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Effect Of Sandbag Breathing Exercise On Respiratory Parameters And Lumbar Stability In Asymptomatic Individuals- An Experimental Study

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Abstract

Aims: To study the effect of sandbag breathing exercise on respiratory parameters and lumbar stability in asymptomatic individuals.

Objectives: To evaluate the effect of sandbag breathing exercise on respiratory parameters and lumbar stability in asymptomatic individuals.

Method: 43 asymptomatic subjects with age group between 20-25 years, chest expansion of not more than 5 cms and having BMI<25 were selected for the study. All of them were given sandbag breathing exercise for 5-10 minutes, thrice a week for 4 weeks. Outcome measures were Vitalograph (FEV₁, FVC, FEV₁/FVC) for respiratory parameters and Pressure Biofeedback Unit for lumbar stability.

Result: Statistical difference was noted between the pre and post respiratory parameters in the form of FEV₁, FVC, FEV₁/FVC and lumbar stability through pressure biofeedback unit, where p-value was <5% significance level (p= <0.05).

Conclusion: Present study concludes that sandbag breathing exercise showed significant effect on respiratory parameters and lumbar stability in asymptomatic individuals. Hence, sandbag breathing exercise are safe and cost-effective which can be done at home on regular basis.

Keywords: Sandbag breathing exercise, Asymptomatic individuals, Respiratory parameters, Lumbar stability, Vitalograph, Pressure Biofeedback Unit

Introduction

Thoracic cage respiratory muscles contract and relax which cause passive contraction and relaxation of the lungs leading to gas exchange between air and lungs^[1]. Diaphragm being the principle muscle of respiration, is a large dome-shaped muscle separating the thoracic and abdominal cavities. Diaphragmatic breathing causes the lower ribs to expand outwards in lateral direction. Costal part of diaphragm expands the lower ribcage and abdominal wall. Apposition of diaphragm causes transmission of intra-abdominal pressure to ribcage and serves as a mechanism wherein diaphragmatic contraction results in outward movement of ribcage during inspiration^[2]. Transverse abdominis is the deepest of the abdominal muscles and functions like a corset by wrapping around the abdomen between lower ribs and top of the pelvis^[3]. It functions as an expiratory muscle and also increases intra-abdominal pressure. The simultaneous contraction and co-ordinated action of diaphragm, transverse abdominis, and pelvic floor muscles are the most vital and basic elements of spinal stabilization^[4]. Diaphragm in co-contraction with abdominal and pelvic floor muscles plays a functional role in respiration and lumbar stability by controlling intra-abdominal pressure and reduces stress on the spine^[5,6]. The hoop like geometry of the abdominal muscles is maintained by increasing intra-abdominal pressure or by unloading the spine hydraulically and increasing trunk stability^[7].

Respiratory training enhances respiratory muscle strength and boosts pulmonary functions of the body^[8]. Abdominal training exercise is the type of rehabilitating exercise which improves pulmonary functions of the patient by building up both abdominal and thoracic pressure and air resistance while breathing which in turn challenges the strength of respiratory muscles when they contract thus the power of respiratory muscle is increased and pulmonary functions are improved^[9]. Abdominal training exercise improves the core stability which in turn

strengthens the lumbo-pelvic complex and maintains the spine in a neutral position^[10,11]. Resistance training is a type of exercise wherein the muscle has to contract against an external resistance which results in increase in strength, tone, mass and endurance. Due to resistance there is microscopic damage or tear to muscle cells which repairs quickly by the body through regeneration of muscle making the muscle grow stronger^[12]. Normal individuals do not use diaphragm effectively due to lack of muscle strength and lack of awareness. In order to this sandbag breathing becomes vital as it will help strengthen diaphragm and help gaining confidence to perform it easily. Also it helps in gaining deeper breath^[13]. Sandbag provides resistance to diaphragm and acts like weight lifting for breathing muscles^[14].

Materials and Methods

Participants were recruited from the KLE's constituent unit in Belagavi. 43 participants were included in the study.

Inclusion criteria:

- Asymptomatic subjects of either gender
- Age 20-25 years
- Chest circumference- Patients whose thoracic expansion is not more than 5 cms during inspiration and expiration at the level of 4th intercostals space
- BMI <25
- Subjects who were willing to participate in the study.

Exclusion criteria:

- Musculoskeletal disorders
- Neurological disorders
- Acute or chronic cardiovascular disorders
- Acute or chronic lung disorders
- Low back pain
- Smokers
- Inability to comply with the study procedure.

Intervention

Subjects included in the study were given sandbag breathing exercise for 5-10 minutes a day, thrice a week for 4 weeks^[15]. Subject was asked to lie on the back with thin cushion/pillow supporting head and neck. The position of arm being resting along the sides of the body and legs apart. Relaxing the flow of breath, place the sandbag (10 pounds) on the abdomen, just below the floating ribs. Subjects were asked to take normal breaths, so

that it just touches the sandbag. Don't try to lift the sandbag. Take the weight off after 5 minutes and continue to breathe relaxing the abdomen. After resting for few minutes subject is supposed to come back to sitting position. Outcome measures used were Vitalograph for measuring Forced expiratory volume in one second (FEV_1), Forced Vital Capacity (FVC), and the ratio (FEV_1/FVC) and Pressure Biofeedback Unit for measuring lumbar stability.



PHOTO 1: PRESSURE BIOFEEDBACK UNIT



PHOTO 2: VITALOGRAPH



PHOTO 3: SANDBAG BREATHING EXERCISE

Outcome Measures

- Forced expiratory volume at one second (FEV_1)
- Forced Vital Capacity (FVC)
- Ratio of the both (FEV_1/FVC)
- Pressure Biofeedback Unit

Results

The difference/change scores from pretest to posttest of FEV1 (%) and FVC (%) follows normal distribution so the parametric dependent t test was applied, but the difference/change scores from pretest to posttest of FEV1/FVC (%) and Pressure Biofeedback Unit does not follow normal

distribution so the non-parametric Wilcoxon matched pairs test was applied. The pre and post respiratory parameters showed significant improvement in FEV1, FVC, FEV₁/FVC values (Table 1). Further the comparison of pre and post Pressure Biofeedback Unit scores showed statistically significant improvement in lumbar stability (Table 2).

Table 1: Comparison of pretest and posttest FEV1 (%) and FVC (%) scores by dependent t-test

Variables	Mean		Standard Deviation		Mean Difference	SD Difference	% of changes	Paired t-test	P value
	Pre	Post	Pre	Post					
FEV1	90.7	99.19	20.27	19.01	-8.49	12	-9.36	-4.6382	0.0001*
FVC	82.88	89.95	14.72	14.74	-7.07	14.59	-8.53	-3.1781	0.0028*

* **p<0.05; FEV1, Forced expiratory volume in 1 second; FVC, Forced vital capacity**

Table 2: Comparison of pretest and posttest FEV1 (%)/FVC (%) and Pressure Biofeedback Unit scores by Wilcoxon matched pairs test

Variables	Mean		Standard Deviation		Mean Difference	SD Difference	% of change	Z- Value	P Value
	Pre	Post	Pre	Post					
FEV1/FVC	114.84	123.02	15.54	7.17	-8.19	14.76	-7.13	3.3416	0.0008*
PBU	56.65	60.33	3.64	3.21	-3.67	2.43	-6.49	5.4424	0.0001*

***p<0.05; PBU, Pressure biofeedback unit**

Discussion

Symptomatic subjects tend to overuse the muscles of neck, chest and shoulders leading to reduction in spinal stability. In adults the action of intercostals muscle results in rising of chest which results in in drawing of the stomach by transverse abdominis muscle and diaphragm is not used effectively. Sunita G, Ravi B.N in their study concluded deep breathing are beneficial for respiratory lung functions and therapeutic exercise programs for sedentary young adults. Present study concluded that sandbag breathing exercise is effective in improving respiratory parameters and lumbar stability^[16]. Prof. Chowdhury Shivani *et al* conducted a study on 30 asymptomatic and apparently healthy individuals to study the efficacy of pilate’s exercise for strengthening of deep abdominal

muscles and found that pilate’s training programme is effective in increasing both abdominal muscle strength and improving lumbar spine stability. But in present study sandbag breathing exercise is effective in increasing lumbar stability as well as improving Forced expiratory volume in one second(FEV₁), Forced Vital Capacity(FVC), and the ratio (FEV₁/FVC)^[17].

Luca Cavaggioni *et al* studied the effects of different core exercises on respiratory parameters and abdominal strength 32 healthy males who were active and concluded that core exercises are effective in improving pulmonary function and abdominal fitness. In present study there was no strenuous activity on the subjects yet it showed improvement on respiratory parameters and lumbar stability^[18]. Eunyoung Kim, Hanyong Lee conducted

a study to know the effects of deep abdominal muscle strengthening exercises on respiratory functions and lumbar stability in which experimental group showed increase in FVC and FEV1 and significant increase in contractility of transverse abdomen muscle. Present study showed significant increase in FEV₁, FVC, FEV₁/FVC and lumbar stability through sandbag breathing exercise^[19]. Limitations of the study includes small sample size, short period of intervention, no equal distribution between men and women.

Limitations of the study

In the present study the limitations were:

1. Small sample size
2. Short duration of study
3. Short period of intervention
4. Long term follow up was not done

Scope for further study

- Studies with longer follow-up can be planned.
- Sandbags with different weights can be compared for further studies.
- Subjects with different age groups can be included in the study.
- Comparison of pilates training, inspiratory muscle training and sandbag training can be carried out as future studies.

Conclusion

Present study concluded that sandbag breathing exercise is effective in improving respiratory parameters through FEV₁, FVC, FEV₁/FVC and lumbar stability was seen through Pressure Biofeedback Unit. Hence, sandbag breathing exercise is safe, simple and cost-effective which can be performed on daily basis at home.

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Declaration of Conflicting Interest

None

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