

## Research article

**Effect of respiratory muscle training with wind instrument among obese individuals**K. Rekha<sup>1</sup>, J. Vanitha<sup>2</sup>, Aishwarya Kiran<sup>2</sup><sup>1</sup>Assistant Professor, <sup>2</sup>BPT Intern, Saveetha College of Physiotherapy, Saveetha Institute of Medical and Technical Sciences, Thandalam, Chennai - 602105, Tamil Nadu, India

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Corresponding author: **K. Rekha**. Email: futurdreams88@gmail.com**ABSTRACT**

**Introduction and Aim:** One of the most utilized parts of the body when playing a wind instrument is diaphragm. It assists to blow air in and out of your lungs and into the instrument to create sound. Using controlled and measured breaths, the breathing and lung capacity could get improve. Even, music therapy, such as playing wind instrument has been used as a technique for managing and fastening recovery on a physical and emotional level. Therefore, aim of this study was to determine the effects of respiratory muscle training with wind instrument among obese individuals. The objective was to find out the effects of respiratory muscle training with wind instrument in improving maximum voluntary ventilation, forced expiratory volume in 1 second, forced vital capacity and reducing dyspnoea among obese individuals.

**Materials and Methods:** Study included 40 individuals with obesity aged 18-30years. Participants were equally divided into 2 groups- A and B. Group A treated with wind instrument (flute) and group B treated with incentive spirometer, both the groups were treated for 5 days a week for 5 weeks in which 1 session per day for 40 minutes with 5 minutes of warm up, 10 minutes of breathing training, 20 minutes of intervention training program and 5 minutes of cool down. Both the groups were tested for maximum voluntary ventilation, forced expiratory volume in 1 second, forced vital capacity using spirometry and dyspnea was graded with modified borg scale as a pre-test and post-test.

**Results:** The comparison of pre and post-test values of maximum voluntary ventilation, forced expiratory volume in 1 second, forced vital capacity and modified borg scale showed a statistically significant difference with p-value <0.0001. While comparing the post-test values of maximum voluntary ventilation, forced expiratory volume in 1 second, forced vital capacity and modified borg scale between group A and group B, group A showed higher result with statistical significant difference of p-value <0.0001.

**Conclusion:** Playing a wind instrument was found to be more effective than respiratory training using an incentive spirometer.

**Keywords:** Incentive spirometer; obesity; respiratory training; wind instrument.

**INTRODUCTION**

One of the major causes of morbidity is said to be obesity with an estimated count of about 1 billion obese people in the world and their average BMI was found to be 30 kg/m<sup>2</sup> or more. According to world health organization, obesity is a medical condition in which excess of body fat accumulation may cause adverse effects on health consequences (1). A high risk has been recognized between obesity and the development of respiratory diseases. COPD and asthma have been commonly related with obesity even though the nature of this relation has not been clearly established. The effect of obesity on respiratory function is not only based on the magnitude of obesity but also based on the presence of abdominal fat. It has found that the accumulation of fat tissue leads to impairment of ventilator function in adults and children. A high correlation has been established between increased BMI and a significant increase in forced expiratory volume in one second (FEV<sub>1</sub>), forced vital capacity (FVC), total lung capacity, expiratory reserve volume

and functional residual volume (2). The obstruction of the diaphragm during respiration and the reduction in thoracic compliance are also mildly accredited to fat deposition on the chest wall and the abdomen (3). Dyspnoea is otherwise called as shortness of breath or difficulty in breathing. It is a very common symptom in the obese. In a large study of patients with non-insulin dependent diabetes, one-third reported troublesome shortness of breath and its severity increased with BMI (4).

For improving the respiratory function using physical therapy interventions, various studies have been conducted using techniques such as core exercise, aerobic exercise and complex breathing exercise. Stabilization of the lumbar from transverse abdominis along with harmonious contraction of diaphragm have found to be an effective method to improve the respiratory function (5). Incentive spirometer proved to be an effective method in improving the inspiratory muscle strength in obese individuals and to improve the MVV, FEV<sub>1</sub> and FVC

as well. The quality of life and dyspnoea of those obese patients have also got improved (6).

Changes in the respiratory system have been observed in individuals who were made to play musical wind instrument. Wind instrument works on the mechanism of vibration of air that is blown inside a tube and music is produced by appropriate fingering on the tube, which depends on the type of instrument played. The instrument is played by deep and quick inhalation after which a long exhalation is done with pursed lips. By the application of this technique using the wind instruments, diaphragmatic breathing was implemented naturally along with pursed lips. It also enabled the patient to engage in enhancement of respiratory function by motivating them to play the instrument as a leisure activity (5).

By playing these wind instruments, one could learn to control and modify the airflow with utmost accuracy, it helped in creating, and sustaining the flow and pressure, which is required by the instrument. Therefore, the body may adapt to changes in the respiratory system just as how it adapts to the changes induced in the respiratory system during physical exercise (7). Since it has been found that morbid obesity might be associated with certain pulmonary ailments, it is necessary to assess and improve the respiratory function in obese patients. The respiratory muscle function of the obese individuals may or may not be improved by playing of wind instrument. Therefore, the aim of this study is to determine the effect of wind instrument in improving the respiratory muscle function among obese individuals.

## **MATERIALS AND METHODS**

All participants were explained about the study procedure with an information sheet and written informed consent was obtained, after which 40 individuals were selected based on the inclusion criteria as both male and female with BMI 30.0 or higher, aged between 18-30 years and the obese individuals with dyspnoea based on modified borg scale. Those who have underweight, restrictive lung disease, obstructive lung disease, unstable cardiovascular disease, any recent trauma or fracture, smokers and alcoholics, pregnant women were also excluded, then the individuals were allocated into two different groups. Group A 20(experimental) and group B 20(control) using odd even method, then experimental group was treated with wind instrument and control group was treated with spirometer. The outcome measures in this study are the FVC, FEV<sub>1</sub>, MVV, and modified borg scale.

Before the onset of treatment session, pre-test assessment was done in both groups by analysing the severity of breathlessness using modified borg scale of dyspnoea, ranging from 0-10 and MVV, FEV<sub>1</sub> and FVC were measured using spirometer. After

preliminary evaluation, the participants in group A and group B were made to proceed into a 5-week treatment program. After five weeks of intervention, post-period assessment same as of pre-test was performed to ensure any differences.

## **Parameters**

Five days a week for 5 weeks. One session per day for 40 minutes with 5 minutes of warm up, 10 minutes of breathing training, 20 minutes of intervention training program and 5 minutes of cool down.

## **Treatment procedure**

**Group A (n=20):** Group A individuals were treated with wind instrument: flute. The participants were asked to perform pursed lip breathing exercise, for which the patient was made to sit comfortably in a chair or in a half lying position. Then patients were asked to inhale slowly through the nose and exhale with pursed lips. As a warm up exercise, it was performed for 5 minutes. Wind instrument training with flute is performed for 20 minutes in which participants were asked to blow through the flute and the flow of the air was controlled by them using their fingers over the flute for maintaining the sound of 1, 4, 6, and 8 beats during each repetition. All sessions consisted of 5 minutes of warm up, 20 minutes of flute and 5 minutes of cool down. Flute playing for 20 minutes comprised 15 to 20 repetitions; each repetition consists of blowing an instrument in 1, 4, 6 and 8 beats for each repetition.

**Group B (n=20):** Group B individuals were treated with an incentive spirometer. The participants were made to be relaxed in a chair suitable for deep breathing. Patients were asked to place the mouthpiece of the incentive spirometer in their mouth with lips tightly sealed and the patient is asked to inhale deeply and slowly through the mouth, while watching the rise of the ball for visual feedback. If possible, the patients were made to sustain the inhalation to create an end-inspiratory hold. Ideally, the inhalation was sustained for 2-3 seconds. Patients were asked to remove the mouthpiece and to exhale normally. It was considered as a mechanical aid for lung expansion and was applied for 15-20 repetitions per set for 4 to 5 sets for 20 minutes per session. All sessions consisted of 5 minutes of warm up, 20 minutes of intervention and 5 minutes of cool down.

## **Statistical analysis**

The collected data was tabulated and analysed using descriptive and inferential statistics. To all parameters mean and standard deviation (SD) was calculated. Within group analysis was made with Paired t-test, and between group analysis was made using unpaired t-test, p-value less than 0.05 is considered as statistically significant.

**RESULTS**

In table 2 comparison of pre-test and post-test values within group A is shown. The pre-test mean value of FVC was 2.78 (0.50) which is increased to 4.09 (0.25) in post-test. The pre-test mean value of FEV1 was 2.56(0.24) which is increased to 4.53(0.40) in post-test. Similarly, pre-test mean value for MVV was 81.52 (1.08) which is increased to 91.79(1.83) in post-test. The pre-test mean value for modified borg scale was 5.55 (0.51) which is decreased to 1.80 (0.77) in post-test. Hence the results are considered to be statistically significant with a p value <0.0001. The pre-test mean value of FVC was 3.10 (0.57) which is increased to 3.22 (0.17) in post-test. The pre-test mean value of FEV1 was 2.35 (0.32) which is increased to 3.22 (0.19) in post-test. Also, the pre-test mean of MVV was 81.07 (1.07) which is increased to 83.14 (0.99) in Post-test. The pre-test mean of modified borg scale was 5.50 (0.51) which is decreased to 2.50 (0.51) in Post-test. Hence the group B results are considered to be statistically significant

with a p value <0.0001 shown in table3. Fig.1 the group A post-test mean value of forced vital capacity was shown as 4.09 which is found to be significantly higher than the group B post-test mean value 3.22 which is considered to be statistically significant with a p value <0.0001. Fig. 2 shows that the group A post-test mean value of forced expiratory volume in one second as 4.53 which is significantly higher than the post-test mean value 3.22. Hence the results are considered to be statistically significant with a p value <0.0001. Fig. 3 show the group A post-test mean value of maximum voluntary ventilation 0.91 which is significantly higher than the group B post-test mean value 0.83. Hence, the results are considered to be statistically significant with a p value <0.0001. Group A post-test mean value of modified borg scale was 1.8 which is significantly lower than the group B post-test mean value 2.5. So, it is considered to be statistically significant as shown in fig. 4.

**Table 1:** Demographic data

Groups	Sex		Age		Height (m)		Weight (kg)		BMI (kg/m <sup>2</sup> )	
	M	F	Mean	SD	Mean	SD	Mean	SD	Mean	SD
A	12	8	23.45	2.88	164.1	8.08	94.55	2.67	35.3	3.14
B	11	9	23.2	1.98	166.1	6.04	97	1.51	35.3	2.61

**Table 2:** Comparison of pre-test and post-test values within group A

Parameters	Pre-test			Post-test			t-value	p-value
	Mean	Standard Deviation (SD)	Standard Error of Mean (SEM)	Mean	Standard Deviation (SD)	Standard Error of Mean (SEM)		
FVC (L)	2.78	0.50	0.11	4.09	0.25	0.05	10.17	<0.0001
FEV <sub>1</sub> (L)	2.56	0.24	0.05	4.53	0.40	0.09	17.59	<0.0001
MVV (L/Min)	81.52	1.08	0.24	91.79	1.83	0.41	20.72	<0.0001
Modified Borg Scale	5.55	0.51	0.11	1.80	0.77	0.17	21.32	<0.0001

**Table 3:** Comparison of pre-test and post-test values within group B

Parameters	Pre-test			Post-test			t-value	p-value
	Mean	Standard Deviation (SD)	Standard Error of Mean (SEM)	Mean	Standard Deviation (SD)	Standard Error of Mean (SEM)		
FVC (L)	3.10	0.57	0.12	3.22	0.17	0.03	0.82	<0.0001
FEV <sub>1</sub> (L)	2.35	0.32	0.07	3.22	0.19	0.04	10.09	<0.0001
MVV (L/Min)	81.07	1.07	0.24	83.14	0.99	0.22	5.69	<0.0001
Modified Borg Scale	5.50	0.51	0.11	2.50	0.51	0.11	18.49	<0.0001

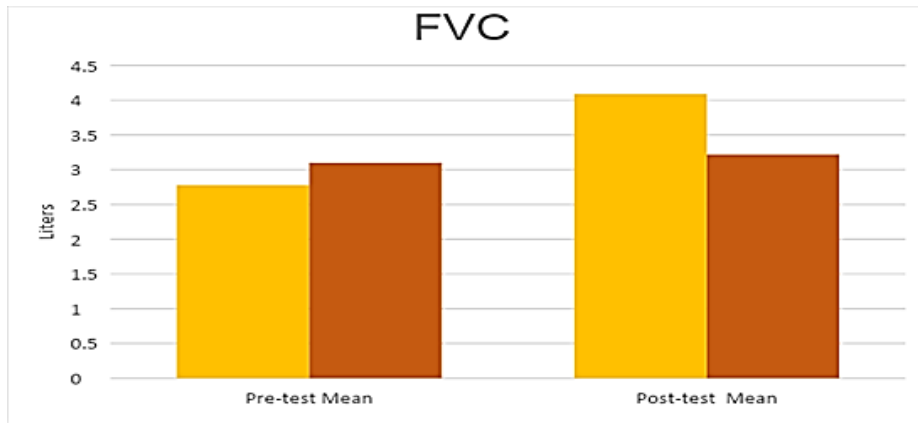


Fig. 1: Comparison of FVC between group A and group B

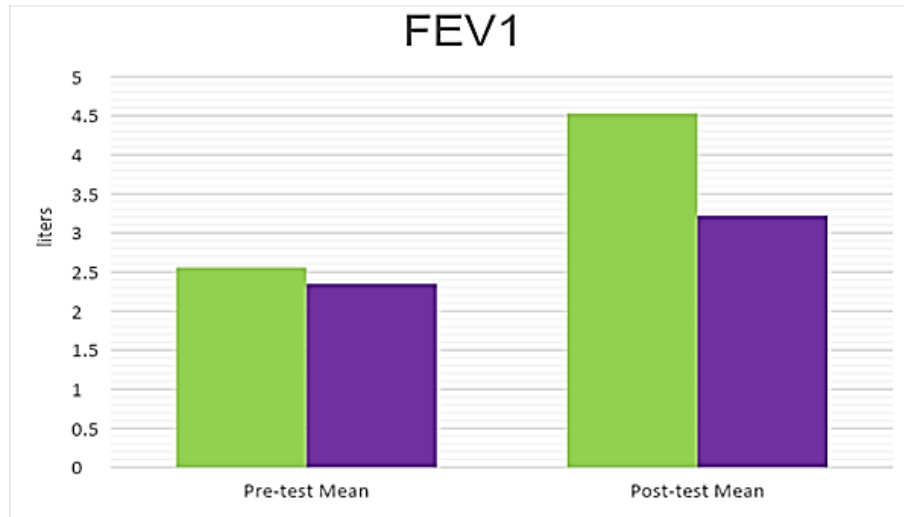


Fig. 2: Comparison of FEV<sub>1</sub> between group A and group B

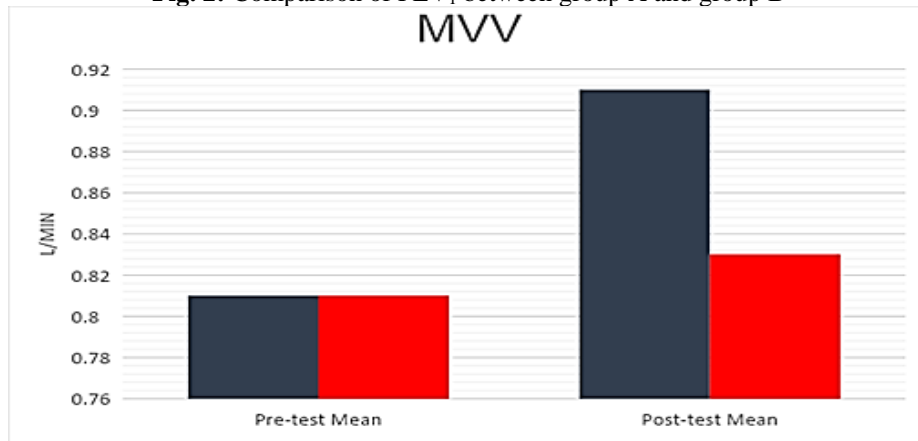


Fig. 3: Comparison of MVV between group A and group B

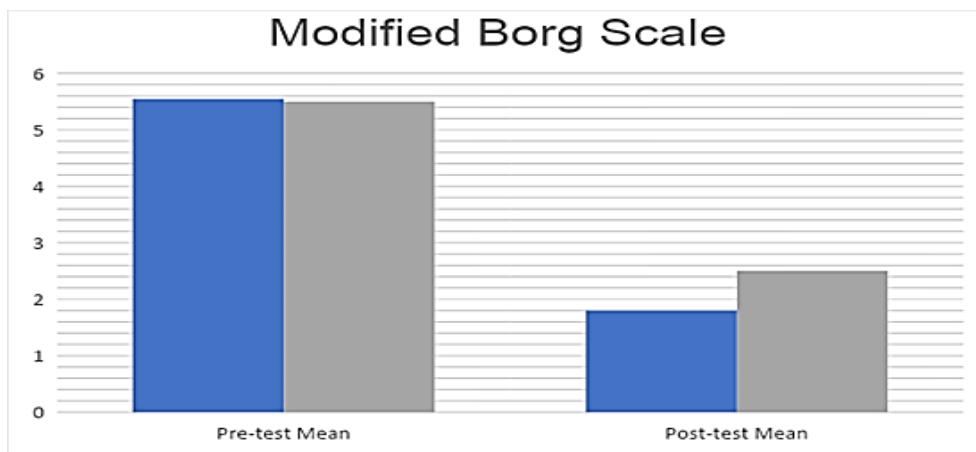


Fig. 4: Comparison of Modified Borg Scale between group A and group B

## DISCUSSION

In obese individuals, the respiratory muscle training shows improvement through learning and practicing the interventions. However, playing the wind instrument shows greater results when compared with other interventions.

Increased pulmonary functions were observed in trained wind instrument players than the control group, this physiological advantage could probably be caused because of regular training of blowing. Thus, application of wind instrument training is suggested as a therapeutic use in daily over a period of 1-2 hours/day to improve expiratory muscle strength of patients especially with chronic respiratory diseases and obstructive sleep apnoea (8). Respiratory muscle training has been shown to improve respiratory muscle performance in healthy subjects and in patients, increasing the strength and/or endurance depending on training modalities. Respiratory muscle function improved well with this type of training when compared with whole-body exercise training (cycling or running). The experiments even suggested that adding respiratory muscle endurance training (RMET) to standard management in obese patients may be a promising tool to reduce dyspnoea symptoms and increase functional capacity in this population (9).

Obesity has multitude effects on pulmonary function. In most situations the respiratory rate is increased to compensate the normally depressed tidal volumes and reduced total respiratory compliance; Conflicting results were observed while partitioning chest wall and lung components as the most consistently affected respiratory parameters were lung volumes and especially Expiratory Reserve Volume (ERV), (10). Obesity could affect the respiratory muscle strength due to fat deposition, which requires more force for ventilation mechanics. The overburden of respiratory muscles leads to adaptation and generates more pressure during respiration. Respiratory changes depend on the type of obesity, duration of obesity and physical activities of the individuals (1).

Obesity has an impact on pulmonary functions the changes are evidenced by the components of the Vital Capacity (VC) [Inspiratory Reserve Volume and Expiratory Reserve Volume]. Further, alterations in respiratory functions indicate deleterious effects on ventilatory mechanics caused by obesity, probable lung compression (reduction in the ERV) leads to a compensatory improvement in the inspiratory reserve volume in order to maintain a constant vital capacity (3).

Although it is known that obesity can be prevented and treated with physical activity and exercise, many obese adults without coexisting disorders may feel difficult to do exercise because of dyspnoea on exertion. Exertional dyspnea is a clinical concern

significantly as well an obstacle for prevention and treatment of obesity, due to which many people do not participate in the physical activity regularly (11). Marked improvement in inspiratory muscle strength, functional capacity, ventilatory response to exercise, recovery oxygen uptake kinetics, and quality of life are achieved through inspiratory muscle training (12).

As adjunct to general exercise reconditioning, Inspiratory muscle training significantly improved inspiratory muscle strength and endurance. Inspiratory muscle training was found to be effective in reducing dyspnoea at rest and during exercise for chronic obstructive pulmonary disease patients (4).

Recently, Kim *et al.*, examined the respiratory muscle training with wind instrument effects among elderly and found that there is an improvement in respiratory function, motor function, and quality of life and suggested that this exercise program can be implemented in various community centres (5). A study concluded that the smokers did not show any differences in their respiratory stress compared to non-smokers and the practice of a wind instrument can function proactively in the respiratory system of individuals who are chronic smokers, with regard to the appearance of a respiratory disease. So, the practice of a wind instrument may have a positive effect on the respiratory function (13).

According to Harode *et al.*, musicians playing wind instrument may be susceptible to chronic upper airway symptoms. High prevalence of sinusitis, nasal catarrh and hoarseness was observed in wind instrument players compared to control group musicians. Wind instrument players had significantly FEV<sub>1</sub> values higher compared to people who do not play wind instruments (14).

When comparing the trained and untrained wind instrument blowers, the trained wind instrument blowers had higher pulmonary functions than the untrained blowers and the non-blowers, which might be mostly due to regular training of blowing. In addition, the trained wind instrument blowers had an exceptional pulmonary function, which was considered as a physiological advantage, and higher forced vital capacity might have been due to their regular breathing pattern in which they use their whole vital capacity skilfully (15). Additionally, a data suggested that playing a wind instrument might be associated with higher-than-expected parameters of lung function (16). Performing wind instrument does not cause any lung ventilation disturbances and the improvements in the spirometric parameters may depend on a period of time of performing the wind instrument (17). However, an inspiratory muscle-training program had significant effects on inspiratory muscle strength in obese population and improved measures such as FVC, FEV<sub>1</sub>, MVV and improvements were also seen in dyspnoea and

quality of life. Hence, this study can be applied to obese individuals to reduce dyspnoea and improve quality of life in the same way but by using a wind instrument (6). The results of this study revealed a statistically significant increase in the values of FVC, FEV<sub>1</sub>, MVV and reduction in the values of Modified Borg Scale after the respiratory training program with wind instrument. Hence, the study shows that wind instrument is effective in improving pulmonary functions also supported by other studies.

## CONCLUSION

The present study provides the comprehensive view of respiratory training among obese individuals and it is done with the playing of the wind instrument-flute. From the result, it has been concluded that playing wind instrument is found to be more effective than respiratory training using an incentive spirometer.

## CONFLICT OF INTEREST

Authors declare no conflicts of interest.

## REFERENCES

1. Shinde, B. V., Phatale, S., Shinde, P. U., Waghmare, S. N. The impact of obesity on respiratory muscle strength in adults. *International Journal of Contemporary Medical Research*. 2017; 4(9): 1879-1882.
2. Mafort, T. T., Rufino, R., Costa, C. H., Lopes, A. J. Obesity: systemic and pulmonary complications, biochemical abnormalities, and impairment of lung function. *MultidiscipRespir Med*. 2016; 11: 28.
3. Costa, D., Barbalh, M. C., Miguel, G. P., Forti, E. M., Azevedo, J. L. The impact of obesity on pulmonary function in adult women. *Hospital das clinicas da FMUSP*. 2008; 6: 719-724.
4. Bulpitt, C. J., Palmer, A. J., Battersby, C. Association of symptoms of type 2 diabetic patients with severity of disease, obesity and blood pressure. *Diabetes Care*. 1998; 21: 111-115.
5. Kim, B. S., Kim, J. H., Park, S. H., Seo, H. S., Lee, H. S., Lee, M. M. Effect of a respiratory training program using wind instrument on cardiopulmonary function, endurance and quality of life of elderly women. *Med SciMonit*. 2018; 29(24): 5271-5278.
6. Rekha, K., Anandh, V., Alagesan, J. Effect of inspiratory muscle training for obesity. *International Journal of Biology, Pharmacy and Allied Sciences*. 2013; 2(7): 1571-1578.
7. Fuhrmann, A. G. Respiratory health and lung function of wind and brass musicians. *Conservatorium of music school of population and global health*. 2009; 24(4): 170-174.
8. Sunita, S., Dhule, Bisht Nene Sunita, Swati. R. Gawali. Pulmonary function tests in wind instrument. *International Journal of Science and Research (IJSR)*. 2013; 2(5): 384-386.
9. Villiot-Danger, J. C., Villiot-Danger, E., Borel, J. C., Pépin, J. L., Wuyam, B., Vergès, S. Respiratory muscle endurance training in obese patients. *Int J Obes (Lond)*. 2011; 35(5): 692-699.
10. Littleton, S. W. Impact of obesity on respiratory function. *Respirology*. 2012; 17(1): 43-49.
11. PDall'Ago, P., Chiappa, G. R., Guths, H., Stein, R., Ribeiro, J. P. Inspiratory muscle training in patients with heart failure and inspiratory muscle weakness: a randomized trial. *J Am CollCardiol*. 2006; 47(4): 757-763.
12. Lötters, F., van Tol, B., Kwakkel, G., Gosselink, R. Effects of controlled inspiratory muscle training in patients with COPD: a meta-analysis. *EurRespir J*. 2002; 20(3): 570-576.
13. Bouros, E., Protogerou, V., Castana, O., Vasilopoulos, G. Respiratory function in wind instrument players. *Mater Sociomed*. 2018; 30(3): 204-208.
14. Harode, D. Study of pulmonary function and its effect on the wind instrument players: A review. *International journal for innovative research in science and technology*. 2015; 1(11): 551-554.
15. Manohar, S. M., Devidas, K. P. Pulmonary function in trained and untrained wind instrument blowers. *People's journal of scientific research*. 2012; 5(2), 22: 9-12.
16. Zuskin, E., Mustajbegovic, J., Schachter, E. N., Kern, J., Vitale, K., Pucaric-Cvetkovic J. Respiratory function in wind instrument players. *LaMedicina del lavoro*. 2009; 100(2): 133-141.
17. Brzęk, A., Famuła, A., Kowalczyk, A., Plinta, R. Efficiency of lung ventilation for people performing wind instruments. *MedPr*. 2016; 67(4): 427-433.