereas flexibility improved marginally more in the core strength training group. These results suggest that both core strengthening and weight training effectively enhance overall physical fitness in school- aged athletes, though the extent of improvement varies across specific components such as endurance, flexibility, and abdominal strength.

Nikola stojanovic et al. 2023 did research on the "School-Based Circuit Training Intervention Improves Local Muscular Endurance in Primary School Students: A Randomized Controlled Trial". The trial lasted for 12 weeks and the involved interventions were circuit training, involving Total body workout, medicine ball, and resistance band. A study concluded that a 12-week circuit training program incorporating bodyweight exercises, resistance bands, and medicine ball activities proved suitable for school-based settings and effectively enhanced local muscular endurance in normal-weight primary school boys. The experimental intervention produced significantly better results than the control group, highlighting the importance of considering each participant's baseline muscular endurance when developing training programs.

#### **Conclusion:**

This literature review suggests that core muscle training has a significant and positive impact on enhancing core endurance in healthy adults. The reviewed studies consistently

reported improvements in trunk stability, postural control, and muscular endurance following structured core training programs. Furthermore, interventions that combined multiple exercise modalities such as resistance, balance, and stabilization training yielded more substantial benefits than those employing a single-method approach.

#### **Limitation and Recommendations:**

Future studies, including systematic reviews, scoping reviews, and additional randomized controlled trials, are recommended to establish standardized core training protocols and evaluate their long-term effectiveness.

These protocols can be included in future studies to improve strength and endurance among various populations.

#### **DECLARATION:**

Ethics approval and consent to participate: NA

Availability of data and material: Data openly available in a public repository that issues datasets with DOIs.

Competing interest: None Funding: NA

Authors contribution:

Ravina Ramjibhai Parmar - Conceptualization, design, data collection, implementation, monitoring, data analysis, interpretation and manuscript writing.

R Sedhunivas - Title formation and final manuscript review. Natasha Verma- Title formation and final manuscript review.

#### **ABBREVIATIONS:**

RCT- Randomized controlled trial CST- Core Stability Training

CRT- Core Resistance Training CSE- Core stability exercise ICE- Isometric core exercise DCE- Dynamic core exercise

HIPRE- High Intensity Progressive Resistance Exercise IDBE- Intensive dynamic back exercises.

US- Ultrasound

ODI- Oswestry disability index VAS- Visual analog scale

NPRS- Numerical pain rating scale

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