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Review Article

Effect of Core Stabilization Exercises on Pulmonary Functions: A Systematic Review and Meta-analysis

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ABSTRACT

Background: Pulmonary function tests [PFTs] are noninvasive tests that examine the functionality of the lungs and provide a precise picture of the respiratory system's efficiency. Core stability [CS] is the capability of transferring forces from the upper to lower extremities and strengthening the lumbopelvic complex while keeping the spine in neutral alignment.

Aim of work: This study investigated the impact of core stabilizing exercises on pulmonary functions in healthy adults aged 18–60 years.

Methods: Seven databases were screened depending on an earlier published protocol. Forced vital capacity [FVC], forced expiratory volume [FEV_1], FEV_1/FVC ratio, peak expiratory flow rate [PEFR], and maximum oxygen volume [VO_2max] outcomes have been extracted from seven studies and synthesized qualitatively and quantitatively.

Results: From seven studies, two studies revealed a non-significant impact of CS exercise on VO_2max but with considerable heterogeneity; two studies demonstrated a significant effect on PEFR with no heterogeneity; six studies showed a significant impact of CS exercise on FVC but with considerable heterogeneity; four studies demonstrated a significant impact of CS exercise on FEV_1, with no heterogeneity, three studies demonstrated significant efficacy of CS exercises on FEV_1/FVC.

Conclusion: Core stability exercises have a significant impact on FVC, FEV_1, FEV_1/FVC, and PEFR, with no significant effect on VO_2 max.

Keywords: Core Stability Exercises; Pulmonary Functions; FVC; FEV_1; FEV_1/FVC ratio; PEFR; VO_2max

INTRODUCTION

Pulmonary function tests [PFTs] are noninvasive tests that measure how effectively the lungs function and provide precise, reproducible evaluation of the respiratory system's functioning [1].

These examinations quantify lung volume, capacity, flow rates, and gas exchange [2]. Recently, there has been significant interest in studying pulmonary functions, especially after the Corona pandemic [3].

Core stability [CS] is the capability to move forces from the upper to lower extremities and strengthen the lumbopelvic complex while keeping the spine in neutral alignment [4].

Anatomically, the "core" part of the body acts as a box with the diaphragm on top, the pelvic floor and hip muscles on the bottom, the abdominals in the front, and the spinal and gluteal muscles in the rear [5].

Core stability exercises enhance diaphragmatic strength and intra-abdominal pressure, both of which are critical in improving pulmonary functions by facilitating efficient respiratory muscle activity. The abdominal muscle group, which represents the anterior border of the core box, is an essential component of the core muscles [6].

The most popular conventional exercises to increase abdominal strength and stability involve weight-bearing exercises that involve static or dynamic contractions in different body positions, beginning with isolated movements and progressing to more complex sequences like crunches, sit-ups, and planks [prone or lateral] [7].

The diaphragm is another essential component of the core muscles. Breathing exercises can improve diaphragmatic strength, which can play a role in enhancing core stability as well as pulmonary functions [2]. Interestingly, many core stability exercises directly affect the respiratory muscles, denoting that the correct breathing is essential to abdominal training [8].

Finally, the back muscles [9] and the pelvic floor represent the posterior and inferior borders of the core box, respectively. Increasing the intra-abdominal pressure is necessary to improve the forced vital capacity [FVC], which benefits from pelvic floor muscle reinforcement through Kegel exercises [10].

Moreover, the back muscles and pelvic floor are essential components of the core stabilizing muscles, and their weakness can lead to pulmonary dysfunction [11].

Pulmonary function impairment is associated with reduced ventilation and oxygen intake, increased stress, anxiety, impaired body functions such as sleep, cognitive, and brain functions, and progressive impairment of respiratory muscles and peripheral limbs, which limit routine activities [9].

All of these might cause adverse consequences on health-related quality of life [HRQOL] [12]. Thus, searching for modalities to enhance the impaired pulmonary function was critical to improving ventilation, oxygen intake, and other body functions**.** In practice, the majority of kinetic chains transmit forces to the extremities through the core muscles [13]. For many years, the most popular core physical training exercises were sit-ups and curl-ups [14].

Pelvic floor exercises are a subset of core stability exercises, focusing specifically on reinforcing the inferior support structures that contribute to intra-abdominal pressure and indirectly affect pulmonary functions

To the authors' knowledge, no systematic review provided clinicians with information regarding the efficacy of core stability and pelvic floor exercises on pulmonary functions.

Despite the growing interest in core stability exercises, there is a lack of systematic evidence demonstrating their impact on specific pulmonary function outcomes, especially in healthy adults.

This study provides a foundation for future clinical trials in pulmonary rehabilitation. This research aims to bridge the gap in understanding how core stability exercises can improve pulmonary rehabilitation protocols. Thus, it summarized the evidence regarding the impact of core stabilizing exercises on pulmonary functions.

METHODS

Protocol registration:

The International Prospective Register of Systematic Reviews [PROSPERO] [www.crd.york.ac.uk/prospero] received the review protocol as an a priori study [registration number: CRD42023415614]. This review was done utilizing the PRISMA standards [www.prisma-statement.org].

Eligibility criteria:

Studies that fulfill the following criteria were involved: 1] Studies comprised healthy subjects aged 18 to 60 years old; 2] English-written studies; 3] The search began from 2000 to 2024; 4] Studies investigated pulmonary functions before and after performing core stability exercises using only randomized control trials [RCTs]; 5] Body mass index ranged from normal to 30kg/m^2. The analysis excluded studies published in languages other than English. The key parameters used to determine the efficacy of CS exercises on pulmonary functions were forced vital capacity [FVC], forced expiratory volume at one second [FEV1], FEV1/FVC ratio, peak expiratory flow rate [PEFR], and VO_2max Table 1 represents the identification of each variable.

Table [1]. Definitions of terms.

Term	Definition
Core stability [CS].	It is the lumbar-pelvic-hip muscle complex's capability to adjust trunk motion and maintain spinal column stability through skeletal disruptions [15].
Pulmonary function tests [PFTs].	They are noninvasive tests that examine the functionality of the lungs [16].
Forced vital capacity [FVC].	The air volume that can be forced out of the lungs after inhaling as deeply as possible [17].
Forced expiratory volume at one second [FEV_1].	The amount of air exhaled in the first second during the forceful expiration following maximum inhalation [measured in liters] [18].
FEV_1/FVC Ratio.	The ratio shows how much air the lungs can forcefully exhale [19].
Peak Expiratory Flow Rate [PEFR].	The amount of air forced out of the lungs in just one, fast exhalation [18].
Maximal Oxygen Uptake [VO_2max].	Maximum rate of oxygen consumption attainable during physical exertion [20].
Maximal Voluntary Ventilation [MVV].	It is the subject's maximum minute respiration volume sustained for 12 to 15 seconds [21].

CS - Core Stability; PFTs - Pulmonary Function Tests; FVC - Forced Vital Capacity; FEV1 - Forced Expiratory Volume at One Second; PEFR - Peak Expiratory Flow Rate; VO2max - Maximal Oxygen Uptake; MVV - Maximal Voluntary Ventilation.

Search strategy and investigated databases

The primary keywords of our search involved core stability, core stability exercises, curl-up exercises, sit-up exercises, planking, pelvic floor exercise, Kegel exercise, bridging exercise, lumbopelvic stability exercise, push-up exercises, abdominal exercises, abdominal muscle activation, pelvic rocking, back muscle activation, pulmonary function, pulmonary function tests, respiratory parameters, FVC, FEV1, peak expiratory flow rate, vital capacity, VC, PEFR, maximal voluntary ventilation, forced expiratory flow at one second, forced vital capacity, MVV, and VO2max. Databases include Cochrane Library, SAGE, EBSCO Host, Web of Science, PubMed, EMBASE, and Scopus. From the beginning to 2024, search engines were looked up [Table 2]. An intensive manual search was conducted through the listed studies' references to find other relevant articles.

Study selection:

Following deleting duplicates, two independent investigators [Mohamed Ahmed Omar Mohamed [M. A. O. M] and Ali Mohamed Ali Ismail [A. M. A. I]] exhibited the titles and abstracts of the relevant obtained papers. Titles and abstracts were initially screened to identify study designs, and full texts were reviewed to confirm their eligibility. The same two researchers retrieved the full texts of the relevant papers and evaluated them based on the eligibility criteria. Conflicts were resolved through discussions till an agreement had been reached.

Evaluation of bias risk:

For randomized control trials [RCTs], two researchers [M. A. O. M. and A. M. A. I] independently assessed the bias risk through the Cochrane risk of bias scale [ROB2]. Throughout the assessment, investigators were blind to the research's authors. Using the appropriate 95% confidence interval [CI] and non-weighted Kappa statistics, the inter-rater agreement among the two researchers was determined. The third researcher 'Fatma Aboelmagd Mohamed' was consulted only when consensus could not be reached between the two primary reviewers to ensure impartiality and avoid bias

Data extraction:

The two reviewers, M.A.O.M. and A.M.A.I., separately extracted the relevant data. They double-checked their findings to confirm the accurate collection of all relevant data. They retrieved the authors, publication year, title, study design, demographics of healthy subjects, pulmonary function measures [FVC, FEV1, FVC/FEV1, PEFR, VO2max, and MVV], results, and conclusions [Table 2]. One researcher, M.A.O.M., extracted the data, and another researcher, A.M.A.I., revised it to ensure accurate data collection. If any data were missed, the corresponding authors of the incorporated studies were informed.

Data presented as the standardized mean difference of FVC, FEV1, FEV1/FVC ratio, PEFR, VO2max, and MVV. A random model was chosen to adjust for heterogeneity, while a forest plot was used to visualize the effect size. Heterogeneity was addressed using a random-effects model, and the adjusted results are presented in the meta-analysis. Moreover, the Egger test was used to assess the symmetry of studies in the funnel plot [publication bias assessment]. Cochrane's Review Manager [RevMan 5.4] program was implemented to perform meta-analysis. Using inverse variance weighting, we determined the standardized mean difference [SMD] and the associated 95% CI [22].

RESULTS

Study selection

The search using various databases produced 2615 articles. **Figure 1** displays the flowchart for the systematic review. Healthy adults aged 18–60 years with a BMI of 18.5–30 kg/m² and studies published in English from 2000 to 2024. Researchers eliminated duplications, reviewed the titles and abstracts of the residual studies [n = 980], and read the complete texts of twelve articles. There were seven articles in this review [23-29] and five articles were excluded as they were different study designs [30-34].

Study characteristics:

Seven databases—Cochrane Library, SAGE, EBSCO Host, Web of Science, PubMed, EMBASE, and Scopus—were screened. The impact of CS exercises on FVC was mentioned in six studies [23-25, 27-29]. The impact of CS exercises on FEV1 was mentioned in four studies [23, 25, 27, 28]. Three studies [26-28] mentioned the impact of core stabilization exercises on FEV1/FVC rate, two studies [23, 27] identified the efficacy of CS exercises on PEFR, and two studies [24, 26] mentioned the impact of CS exercises on VO_2max.

Risk of bias:

Table 3 displays the quality assessment of the relevant articles. The Kappa statistics revealed significant agreement between the two reviewers, with a score of 0.76 [95% CI, 0.56-0.95] [35]. All the included studies were scored on their methodological accuracy using the ROB2 scale, which is more specific to rating RCT quality [36]. Six of the involved studies were classified as high-risk, while one was classified as of some concern. Meta-analysis applied for the seven studies revealed a statistically significant effect of core stability exercises and pelvic floor exercises on pulmonary functions.

A-meta-analysis of the effect of CS on vo2max:

Figure 2 represents the meta-analysis data for the impact of core stabilization and pelvic floor exercises on VO2 max, extracted from the two studies [24, 26]**.** The analysis of the results demonstrated a non-significant effect of core stability exercise on VO2 max. [SMD = 3.52 [95% CI = [-3.32 to 10.37], p = 0.31], but with considerable heterogeneity [I2 = 98%, p = 0.0001].

B-Meta-analysis of the efficacy of CS on PEFR:

Figure 3 represents the meta-analysis data for the impact of core stabilization exercise on PEFR, extracted from two studies [23, 27]. The analysis of the results indicated a significant effect on PEFR. [SMD = 1.21 [95% CI = [.66 to 1.76], p < 0.0001], with no heterogeneity [I^2 = 0%, p = 0.67].

C-Meta-analysis of the effect of CS exercise on FVC:

Figure 4 represents the meta-analysis data for measuring the impact of CS exercises and pelvic floor exercises on FVC, extracted from the six studies [23-25, 27-29]**.** The analysis of the results demonstrated significant SG group improvement when compared to the CG for FVC [SMD = 1.26 [95% CI = 0.53 to 1.99], p = 0.0007], but with considerable heterogeneity [I2 = 81%, p < 0.00001].

D-Meta-analysis of the efficacy of CS exercise on FEV1:

Figure 5 represents the meta-analysis data for measuring the impact of CS exercises and pelvic floor exercises on FEV_1, extracted from the four studies [23, 25, 27, 28]. The analysis of the results demonstrated significant SG group improvement when compared to the CG for FEV_1. [SMD = 0.88 [95% CI = 0.48 to 1.27], p = .0001], with no heterogeneity [I^2 = 0%, p <0.0001].

E-Meta-analysis of the effect of CS on FEV1/FVC:

Figure 6 represents the meta-analysis data for measuring the impact of CS exercises and pelvic floor exercises on FEV_1/FVC, extracted from the three studies [26-28]. The analysis of the results demonstrated significant SG group improvement when compared to the control group for FEV_1/FVC. [SMD 1.12 [95% CI = 0.66 to 1.58], p = .0001], with no heterogeneity [I^2 = 0%, p < 0.00001].

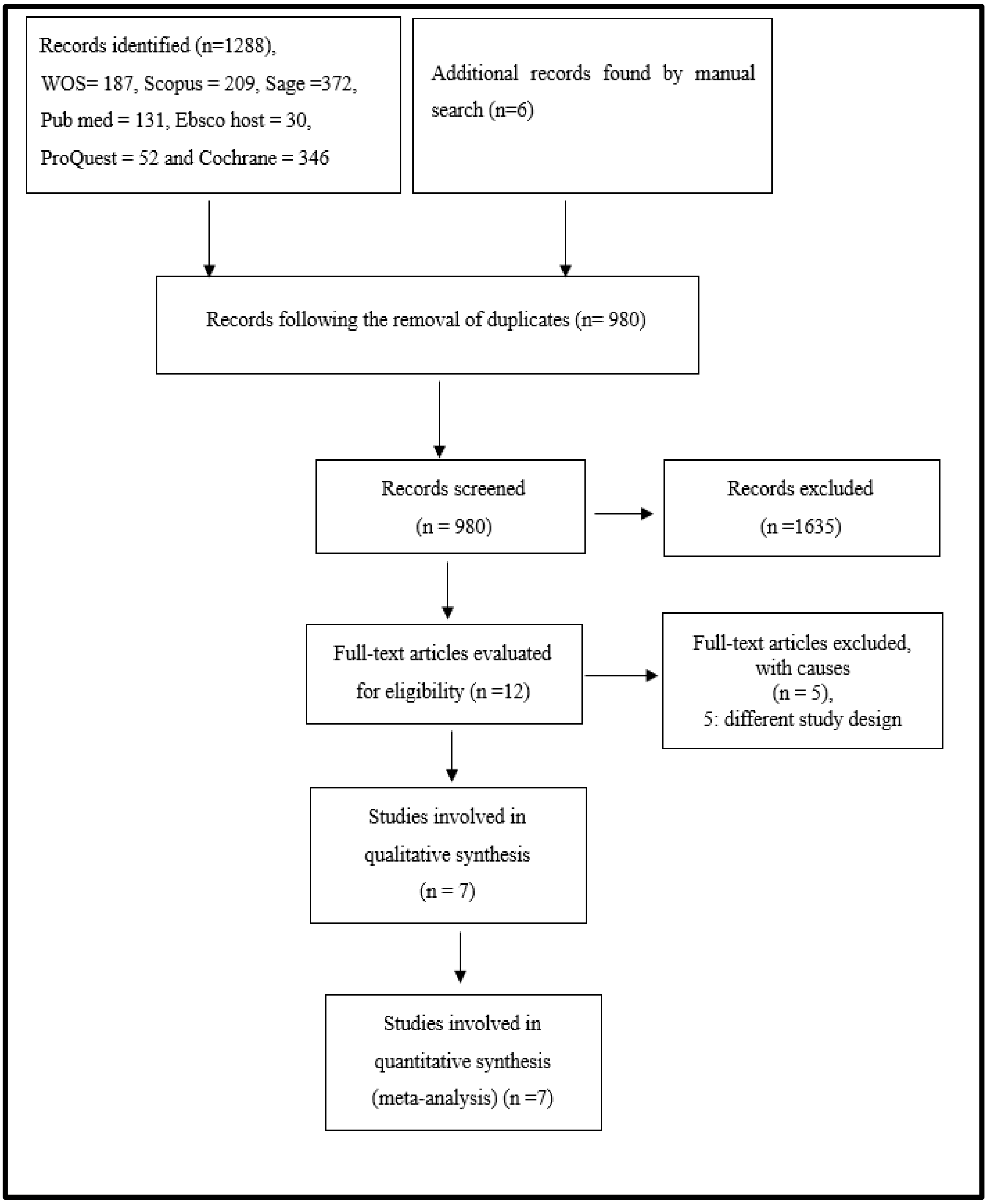

Figure 1. PRISMA flow diagram

Table 2. Data extraction sheet for the reviewed studies

Study	Participants	Interventions		Out-comes	Results
		study group [SG]	control group [CG]		
Han and Ha [2015] [27]	Total. N= 30 Study: 15 Control: 15	Kegel Exercises Dosage = 4 weeks.	No treatment.= 4 weeks.	- FVC - MVV - FEV_1 - PEFR - FEV_1/FVC [%]	The experimental group's FVC, FEV1, PEFR, and MVV all significantly improved after performing Kegel exercises, while the control group experienced no improvement at all.
Rathore and Mish ra [2017][29]	Total. N= 45 Study:30 [Static:15and Dynamic:15] Control: 15	Static and dynamic core exercise= 12 weeks.	No treatment. = 12 weeks	- FVC	The experimental group's vital capacity was significantly enhanced by practicing both static and dynamic core exercises. Vital capacity was observed to differ significantly between the dynamic core exercise group and the CG. The findings further support the conclusion that a dynamic core exercise training program is superior to a static program in terms of its ability to improve vital capacity.
Ansari and Mishra [2022] [23]	Total. N= 30. Experimental Group 1 [EG1]: [n= 10]. Experimental Group2[EG2] :[n=10]. CG: [n= 10].	EG1 carried out core exercises with diaphragmatic breathing. EG2 only carried out core exercises. Dosage= 6week	The CG group did not perform any exercise through these six weeks.	FVC, FEV_1, and PEFR	Following the training assessment, all pulmonary variables in the EG1 and EG2 groups showed significant changes over baseline, but no outcomes in the control showed any significant changes.
Karapolat et al. [2020] [28]	Total. N= 22 SG: [n= 11] CG: [n= 11]	The SG performed a core training program three days a week for eight weeks.	Received no treatment. For eight weeks	FVC, FEV_1, FEV_1/FVC and maximal inspiratory muscle strength.	The study group's inspiratory muscle strength levels and respiratory parameters demonstrated a statistically significant difference.
Gercek et al. [2023] [26]	-Total. N= 51 -CS Group [n = 17] -Auxiliary Respiratory Muscle [ARM] strengthening exercise. Group [n = 17] -Control [CG] Group [n = 17].	CS and ARM strengthening exercises were practiced three times weekly for six weeks.	Received no treatment for 6 weeks.	VO_2max, FEV_1, FEV_1/FVC and MVV.	CS and ARM strengthening exercises had a valuable impact on FEV1/FVC and MVV.
Balaji et al. [2016] [24]	Total. N= 30 CS exercises group: [n= 15] CG: [n= 15]	CS exercises three times a week for 12 weeks.	Received no treatment for 12 weeks.	FVC and VO_2max.	The CS exercise group significantly outperformed the control in vital capacity and VO_2max, indicating a significant improvement.
Bostanci et al. [2020] [25]	Total. N= 22 SG: [n= 11] CG:[n= 11]	Core stability exercises for 8 weeks.	Received no treatment for 8 weeks.	FVC, FEV_1, and slow vital capacity [SVC]. - MIP and MEP	Significant improvements were detected in FVC, MIP, and MEP in EG between the pretest and post-test [p<0.05]. - Post-test results indicated significant changes [p<0.05] in FEV1, SVC, and MEP between EG and CG. - The results revealed that CS training strengthened the respiratory muscles and improved certain lung functions. Accordingly, young soccer players benefit from CS training in their pulmonary functions, especially their respiratory muscle strength.

FVC - Forced Vital Capacity; MVV - Maximal Voluntary Ventilation; FEV1 - Forced Expiratory Volume at One Second; PEFR - Peak Expiratory Flow Rate; FEV1/FVC - Ratio of Forced Expiratory Volume at One Second to Forced Vital Capacity; VO2max - Maximal Oxygen Uptake; SVC - Slow Vital Capacity; MIP - Maximal Inspiratory Pressure; MEP - Maximal Expiratory Pressure; CS - Core Stability; ARM - Auxiliary Respiratory Muscle.

Table [3]. Evaluation of bias risk

Study	D1	D2	D3	D4	D5	overall bias
Han and Ha [2015] [27].	Some concern	Some concern	Low risk	High risk	Some concern	High risk
Rathore and Mishra [2017] [29].	Some concern	Some concern	Low risk	High risk	Some concern	High risk
Ansari and Mishra [2022] [23].	Some concern	Some concern	Low risk	High risk	Some concern	High risk
Karapolat et al. [2020] [28].	Some concern	Some concern	Low risk	High risk	Some concern	High risk
Gercek et al. [2023] [26].	Low risk	Low risk	Low risk	Some concern	Low risk	Some concern
Balaji et al. [2016] [24].	Some concern	Some concern	Low risk	High risk	Some concern	High risk
Bostanci et al. [2020] [25].	Some concern	Some concern	Low risk	High risk	Some concern	High risk

D1 - Bias arising from the randomization process; **D2** - Bias due to deviations from intended interventions; **D3** - Bias due to missing outcome data; **D4** - Bias in the measurement of the outcome; **D5** - Bias in the selection of the reported result. This table evaluates the risk of bias across five domains [D1-D5] for each study, providing an overall bias assessment.

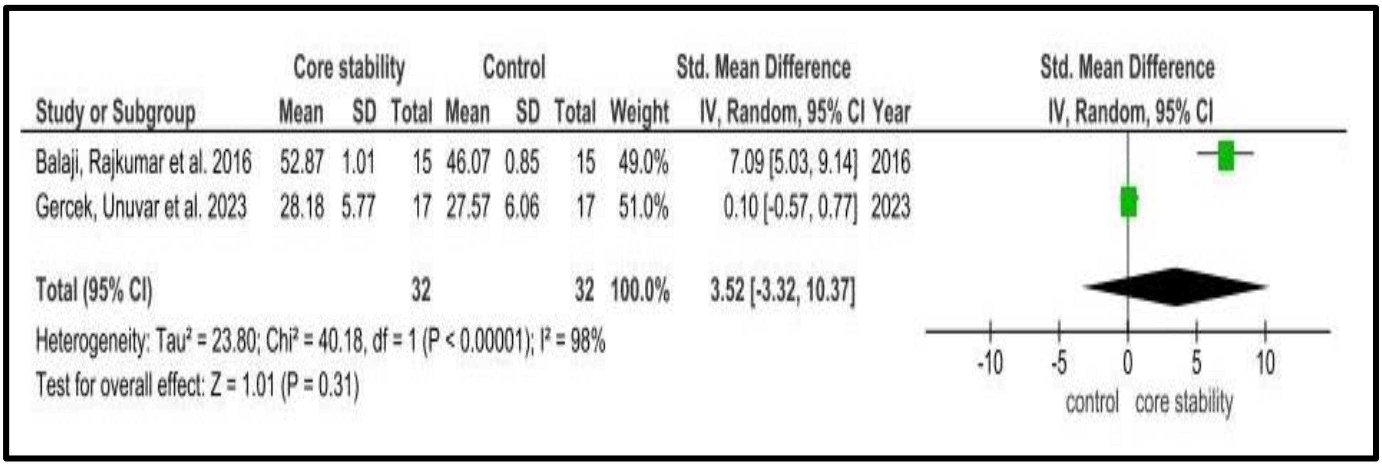

Figure 2. Meta-analysis of the effect of CS exercises and pelvic floor exercises on VO_2max.

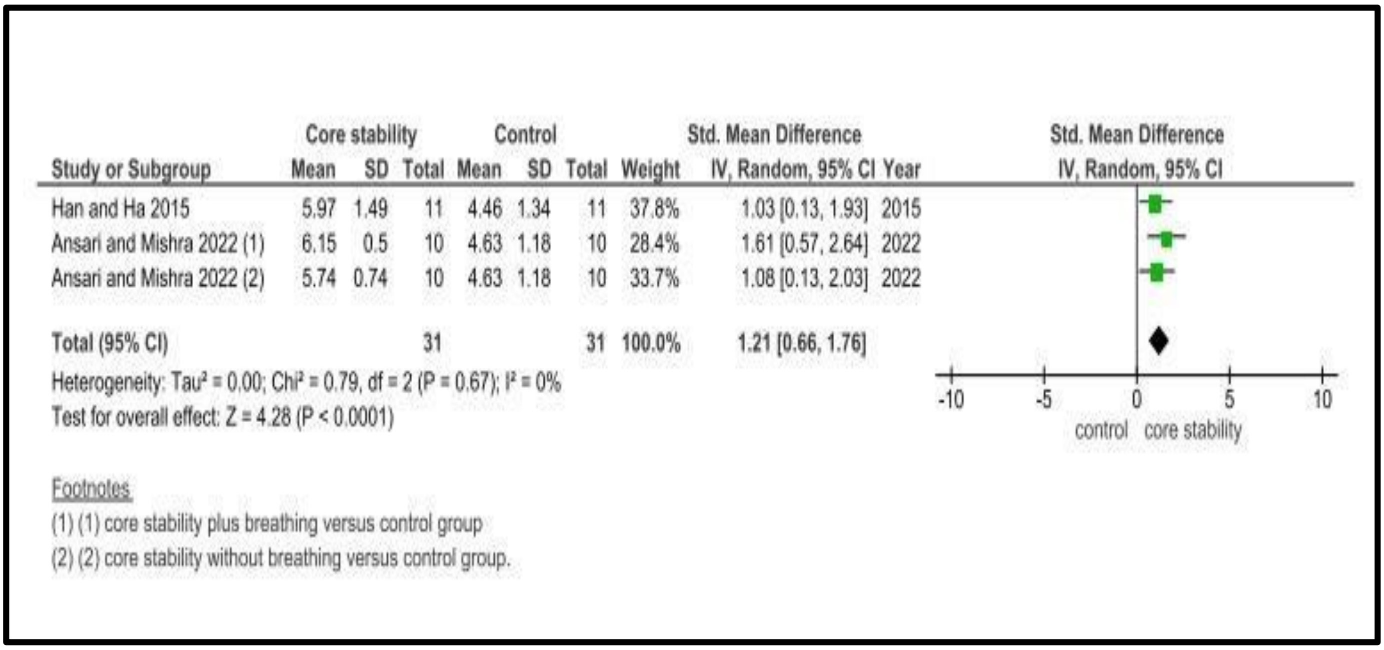

Figure 3. Meta-analysis of the effect of CS exercises and pelvic floor exercises on PEFR.

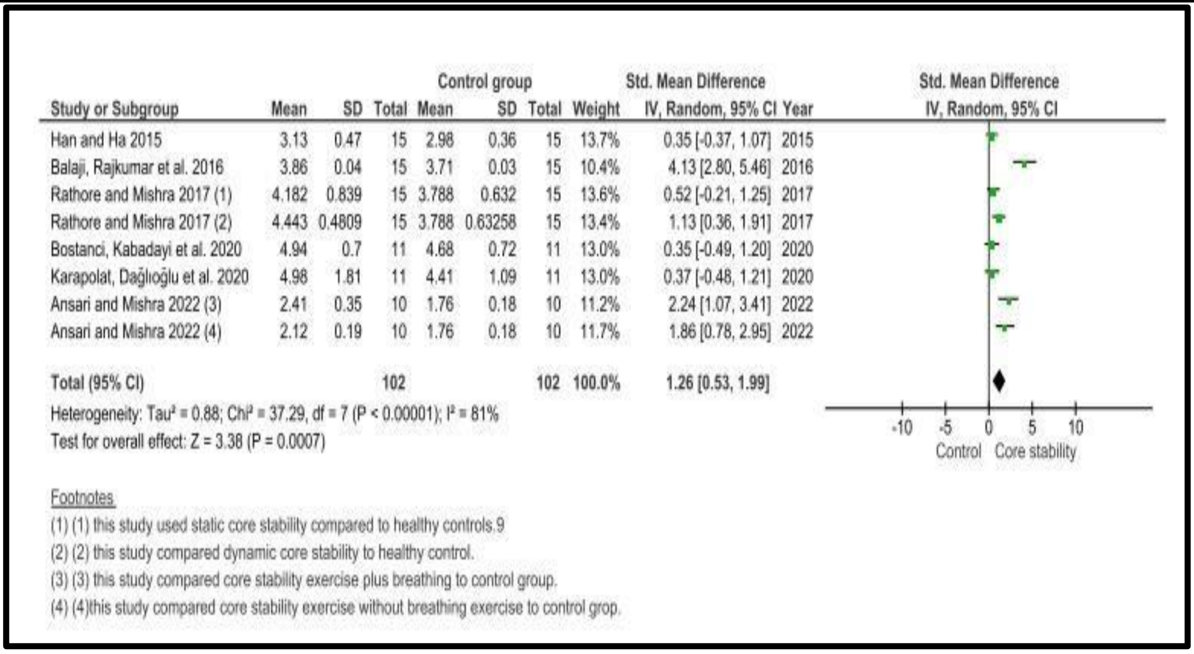

Figure [4]. Meta-analysis of the effect of CS exercises and pelvic floor exercises on FVC.

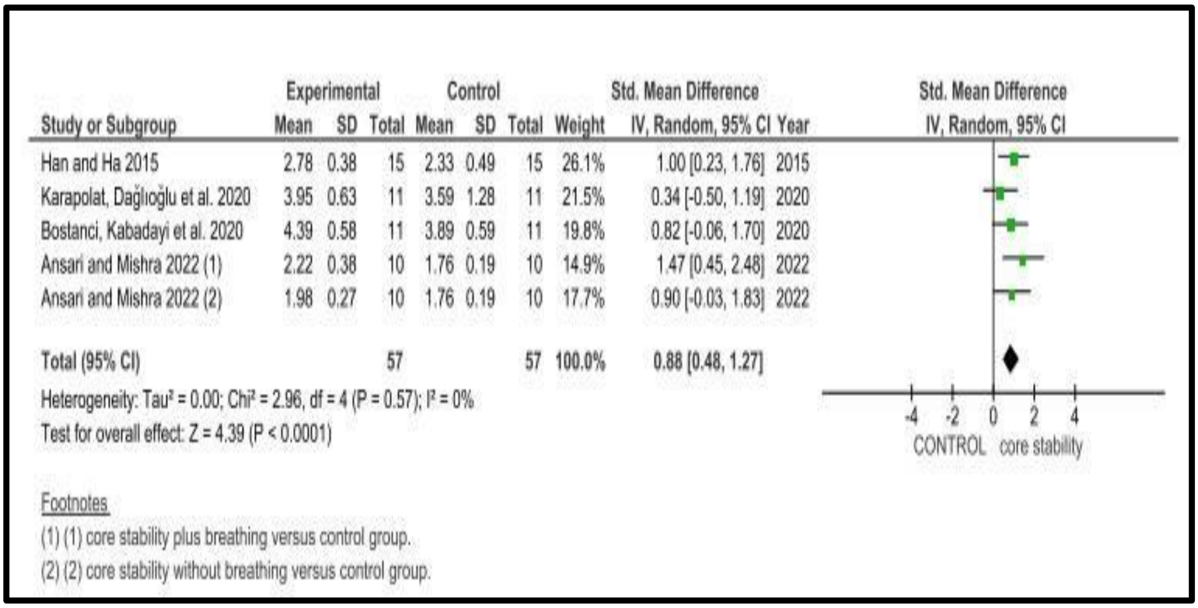

Figure [5]. Meta-analysis of the effect of CS exercises and pelvic floor exercises on FEV_1.

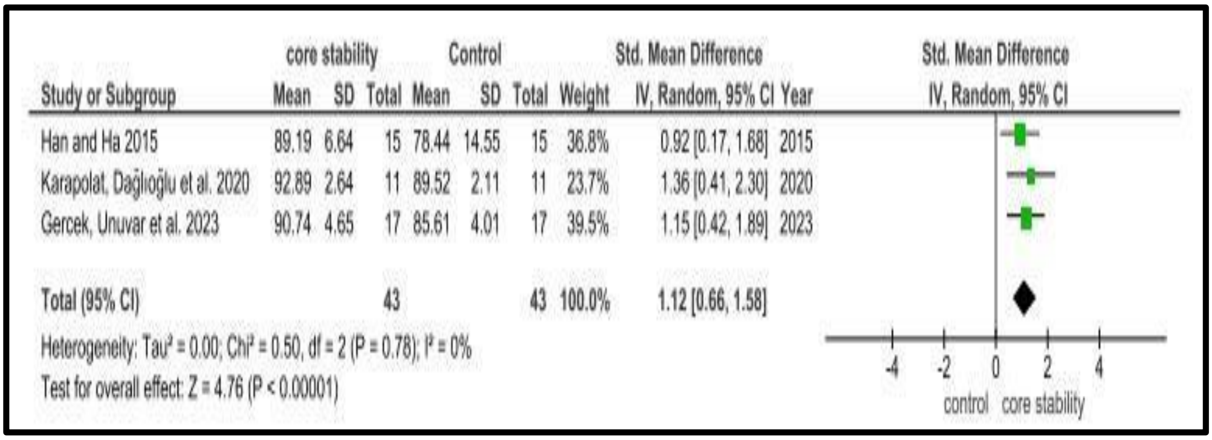

Figure [6]: Meta-analysis of the effect of CS exercises and pelvic floor exercises on FEV_1/FVC.

DISCUSSION

This systematic review and meta-analysis were executed to systematically summarize the present research that examined the impact of core stabilization exercises and pelvic floor exercises on pulmonary functions, which include FVC, FEV1, FEV1/FVC, PEFR, and VO_2max.

The studies included in this evaluation span the years from inception to 2024. Precise selection procedures were employed to examine seven RCTs for inclusion in the current systematic review. Meta-analysis was applied to seven studies [23-29]. Out of the seven studies, two studies [24, 26] examined the impact of CS exercises on VO_2max. The meta-analysis results revealed that core stabilization exercise had a non-significant impact on VO_2max but with considerable heterogeneity. Two studies [23, 27] investigated the impact of core stabilization exercises on PEFR; the meta-analysis results demonstrated a significant effect on PEFR with no heterogeneity. Six studies [23-25, 27-29] examined the efficacy of CS exercises on FVC; the analysis of the results demonstrated a significant impact of core stabilization exercises on FVC, but with considerable heterogeneity. Four studies [23, 25, 27, 28] examined the impact of core stability exercises on FEV1; the analysis of the results demonstrated significant efficacy of CS exercise on FEV1 but with no heterogeneity. Three studies [26-28] explored the efficacy of CS exercises on FEV1/FVC. The analysis of the results demonstrated a significant impact of core stabilization exercise on FEV1/FVC.

The current study found a significant effect of CS exercises on FVC, FEV1, FEV1/FVC, and PEFR. Regrettably, the meta-analysis examining the impact of CS on vo2max included only two studies, resulting in a non-significant effect on vo2max.

These findings could potentially relate to the effect of CS exercises on abdominal pressure. During normal breathing, inspiration is the process by which outside air enters the body as the diaphragm contracts and descends. But exhalation is the process by which the contracted diaphragm relaxes and moves upward. On the other hand, the anterior and lateral abdominal muscles tighten during forced expiration or coughing, creating pressure that forcefully raises the diaphragm. PFM contraction hence aids in maintaining abdominal pressure [18]. Through their coordinated contractions, the core muscles assist in breathing and maintaining abdominal pressure [37]. From this perspective, strengthening core muscles through CS exercises improved pulmonary function.

Han and Ha [27] studied the effect of the Kegel exercises on FVC, FEV1, PER, FEF 25–75%, IC, and MVV compared to the control group, which received no treatment. The frequency of training performed three times daily for four weeks showed a significant effect of the Kegel exercises on FVC, FEV1, PER, FEF 25–75%, IC, and MVV compared to the control group. These results were consistent with the study performed by **Rathore and Mishra** [29] to explore the impact of 12 weeks of static and dynamic core stabilization exercises on FVC compared to the control group, who received no treatment. The results showed a significant impact of the static and dynamic core stabilization exercises on FVC compared to the control group, who received no treatment.

Regarding Ansari and Mishra [23], the impact of CS alone and CS with diaphragmatic breathing on FVC, FEV1, and PEFR in comparison to the control group, who received no treatment, the frequency of training was performed for six weeks which showed a significant effect of the CS alone and CS with diaphragmatic breathing on FVC, FEV1, and PEFR compared to the control group. **Karapolat *et al.*** [28] studied the effect of CS exercises on MIP, VC, FVC, FEV1, and FEV1/FVC for eight weeks of training compared to a control group that did not practice exercises. They showed significant effects of core exercises on MIP, VC, FVC, FEV1, and FEV1/FVC compared to the control group. **Gercek *et al.*** [26] compared the effects of CS and ARM strengthening exercises on VO_2max, FEV1/FVC, and MVV over six weeks to the control group that did not receive any type of intervention. The results showed that CS and ARM strengthening exercises had significant impacts on VO_2max, FEV1/FVC, and MVV compared to the control group. Furthermore, CS exercises for 12 weeks had a significant effect on vital capacity and VO2max compared to the control group which received no training [24]. **Bostanci *et al.*** [25] examined the impact of CS exercises for eight weeks on forced vital capacity compared to the control group who received no treatment. The results showed a significant efficacy of CS exercises on FVC compared to the control group in young soccer players.

Our findings revealed that core stabilization and pelvic floor exercises significantly impact pulmonary function. These findings align with previous studies demonstrating the role of core stability in enhancing respiratory muscle efficiency. However, variability in exercise protocols suggests the need for standardized guidelines.

Limitations of the review: The current study found a significant effect of CS exercises on FVC, FEV1, FEV1/FVC, and PEFR. However, there was no significant impact on vo2max due to the limited trials [only two] included in the meta-analysis examining the effectiveness of core stability on vo2max. Six of the seven involved studies in the review were of high-risk quality, while one was of some concern. High risk of bias in six studies affects the strength of evidence. However, the synthesis provides a preliminary understanding to guide future well-designed trials. While meta-analysis was conducted with two studies for certain outcomes, this preliminary synthesis serves to highlight areas requiring further research. Despite methodological limitations, meta-analysis provides an initial synthesis of evidence to inform future research. Therefore, more research is necessary to confirm the outcomes of the current review.

Conclusion: All the included studies were scored on methodological accuracy using the ROB2 scale, which is more specific to rating RCT quality. Six of the involved studies were of high-risk quality, while one was of some concern. The meta-analysis executed on the seven studies revealed a statistically significant effect of core stabilizing and pelvic floor exercises on pulmonary functions. These findings highlight the clinical relevance of core stability exercises in pulmonary rehabilitation, particularly for improving vital capacity and expiratory flow rates. The currently available data supports the effectiveness of core stabilizing and pelvic floor exercises on pulmonary functions. However, further clinical trials are required to clinically support the impact of core stability and pelvic floor exercises on pulmonary functions.

Core stability exercises consistently improved pulmonary parameters such as FVC and FEV1 across studies. Differences in the duration and intensity of interventions highlight areas for standardization in future studies. Implications include potential applications in pulmonary rehabilitation for both healthy individuals and clinical populations.

Future implications of the review: More RCTs are still required to explore the impact of core stabilization and pelvic floor exercises on pulmonary functions. More clinical trials will be needed to determine the efficacy of core stability exercises on patients with pulmonary diseases. Future studies will be required to explore the impacts of core stability exercises on vo2max.

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