



EFFECT OF DIFFERENT CORE MUSCLE STRENGTHENING EXERCISES ON RESPIRATORY PARAMETERS– AN EVIDENCE BASED STUDY

Medicine

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ABSTRACT

Introduction: The role of the abdominal muscles is seen in both quiet and forceful breathing.¹ De Troyer et al. (1990) During voluntary efforts such as expiration from functional residual capacity, speaking, expulsive maneuvers, and isovolume belly-in maneuvers, the Transverses Abdominis (TrA) is in general contracted together with the External oblique and Rectus abdominis.² They have wide variety of functions, including participation in postural, ventilatory, and airway defensive reflexes. For example, Rectus abdominis is considered to be primarily a postural muscle, whereas the TrA has both postural and ventilatory functions.^{2,3}

Objective: The aim of this study was to systematically evaluate the existing literature showing correlation between core muscle strength with various respiratory parameters and to find the evidences for the effect of core stability and core muscle strengthening exercises on respiratory parameters

Methods: Data was collected from several databases: (PubMed, GOOGLE SCHOLAR, and MEDLINE) using Keywords. Studies selected were from year 2002 to 2020. Our inclusion criteria consisted of articles published in a peer-reviewed journal in English, using any clinical study design, where Treatment is performed with core stabilization, deep abdominal or core muscle strengthening exercises. FEV1; FVC; FEV1/FVC and PEF were used as outcome measures. 21 Articles retrieved of necessary information out of which 12 articles were reviewed in study while other articles are showing relationship between core strength and pulmonary functions were excluded. The study design, participant information, description of interventions in the control and experimental groups and outcome measures were extracted. The Methodological quality was evaluated with PEDro scale.⁴

Results: Evidences were systematically reviewed and analyzed. Ten out of twelve studies confirmed that effect of core muscle strengthening exercises were statistically significant in improving respiratory parameters, Where two studies showed that effect of core muscle strengthening exercises were not statistically significant in improving respiratory parameters.

Conclusions: Based on evidences core strengthening exercises are effective in improving respiratory functions.

KEYWORDS

Pulmonary function test; Abdominal drawing manoeuvre; Core stability exercise; Vital capacity; Respiratory parameters

INTRODUCTION

The “core” is anatomically defined as an envelope with the Abdominals in the front, Paraspinals and Gluteals in the back, the Diaphragm as the roof, and the Pelvic Floor and hip girdle musculature as the bottom.^{5,6,7} Activating core muscles through exercise training programs has been effective for treatment of musculoskeletal conditions⁸ and prevention of injuries.⁹ Gurudut P et al.(2017) Core has been linked through a kinetic chain formed with lower and upper extremities. Hence, the core is center to all forms of functions and performance tasks. The stronger core will help to maximize upper and lower extremity function.¹⁰ Core stability is usually to strengthen the muscle around the abdominal, lumbar, and pelvic regions, because the muscles of these regions play an important role in stability as well as in controlling the lumbar posture by using tonic and postural muscles during whole body exercise.¹¹

The diaphragm serves as the roof of the muscular box of the core. Several muscles worked for the postural control and respiration are similar that is diaphragm, transverses abdominis and muscles comprising the pelvic floor, studies have found that diaphragm has contributed biomechanically to maintain trunk stability.¹² Diaphragm performs both postural and breathing function. Disruption in one function could negatively affect the other.¹³ Impaired kinematics of diaphragm and core muscle and changes in breathing pattern were observed in patient with back pain undergoing a motor task.¹³

When both abdominal muscles and diaphragm are contracted together leads to increases the intra abdominal pressure and the stability of the trunk can be enhanced.¹⁴ It is believed that when the ventilatory capacity of the lungs are compromised, the respiratory functions are affected and the individual would utilize the deep abdominal muscles to perform forced expiration, thus giving scope for lateral breathing to improve inspiratory action. But there is gap in literature where studies are done to assess the effect of core strengthening on respiratory parameters.

OBJECTIVE:

The aim of this study was to systematically evaluate the existing literature to find the evidences for the effect of core stability and core muscle strengthening exercises on various respiratory parameters.

CLINICAL QUESTION ?

Does core stability and core muscle strengthening exercises have effect on respiratory parameters?

MATERIALS AND METHODS:

Search strategy :

A systematic search was conducted with search terms Deep Abdominal muscle strengthening; Core stability exercise ; Forced pulmonary function; Vital capacity. Published articles from 2002 to Dec 2020 were identified using electronic database like Google Scholar, Pubmed, Medline, Libgen.

INCLUSION CRITERIA:

1. Must be published in a peer-reviewed journal in English, using any clinical study design.
2. Studies must have utilized treatment strategies performed with core stabilization, deep abdominal or core muscle strengthening exercises.
3. FEV1; FVC; FEV1/FVC and PEF were used as outcome measures.

EXCLUSION CRITERIA:

Studies which shows only association or relationship between core strength and endurance with respiratory parameters but not performing any strengthening exercises were excluded.

Data Extraction :

The participant information, study design, details of interventions in the control and experimental groups and outcome measures were extracted. Outcome measures mostly used in were FEV1; FVC; FEV1/FVC and PEFR. Two reviewer separately assessed titles, abstracts and full texts of articles. Disagreements were resolved by discussion.

PEDro, impact factor of journal, type of study and number of subjects in a study were used for quality assessment of selected studies.

Study selection:

Our search strategy resulted in the identification of 5750 records; after

excluding duplicates, 820 publications were manually screened by titles and abstracts among them 799 records excluded and 21 papers were eligible for inclusion. (Figure 1) On the basis of review of full-text articles and 15 met our inclusion criteria. After discussion, three articles were subsequently removed as they were duplicate. Thus, total of 12 studies were finally included in this overview.

Methodological quality:

The quality was evaluated using the PEDro (Physiotherapy Evidence Database) scale.⁴ The PEDro scale assesses methodological quality and consists of a checklist of 11 criteria, 10 of which are scored. 1 point was awarded against each criterion the study met. The points were given score out of 10. The scale applies only to experimental studies. For this review, studies with PEDro scores of 6 to 10 were considered high quality, of 4 to 5 were considered moderate quality, and of 0 to 3 were considered low quality. The PEDro scale does not evaluate clinical usefulness.

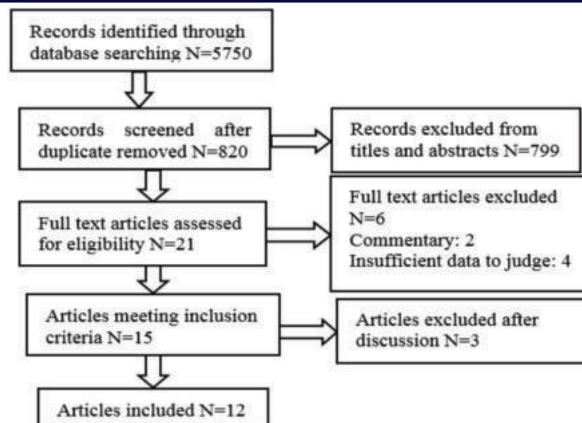


Figure 1. Flow diagram of literature search

RESULTS:

TITLE	N	STUDY DESIGN	DURATION	OUTCOME MEASURES	RESULT	PEDRO SCORE
A study on core stability training for postural control ability and respiratory function in patients with chronic stroke Chun SP, Kim KY, Kang TG, Kim GD (2015) ¹⁵	30 subjects Experimental group (n=15) received core- stability training and control group (n=15) received general exercise	Randomly divided	8weeks	FEV1, FVC	The experimental group showed significantly increases from control group at post in FVC and FEV1 (p<.05)	PEDRO 7/11
The effects of deep abdominal muscle strengthening exercises on respiratory function and lumbar stability. Kim E, Lee H. (2013) ¹⁶	22 Students Experimental group – 11 deep abdominal muscle strengthening exercises Control group of 11-no particular intervention.	Randomly divided PED	8 weeks	FEV1, FVC	Experimental group showed significant increases in both FVC and FEV1	PEDRO 7/11
Comparison of the effects of core stabilization and chest mobilization exercises on lung function and chest wall expansion in stroke patients. Park SJ, Lee JH, Min KO. (2017) ¹⁷	30 patients with chronic stroke	Randomly divided PED	4 weeks	FEV1, FVC, FEV1/FVC, PEF	There was no significant difference in the pulmonary function and chest-wall expansion between the two groups	PEDRO 7/11
Effects of Deep Abdominal Muscle Strengthening Exercises on Pulmonary Function and the Ability to Balance in Stroke Patients Jeong-Il K.et(2015) ¹⁸	20 hemiplegic Deep abdominal muscle strengthening (n=10) control group (n=10)	Randomly divided PE	6 weeks	DRO-7/11 FVC FEV1	The changes in FVC and FEV1 within the group showed a significant difference only in the experimental group (p<0.001)	PEDRO 7/11
Effects of the Abdominal Drawing-in Maneuver and the Abdominal Expansion Maneuver on Grip Strength, Balance and Pulmonary Function in Stroke Patients Yoon MR, Choi HS, Shin WS. (2015) ¹⁹	36 stroke patients ADIM- (n=12) AEM- (n=12) CONTR OL- (n=12)	Single-blind randomize controlled trial PE	4 weeks DRO-7/11	FEV1 FVC FEV1/FVC PEF FRT grip strength	AEM group showed significantly greater improvements than the control group (p<0.05)	PEDRO 7/11
The effect of lumbar stabilization exercise on the pulmonary function of stroke patients Oh DS, Park SE. (2016) ²⁰	40 stroke patients LSE (n=20) GPT (n=20)	Randomly and equally divided	8 weeks	FVC,FEV1, FEV1/FVC, PEF	These results indicate that lumbar stabilization exercise had a more positive effect on pulmonary function (p<0.05)	PEDRO 6/11
Effects of different core exercises on respiratory parameters and abdominal strength Cavaggioni L, Ongaro L et al. (2015) ²¹	32 physically active, healthy males DRO-7/11	Randomly divided	6 weeks core stabilization exercises combined diaphragmatic breathing exercises with global stretching postures (n= 16)	FEV1, FVC PEF	FVC improved by 12.2% (p<0.05) significant increase in FEV1 (12.5%) significant increase of 15.6% in PEF	PEDRO 7/11
The Effect of Aerobic and Core Exercises on Forced Vital Capacity Çiçek G, Güllü A, et al (2018) ²²	40 healthy sedentary women	Randomly divided	12 weeks	RHR VO2max FVC FEV1	inter-group values of the AEG and CEG no significant difference was observed in the RHR, VO2max, FVC, and FEV1 values	PEDRO 7/11

A comparative effect of static and dynamic core exercises on vital capacity of male physical education students. Rathore VS, Mishra MK. (2017) ²³	45 male students static core exercise group (A) dynamic core exercise group(B) Control(C)	Randomly divided PE	36 sessions	FVC	There was significant difference found in vital capacity between dynamic core exercise group and control group p< 0.05	PEDRO 6/11
Effects of Hemibridge with Ball and Balloon Exercise on Forced Expiratory Volume and Pain in Patients with Chronic Low Back Pain: An Experimental Study Jorida Fernandes1 and Akshay Chougule (2017) ²⁴	30 participants with chronic non-specific LBP	Randomly divided	3 sessions over 3 days	VAS, FEV1 FEV6 MODQ	significantly greater post intervention reduction in pain and FEV6 (p<0.05) No significant change was found in FEV1 (p=0.09)	PEDRO 5/11
Effect of Static Abdominals Training and Incentive Spirometer in Improvement of Pulmonary Function and Abdominal Strength in Spinal Cord Injury Patients- A Comparative Study Mantri B, Pattnaik M, Mohanty P (2017) ²⁵	30 SCI (T9-T12) subjects	Randomly divided PE	6 weeks	FEV1 VC MVV Static abdominal strength	Incentive spirometer group showed significant more improvement than static abdominals group.(p=0.004)	PEDRO 6/11
Effect of Core training program on Respiratory function and Inspiratory muscle strength in swimmers Karapolat S, Dağlıoğlu Ö. (2020) ²⁶	22 male swimmers	Randomly divided PE	3 days a week for 8 weeks DRO-5/	MIP,VC, FVC,FEV1,FEV1/FVC% 11	significant improvement was found in VC, FVC, FEV1, FEV1 / FVC% and MIP values in favor of the experimental group (p<0.05)	PEDRO 5/11

Total twelve articles were reviewed to determine effect of core strengthening exercises on respiratory functions. Ten out of twelve studies confirmed that effect of core muscle strengthening exercises were statistically significant in improving respiratory parameters.^{15,16,18,19,20,21,23,24,25,26}

Two out of twelve studies showed that effect of core muscle strengthening exercises were not statistically significant in improving respiratory parameters.^{17,22}

DISCUSSION:

The diaphragm is a main muscle of inspiration. It involves in trunk stability and posture control along with Abdominal muscles like Transverses abdominis, Internal oblique, External oblique, and Rectus abdominis.¹⁶ By increasing intra-abdominal pressure, the abdominal muscles can push the diaphragm upward into the thoracic cage provides optimal length-tension relationship, hence increasing both the volume and speed of exhalation.²⁷

Hodges et al.(2000) One of the most essential factor looked by the therapist is maintaining an optimal zone of apposition of the diaphragm, The zone of apposition (ZOA) is the area of the diaphragm encircling the cylindrical portion which corresponds to the portion directly opposed to the internal aspect of the rib cage.

The ZOA is important because it is controlled by abdominal muscles and directs diaphragmatic tension.²⁸

When the ZOA is decreased, there will be several harmful consequences of inadequate respiration and diminished activation of the transverse abdominis.^{12,29}

Cavaggioni et al. studied effect of six week core strengthening exercise on respiratory parameters combined with diaphragmatic breathing showed statically significant improvements in FVC, FEV1 and PEFR in exercise group compared to control group.²¹

From this study it is concluded Core strengthening and deep abdominal muscle strengthening exercises not only increased respiratory volumes but also played a role in stabilizing the lumbar spine through the contraction of the diaphragm and transverses abdominis.¹⁶

CONCLUSION:

Based on evidences available core strengthening exercises are effective in improving respiratory functions in subjects with impaired respiratory functions.

The quality of literature on the use of core strengthening exercises for treatment of patients with respiratory function impairments is moderate to high.

The presented evidences have been conducted on small sample size and diverse study populations using different techniques of core exercises as interventions that vary thoroughly.

CLINICAL IMPLICATION:

Core stability and strengthening exercises can utilize for planning a rehabilitation program in patient with respiratory function impairments.

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