



## Suspension Training, A Viable Resistance Training Mode for Increasing Muscular Fitness in Adults- A Scoping Review.

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### KEYWORDS

Resistance training, Suspension training, TRX, muscle strength, muscle power, muscle fitness.

### ABSTRACT:

**Introduction:** The aging process leads to a reduction in the number of motor units and the number and size of muscle fibres, frequently resulting in a loss of strength, balance and mobility. However, previous studies have demonstrated positive effects of Suspension Training on age related muscular degeneration. This scoping review evaluates the effects of Suspension Training on muscular fitness among adults. It focuses on the RCT that are published from 2019 to 2024, and utilized the data bases extracted from Google Scholar, PubMed, Cochrane, Embase, CINHAL, SPORTDiscus and PEDro

**Objectives:** This study assesses the impact of Suspension Training exercises on muscular fitness parameters like, muscle endurance, strength and power among young adults.

**Methods:** Computerized electronic databases were searched using key words related to Suspension training (Resistance training, Suspension training, TRX, muscle strength, muscle power, muscle fitness) in Google Scholar, PubMed, Cochrane, Embase, CINHAL, SPORTDiscus and PEDro published from 2019 to May 2024 using PRISMA guidelines.

**Results:** The current scoping review found that Suspension Training enhances muscular fitness, including endurance, strength, and power, in both younger and middle-aged adults. The review highlights significant improvement of motor function.

**Conclusions:** Findings from the current scoping review supports the speculation that Suspension Training improves the muscle endurance, strength and power in adults and can be tested as a feasible alternative to traditional exercise modalities.

### 1. Introduction

Muscular fitness is considered to be the primary, powerful and independent marker of health in adults.<sup>1</sup> Exercise and physical activity plays an important role in health and prevention of chronic diseases such as diabetes, heart disease, obesity, overweight, liver disorders, etc. Involving in regular physical activity

increases the physical and mental performance of individuals.<sup>2,3, 4</sup> Resistance training involves physical exercises that are designed to enhance muscle strength have proved to be effective in improving muscle power, and functional performance in addition to muscle mass and strength.<sup>5</sup> Adults with optimum muscle strength were associated with a 20–35% lower risk of premature



mortality due to cardiovascular disease than other factor, like blood pressure and high body mass index.<sup>6</sup>

In a study by Soligon et al. (2020), it was apparent that Suspension Training (ST) was effective in significantly augmenting the skeletal muscle mass and strength. However, it did not record an increase in functional performance and muscle power in older adults.<sup>7</sup> Improving muscle strength is an essential component to improve the functional performance in adults which can be achieved through resistance training. Resistance training can be imparted by various techniques such as free body weight exercises, dumbbells, resistance band, plyometrics, etc. One of the frequent challenges encountered with adherence to any form of exercise technique is monotony. Introduction of novel training methods is more likely to drive the individual to endure in the physical activities and also makes the experience enjoyable.<sup>9</sup> There are different methods of training such as Bosu ball, Pilates, TheraBand, medicine balls, F45, CrossFit etc.<sup>10,11</sup> ST exercises which has recently gained popularity is a form of training that uses body weight for resistance while focusing on strength, balance, flexibility, and core stability. It is easily adaptable, safe at all fitness levels, and supports a wide range of exercises. This type of training requires a greater coordination of muscles thus functioning as both cardiovascular and resistance training modality. ST is a type of resistance training uses ropes to suspend the body's segments and joints along various movement planes to employ the resistance generated by the individuals body weight opposite to the gravity, thereby effectively generating the neuromuscular responses and exercise stress necessary for the beneficial effects of physical activity. This makes it a more demanding form of physical activity<sup>12, 13, 14</sup>

The current scoping review aims to investigate the role of ST as an effective resistance training techniques and to explore its effects on muscle power and endurance among young adults. This could possibly provide us with a direction for our prospective research in this domain.

## 2. Objectives

This study assesses the impact of ST exercises on muscular fitness parameters like, muscle endurance, strength and power among young adults.

## 3. Methods

### Literature Search Strategy

Computerized electronic databases were searched using PRISMA guidelines for this Scoping review to identify relevant studies on ST as a viable Resistance Training technique. Specific key words like, Resistance training, Suspension training, TRX, muscle strength, muscle power and muscle fitness were used to extract articles from Google Scholar, PubMed, Cochrane, Embase, CINHAL, SPORTDiscus and PEDro. Articles other than English as well as non-RCT studies with non-specific outcome measures and poor-quality studies were omitted. Nine articles that met the study criteria represented in table-1, whereas selected for this scoping review. The study selection process is represented in Figure 1.

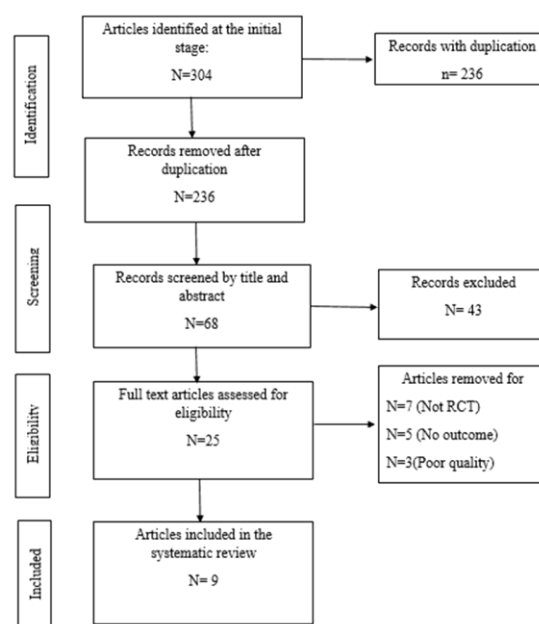


Figure- 1: Flow diagram of studies search, selection and inclusion process



### Inclusion and Exclusion Criteria:

Category	Inclusion	exclusion
<b>Population</b>	Studies that included male and female participants between 18 years to 35 years, with no restrictions concerning the level of physical fitness or the sport practiced.	Individuals with any impairments, obesity, diabetic, cardiovascular ailments, hypertensive, acute musculoskeletal injuries, and recent surgeries
<b>Intervention</b>	Studies that included suspension training program lasting $\geq 6$ weeks to $\geq 12$ weeks with at least 3 sessions comprising of whole body workout	Studies that included exercise interventions involving only the specific area like core, or only a particular body segment.
<b>Comparator/control</b>	Studies that included active suspension therapy with an alternate intervention as control group	Studies without a control group
<b>Outcome</b>	Studies reporting at least one measure related to fitness (e.g., jump height-distance or related jump measure [e.g., force; power]; muscle strength; flexibility) pre and post the training intervention	Studies without any baseline data physical fitness
<b>Study design</b>	Experimental study design including randomized control study design	Single-group interventions

**Table:1** Incusion and Exclusion Criteria

## 4. Results

The findings of this scoping review indicated that ST improves muscular fitness variables in both younger and middle-aged adults and has a positive effect on muscular fitness parameters like, muscle endurance, strength and power in young adults. The results also reflected that ST has a more significant role in improving motor dysfunction and physical coordination.

## 5. Discussion

This scoping review attempted to validate if ST would significantly improve the muscle endurance, strength and power and also have a positive impact on cardiovascular health, endurance, balance, and flexibility. Earlier

published studies shows that functional training methods are more effective compared to traditional workouts. Ozgur Nalbant et al. conducted a study examining the impact of the ST system on the strength and agility parameters of elite young male basketball players over six weeks.<sup>15</sup> The findings indicated significant improvement in the hip joint range of motion due to angular eccentric contraction, resulting in enhanced flexibility. The study demonstrated that ST effectively increased standing long jump (SLJ) and vertical jump (VJ) performance by strengthening the core, back, and leg muscles. During a six-week duration, ST also improved the agility and strength of basketball players. Research conducted by Pancar et al, investigated the impact of an 8-week ST exercise regimen on flexibility, strength, speed, and vertical leap in sedentary young males.<sup>16</sup> The study revealed that while the groups



exhibited no variance in speed, the ST group had a substantial enhancement in flexibility and strength metrics relative to the control group. Liping Liao et al indicated that the use of ST in the fitness regime of swimmers proved to be superior to conventional training, evidenced by a rise in the athletes' experimental scores from 15.33 to 17 points. Following ST training, shoulder flexibility and trunk rotational stability improved serving as necessary evidence to support the creation of specialized training material and methodologies for players from diverse sports and fitness levels in an attempt to minimize the sports injuries. ST significantly improves motor function, physical coordination, and stability thereby effectively enhancing the physical fitness and sports performance of an individual.<sup>17</sup> While ST involving high-intensity, low-repetition, improve the strength variables, low-intensity, high-repetition workouts with brief rest periods, promote muscle endurance. A study compared the benefits of a 5-week ST exercise program with a standard resistance workout regimen. The group had a considerable improvement in jump performance with increase in muscles strength and muscle mass.<sup>18,19</sup> Nalbant and Kinik (2018) identified a beneficial impact on explosive power in his research involving 20 basketball players who engaged in six weeks of exercise that assessed the impact of ST exercises on muscle strength, power as well as the physiological and metabolic health benefits across several parameters. The rationale behind the mode of action of ST is that, the oxidative capacity of skeletal muscles enhances with high-intensity exercise. Likewise, high-intensity exercise may reduce the dependence on energy generation through the substrate-level phosphorylation pathway, resulting in a reduction of metabolic byproducts such as lactate in the muscle and bloodstream. High-intensity circuit training alters many molecular signalling pathways, including Ca<sup>2+</sup>/calmodulin-dependent protein kinase, AMP-activated protein kinase, sirtuin 1, and peroxisome proliferator-activated receptor gamma coactivator 1-alpha.<sup>20</sup> This could explain why ST enhances individuals' performance in their respective activities and may enhance the oxidative capacity of skeletal muscle, mitigate fatigue, and hence elevate performance in endurance sports such as long-distance running. ST uses an unstable surface thereby promoting more activation of the muscles. Researchers concluded that exercising in

challenging situations activates the sensorimotor system, thereby facilitating the necessary response for maintaining postural stability and enhancing the movement precision. Furthermore, closed-chain workouts that include multijoint motions in an unstable condition facilitates the integration of signals used for postural correction.<sup>21</sup>

**Limitations and strength:** Although the advantages of ST are emphasized in the scoping review, it is important to acknowledge the limitations and strengths of the current study. Our study did not focus on the long-term effects of ST on physical fitness parameters. There may be a risk of bias in the selection in the included studies. This scoping review has only included studies published in English, by potentially excluding relevant research published in other languages. When drawing conclusions from this study, it is crucial to take into account the diversity of the research.

#### **Future Research Recommendations:**

The long-term effects, and research on diverse populations investigating the effects on physiological and metabolic health benefits may be included in future studies.

**Conclusion:** Findings from the current scoping review supports that ST improves the muscle endurance, strength and power in adults and can be used as a feasible alternative to traditional exercise modalities. Regular participation in ST improved muscular fitness, hand grip strength, and also demonstrated a positive result on reduction in waist circumference, both systolic and diastolic blood pressures, body fat, and improved the cellular health and function. Also, ST was found to generate high levels of core muscle activation and hence ST can also be employed as a rehabilitation method to musculoskeletal conditions. Fitness professionals can incorporate ST as a novel and unconventional mode of exercise training in their routine practice.

**Conflict of interest:** The authors declare that there is no conflict of interest.



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