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Core Stability and Diaphragmatic breathing on dypsnea and six-minute walk test in sedentary young women

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This study determined the effect of core stability and diaphragmatic breathing exercises on six-minute walk test and dyspnea in sedentary young women. Thirty subjects were recruited from Physical therapy department of Umm-Al Qura University Makkah Saudi Arabia. They were healthy sedentary women students, with Body Mass Index ranged from 18 to 29.9 kg/m^2. Their age ranged from 18 to 23 years. Subjects were divided into equal 2 groups. Fifteen subjects performed core stability and diaphragmatic breathing exercises for 4 weeks (2 times\week) in Study group while Control group were fifteen subjects who had the same activities of daily living of study group. 6-minute walk test (Distance) and Dyspnea level was measured after 6-minute walk test by Modified Borg Dyspnea Scale. There was a significant increase in 6MWT and decrease in Modified Borg dyspnea scale post treatment in the study group compared with that pretreatment, while there was no significant difference between pre and after 4 weeks in control group in both variables. Comparison between the study and control groups revealed a significant increase in 6MWTof the study group compared with that of the control group and a significant decrease in Modified Borg dyspnea scale of the study group compared with that of the control group. The core stability with diaphragmatic breathing exercises had a positive effect on six-minute walk test and dyspnea level in sedentary young women.

Keywords: Core stability, Abdominal Breathing, functional capacity, Breathlessness.

INTRODUCTION

Sedentary lifestyle is a problem which mortality and morbidity rate are augmented. The high inactivity levels, especially among young women in Saudi Arabia are of great concern. Active living encouragement must be a national authority for public health [1]. The sedentary behavior magnitude in Saudi women was generally more than what had previously been stated among other populations [2]. So to prevent the health-threatening, thus non-communicable diseases and obesity which increases due to physical inactivity lifestyles where the focus should be on the specific states and needs of women in Saudi Arabia [3]. The activity has good effects on respiratory (lung) and cardiovascular (heart) systems. Endurance and reduces dyspnea are achieved by physical activity [4]. The physical

activity declination is a common problem among Saudi individuals. Those who are physically active have good lung function, whereas the sedentary lifestyle is combined with lower lung function [5, 6].

Core stability can be defined as the ability to control the position and motion of the trunk over the pelvis to produce optimum production, transfer and controlling forces and motion to the terminal segment, which means maintain stability from proximal to distal mobility [7]. The core can be described as a muscular cylinder with the abdominals, the Para-spinal and glutei muscles, the diaphragm, the pelvic floor and hip girdle muscles [8].

Core stability strength improved by abdominal muscle training, which is to strengthen the lumbopelvic complex, transmissioning forces from the upper to the lower extremities of the body while maintaining the spine in a neutral position [9]. Generally, the core muscles forms the primary muscle group or maintaining spinal stability [10]. Three subsystems must work together to maintain spinal stabilization include central nervous system (Control) skeletal system (Passive) and musculoskeletal system (Active). Any interruption or problems in one of these system can cause low back pain and affect the stability because stability of spine don't just depend on musculoskeletal system and strength but also a proper neural impulses from the central nervous system[11].

Diaphragmatic breathing exercise is a breathing technique that done by taking deep inspiration through the nose that subsequently causes downward motion of diaphragm and expansion of belly outwards followed by slow exhalation by mouth which helps in decreasing breathing rate and maximizing the exchange on blood gases[12]. Breathing exercises may have a synchronize high effect on core function and movement of body [13].

Proper breathing is necessary to abdominal training since respiratory muscle is directly involved in core stability exercises [14, 15]. **(**Many studies suggested that diaphragmatic exercise can help with stabilization of the trunk. The necessary part for core stability is the controlled diaphragmatic breathing [16].

Dyspnea is a subjective awareness of breathing discomfort which have qualitatively distinct feelings that differ in intensity, and may be one of two acute or chronic. The distinct sensations often expressed by patients include effort of breathing, chest tightness, and air starvation (a feeling of not enough air on inhalation) [17].

Six minutes walk test (6MWT) is sub-maximal level of functional capacity measurement [18]. The 6MWT is performed on a flat plane, with a pre known distance measured and remarkable, and the procedures must explain to individual before starting the test [19].

Breathing exercises including diaphragmatic breathing can reduce dyspnea and enhance the daily living activity because it strengthens the breathing muscles, oxygenation become well, assist in reducing efforts in breathing and help in relaxation [20, 21].

It was stated that diaphragmatic breathing behavior through exercise leads to lowering in the sensation of dyspnea and leg fatigue. These changes were because of the decreases of breathing rate, the increase of expiratory time, minute ventilation, tidal volume and oxygen saturation [22]. Also, other studies reported a decrease in dyspnea after diaphragmatic breathing [23, 24]. Core stability exercises combined with muscular chain stretching and diaphragmatic breathing exercise have been reported to enhance in respiratory parameters [13].

Core stabilization exercise preformed with deep breathing leaded to significant decrease in MRC dyspnea score in adolescents with substance use disorder [25], another significant reduction of dyspnea after core stability training was found in children with bronchiectasis [26].

Controlled diaphragmatic breathing improved the recruitment of diaphragm muscle; furthermore, possibility is that breathing retraining a better control over respiratory muscles and reduced the fatigue of accessory muscles and improved their functional capacity to exercise [27].Core stabilization exercise can improve lung function, strength muscles responsible of respiration and functional capacity [16].

Aim of the study

Was to answer the research question: Is there any effect of core Stability and diaphragmatic breathing on dypsnea and 6MWT in sedentary young women?

Study Design

The research design of this study was Quasi-experimental design.

MATERIALS AND METHODS

Thirty (30) sedentary young women were recruited in this study. The study was conducted

in Department of Physical Therapy, Faculty of Applied Medical Sciences- Umm Al - Qura University. It was concerned with evaluating the level of dyspnea and 6MWD. They were selected according to the following criteria:

Inclusion criteria:

All young women were from physical therapy students at Umm-Al Qura university, sedentary lifestyle, healthy, with Body Mass Index BMI ranged 18 to 29.9 kg/$m^2$and with age ranged from 18 to 23 years.

Exclusion criteria:

Subjects were young women with body mass index below 18 and above or equal to 30 kg\ m^2, athletic, pregnant and pulmonary disease or a history of low back pain.

Fifteen participants (study group) performed core stability and diaphragmatic breathing exercises two sessions of core stability and diaphragmatic breathing exercises per week for four weeks. while Control group: Fifteen Participants had the same activities of daily living (ADL) as study group such as bathing, dressing, toileting, continence, feeding [28]. Written informed consent was obtained from each participant giving agreement for participation of the study. This study was accomplished from 3 October 2019 to 1 March 2020.

Measurement of Wight and Height

Use the height rod for measuring the height then adjust the weight board to the correct participant weight from Standing upright (Detecto's ProMed® 6129 medical scale, USA). Then Body mass index (BMI) was calculated by the following formula:

BMI = Weight (Kg) ÷ Height^2 (m**)** [29].

6-Minute walk test

The walk tests were conducted in a temperature-controlled, measured and marked corridor (8 meter). The turnaround points were marked with a colored taps on ground. The tape marks on the floor from the beginning point to the endpoint (each 8-m)**.**

Reasons for immediately stopping a 6MWT include the following:

Chest pain, intolerable dyspnea, cramps of lower limbs or pale face.

Measurements: The participant should sit at rest in a chair, located near the starting position, for at least 10 minutes before the test starts. The participant was instructed to walk similar to his maximal habitual walking from end to end, trying to pass as much distance as possible within 6 minutes. They were instructed every thirty seconds to walk fast without running during walk the examiner recorded the time using stopwatch, distance walked. The 6-MWTs were symptom limited, so participants were allowed to stop [30].

Modified Borg Dyspnea Scale

This is a scale that asks for breathlessness rating. It is number 0 at the beginning at where breathing is causing no difficulty at all and progresses through to number 10 where breathing difficulty is maximal [31].

Young women performed twice week core stability with diaphragmatic breathing exercises for 4 weeks. Before the exercises, therapist explained to the participants how to maintain a neutral position of the lumbo-pelvic-hip complex (LPHC) during exercise, which was necessary in core stability training. All time was 45 minutes. There were many exercises that stimulated all muscles of the core.

Firstly, warm-up:

It was started with warm-up by stretching exercise for 10-15 minutes with 30 second hold during stretching, 30 second rest in between repetition and with 3 repetitions for each exercise.

Warm-up can enhance aerobic capacity and lower levels of lactate, facilitated oxygen transport, and increased cardiac output and blood flow [32]**.**

The core exercises were :

1- Crook lying abdominal hollowing for 10 s with curl up 15 repetitions\ 2 sets.
2- Bridge exercise (holding position for 10 s – 10 reps. slowly up and down 2 sets).
3- Exercise of Russian twist– 10 reps on each side with 2 sets.
4- Quadruped position: holding position for 3 s – 10 reps on each side with 2 set.
5- Cat and camel exercise (Quadruped position) Holding 10 s – 10 reps. 2 sets.
6- Superman alternatively – 10 reps. 2 sets.
7- Plank from different positions (forearm, forearm supporting on knee) holding position for 10 s – 10 reps for each. Rest 30 second 1 set then 2 sets then 3 sets.

Cool-down

After training, low-intensity cool-down exercises must be performed to facilitate a

gradual transference from an exercise level to a resting status. A cool-down period is necessary after an exercise session and should continue approximately 10-15 minutes. This cool-down period is described as a way to gain relaxation after exercise and if done correctly can optimize the process of recovery. Actually, a cool- down protocol is able to effectively regain the heart rate and blood pressure to before-exercise resting levels Thus, intensity should be gradually reduced followed by stretching, the cool-down may decrease muscle soreness and stiffness after exercise or competition [32].

Stretching exercises for Warm-Up and Cool Down [32]:

1-Hamstring Stretch (Modified Hurdler Stretch)
2-Lunge hip flexors stretch
3- Cobra poses stretch
4- Child poses stretch
For each stretch hold 30 sec followed by 30 sec rest, 3 times.

Diaphragmatic breathing exercise:

Subjects were asked to get crook lying position. They were instructed to set the dominant hand on their abdomen with elbows supported and maintaining their shoulder relaxed. Allow their hand to rise smoothly while visualizing air filling the abdomen as a balloon [8]. Progress this exercises to side lying and comfortable standing. The beneficial effects are enhancing pulmonary function and ventilation (5-10 minutes Holding 3 second) [34].

Statistical analysis

Descriptive statistics and Unpaired t-test were conducted for comparison of subject characteristics between both groups. Normal distribution of data was checked using the Shapiro-Wilk test. Levene's test for homogeneity of variances was conducted to test the homogeneity between groups. Unpaired t-test was conducted to compare the mean values of 6MWT between the study and control groups. Paired t-test was conducted for comparison of 6MWT between pre and after 4 weeks in each group. Modified Borg dyspnea scale were compared between groups byMann–Whitney U test and between pre and after 4 weeks in each group by Wilcoxon Signed Ranks. The level of significance for all statistical tests was set at $p < 0.05$. All statistical analysis was conducted through the statistical package for social studies (SPSS) version 22 for windows (IBM SPSS, Chicago, IL, USA).

RESULTS

Subject characteristics:

Table (1) showed the Subject characteristics of the study and control groups. There was no significant difference between both groups in the mean age, weight, height and BMI ($p > 0.05$).

Effect of treatment on 6MWT and Modified Borg dyspnea scale (figure-1):

Within group comparison:

There was a significant increase in 6MWTpost treatment in the study groups compared with that pretreatment ($p < 0.001$), while there was no significant difference between pre and after 4 weeks in control group ($p > 0.05$), (Table 2).

There was a significant decrease in Modified Borg dyspnea scale post treatment in the study groups compared with that pretreatment ($p < 0.001$), while there was no significant difference between pre and after 4 weeks grades in control group ($p > 0.05$), (Table 3).

Table 1: Comparison of subject characteristics between study and control groups:

	x̄±SD		MD	t- value	p-value
	Study group	**Control group**			
Age (years)	21.4 ± 0.73	21.13 ± 0.91	0.27	0.87	0.38
Weight (kg)	55.24 ± 8.43	55.58 ± 9.86	-0.34	-0.1	0.92
Height (cm)	158.93 ± 4.46	157.26 ± 7.36	1.67	0.75	0.46
BMI (kg/m²)	21.89 ± 3.42	22.37 ± 2.9	-0.48	-0.41	0.67

x̄, Mean; SD, Standard deviation; MD, Mean difference;p value, Probability value

Table 2: Mean 6 MWT pre and after 4 weeks of the study and control groups:

	Study group	Control group			
6 MWT (meter)	**x̄±SD**	**x̄±SD**	**MD**	**t- value**	**p value**
Pre treatment	452.6 ± 55.07	478.93 ± 64.27	-26.33	-1.2	0.23
Post treatment	562.93 ± 79.17	471.86 ± 63.21	91.07	3.48	0.002
MD	-110.33	7.07			
% of change	24.37	1.47			
t- value	-7.13	0.42			
	p = 0.001	p = 0.67			

x̄, Mean; SD, standard deviation; p-value, level of significance

Table 3:Median values of modified Borg dyspnea scale pre and after 4 weeks of study and control groups:

Modified Borg dyspnea scale	**Study group**	**Control group**		
	Median (IQR)	**Median(IQR)**	**U- value**	**p-value**
Pre treatment	2 (1,2)	2(1,2)	***88***	0.***24***
Post treatment	0 (0,1)	2(1,2)	***25***	0.001
Z- value	***3.39***	***0***		
	p = 0.001	p = ***1***		

IQR, inter quartile range; U- value, Mann-Whitney test value; Z- value, Wilcoxon signed ranks test value;p-value, level of significance

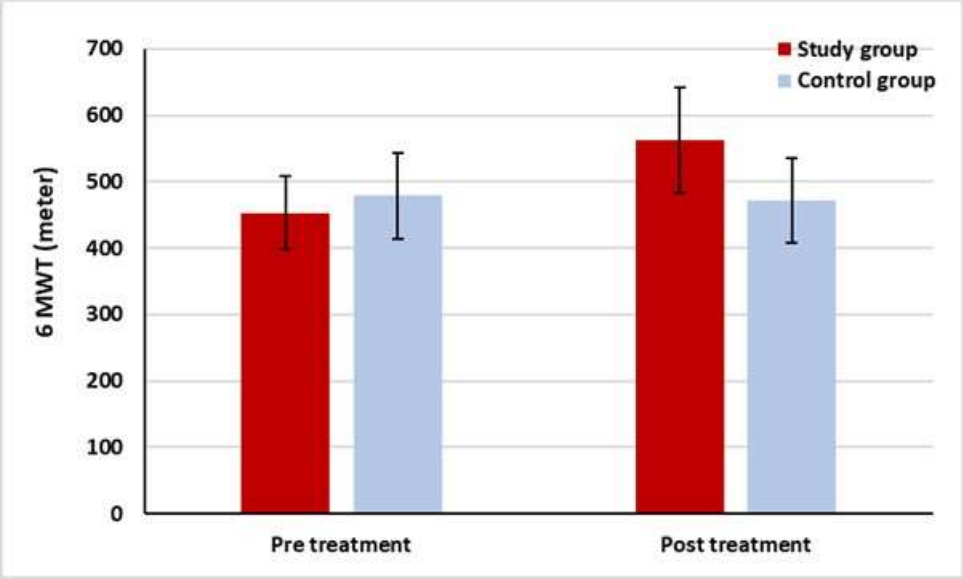

Figure1: Mean 6 MWT pre and post treatment of the study and control groups.

Between groups' comparison:

There was no significant difference in 6MWT and Modified Borg dyspnea scale between both groups pre-treatment (p > 0.05). Comparison between the study and control groups after 4 weeks revealed a significant increase in 6MWTof the study group compared with that of the control group(p = 0.002) and a significant decrease in Modified Borg dyspnea scale of the study group

compared with that of the control group ($p < 0.001$), (Table 2,3).

DISCUSSION

Our target in this study was to analyze the effect of core Stability and diaphragmatic breathing on dypsnea and 6-minute walking distance in sedentary young women.

The results showed increasing significantly in the dyspnea level and 6-minute walking distance post training compared with pre.

In accordance with results of our study, Cavaggioni et al. mentioned that Significant changes functional movement efficacy was recorded after combination of different core exercises and diaphragmatic breathing exercises with global stretching postures on respiratory parameters and abdominal strength in thirty-two physically active males for 6 weeks[13].

Many previous trials carried out on the concept of when focusing on abdominal breathing exercises, it was necessary not only to preserve a respiratory pattern correctly but also to provide spine stabilization though intra-abdominal pressure increasing [35, 36, 37]. Stephens et al. believed that abdominal breathing exercises could lead to diaphragm and core muscles strength [38].

Other study by Kale et al. investigated the effectiveness of controlled diaphragmatic breathing for three weeks on pulmonary function and six-minute walk distance in stable COPD patients. They trained Controlled diaphragmatic breathing improved the recruitment of diaphragm muscle; furthermore, possibility is that breathing retraining a better control over respiratory muscles and reduced the fatigue of accessory muscles and improved their functional capacity to exercise [27].

Mustafaoglu et al. supported the results achieved in our study, as they evaluated the impact of respiratory muscle strength on functional capacity in adolescents through core stabilization exercises combined with deep breathing and reported their efficiency in The distance during 6-minute walking[25].

Beside these effective results for diaphragmatic breathing training program a study done by Yamagutiet al. who studied the improved abdominal motion during natural breathing in patients with chronic obstructive pulmonary disease; they declare that immediately after the 4-week, the results showed greater diaphragmatic mobility, 6-minute walk test and in health-related quality of life [24].

This believes was supported by Amola et al. to evaluate functional capacity in pregnant women after diaphragmatic breathing through 6MWT which increased significantly after four weeks [12].

The current study agrees with the findings of Develi et al. who showed 6MWT improvement after combination of core stabilization exercises with the patient education program and diaphragmatic breathing exercises [39]. In addition, Lee et al. studied the effects diaphragm and deep abdominal muscle exercise on walking ability in patients with hemiplegia due to stroke. There were significantly increases in distance though the 10MWT and 6MWT after diaphragm and deep abdominal muscle exercise [40].

The level of dyspnea reduced due to the results of Mustafaoglu et al. that proved that there were significant improvements in maximal inspiratory pressure, maximal expiratory pressure, lung functions in the core stabilization and diaphragmatic breathing exercise group for 6 weeks compared with the control group [25].

In other study by Park et al. who supported the results achieved in our study, as he compared the effects of core stabilization and chest mobilization exercises for 4 weeks in stroke patients and observed their significant increase effect of Core stabilization exercise on lung function[41] . Also, Cavaggioni et al. proved that core stabilization exercises based on breathing and global stretching postures are more effective in improving pulmonary function and abdominal strength in physically active, healthy males twice weekly for 6 weeks [13]. So, dyspnea level reduced after training with core stabilization exercises.

A previous study declared that breathing pattern and ventilatory efficiency without causing dyspnea in patients whose respiratory muscular system is preserved after diaphragmatic breathing (DB). DB was associated with a significant increase in tidal volume and reduction in breathing frequency (low scores for dyspnea), leading to higher ventilation and oxygen saturation, with a reduction in dead space ventilation and ventilatory equivalent for carbon dioxide [42].

In contrary, there's multiple studied showed that diaphragmatic breathing has no effect on dyspnea level and also it can worsen it actually.

In a study by Ubolnuar et al. found that diaphragmatic breathing had decreased quality of improvement in breathing rate [43].Also, Morrow et al. studied that The effect of diaphragmatic breathing exercises for only one session increase respiratory muscle activity but level of perceived dyspnea was using a Modified Borg Dyspnoea Scale were not changed [44]. Previous reports

have been contradicts, with some observing increased levels of dyspnoea by Gosselink *et al*. [45] and others a decrease in dyspnoea after diaphragmatic breathing [23,24]. Mustafaoglu et al. reported that there were no changes of dyspnea Scale through MMRC after respiratory muscle strength in adolescents [46]

CONCLUSION

The core stability with diaphragmatic breathing exercises had a positive effect on dyspnea level and 6 minute walk test in sedentary young women.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS

All authors designed, performed the practical part of the study with data collection & analysis and also wrote the manuscript. All authors read and approved the final version.

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