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# Effect of Acupressure on Pulmonary Function of Workers Exposed to Sulfur Dioxide Gas

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**Abstract**

**Background:** Acupressure is a branch of complementary medicine that is non-pharmacological and non-invasive. We conducted this technique to see its effect on pulmonary function in Rafsanjan Sarcheshmeh Copper Complex workers.

**Materials and Methods:** This study was a randomized controlled clinical trial conducted on 82 workers with abnormal spirometry results. Respondents were selected by convenient sampling and then randomly divided into the two groups of 41 people. In the intervention group, after acupressure training, the participants were asked to stimulate 2 points first on one side of the body and then on the other side. The Two points were LU7 and LU9. The pressure was applied using fingers for 2 minutes at each point, at a specific time, and for 5 days by the participants themselves. In the control group, acupressure was used at ineffective points that the samples did not know about. FVC, FEV1 indices, and six-minute walk test (6MWT) in both groups were measured and compared before and after the intervention.

**Results:** No significant difference was observed between the control and intervention groups before the study based on FVC, FEV1 and 6MWT scors. There was also no difference in the control group before and after the study based on these indices. However, in the treatment group, the FEV1 and FEV1/FVC ratios significantly increased after the intervention (P<0.05).

**Conclusions:** Acupressure can effectively improve the functional parameters of the lungs, especially in workers who suffer from pulmonary dysfunction due to occupational diseases.

**Keywords:** Occupational Diseases, Acupressure, Spirometry

## Introduction

Pulmonary diseases are highly prevalent across the world and occur in any gender, age, or race. These diseases vary from well-known conditions like asthma and Chronic obstructive pulmonary disease (COPD) to rare conditions like lymphangioleiomyomatosis (LAM) [1]. At least 4 out of 10 deaths due to internal medicine problems are somehow related to pulmonary dysfunction in America. Nowadays, the rate of pulmonary diseases has increased because of changes in lifestyle, the rise of air pollution, increased interest in smoking, and occupational diseases that occur due to exposure to hazardous factors in the workplace [2].

Some specific tests assess pulmonary function, and one of these most important tests is spirometry, which measures some criteria such as forced expiratory volume in the first second (FEV1), forced vital capacity

(FVC), and FEV1/FVC ratio [3]. Another test that can be used to evaluate lung function is the six-minute walk test (6MWT), which plays a key role in determining the prognosis and evaluating the response to treatment in a wide range of respiratory diseases [4]. In this test, the patient walks for 6 minutes on a hard, flat surface, and the distance that the patient can walk over this time is measured in the normal range of 30 meters. During this time, hemoglobin oxygen saturation is measured. A decrease in hemoglobin oxygen saturation is abnormal and indicates a disturbance in gas exchange ability [1].

Considering the drug expenses and their side effects, it is important to use a non-pharmacological method to treat or manage patients with lung diseases [5]. Among non-pharmacological methods, acupressure has received a lot of attention these days, and it is an easy and available technique that the nurse and even the patient himself can perform after receiving training. In this technique, stimulating specific body points using pressure can stimulate some nerve fibers and send impulses to the spinal cord, midbrain, pituitary gland, and hypothalamus. In other words, some special channels in the human body called meridians regulate the flow of energy and restore health to the body by balancing the energy. This method is safe and does not require any special equipment [5, 6]. In China, acupuncture treats a wide range of lung diseases, including asthma, tumors, tuberculosis, viral pneumonia, pneumothorax, and pleural effusion. Research also confirms this medicine's effectiveness in treating asthma, chronic bronchitis, and other obstructive lung diseases [7]. The mechanism of acupuncture therapy is often explained using the meridian system. It is said that the activation of the meridians (energy channel) can manipulate the body's function [8].

In Iran, the Sarcheshmeh copper complex has a huge amount of copper mineral deposits, and its rock type is sulfur. Therefore, while refining the rocks to extract the purer copper metal, a considerable amount of sulfur in the rocks turns into SO2 gas. Inhaling the SO2 gas causes shortness of breath and severe respiratory disorder [9].

The results of research conducted to see the effect of pollutants released from the chimneys of the power plants on human health from an economic perspective show that the increase in the concentration of SO2 pollutants from the mentioned power plants can increase the number of respiratory patients from 28.9 to 51.72 people per year, by itself [10, 11]. Another study showed that the lung volumes of workers in the Sarcheshmeh copper complex have decreased due to occupational diseases [12]. According to the researcher's experience working with the workers in the Sarcheshme copper complex, it seems that a solution to improve the respiratory performance of these people must be found. In the literature review, no study was found regarding the effect of acupressure on lung function in Iran. Therefore, this question remains whether acupressure is an effective, uncomplicated, and cheap intervention to help these people and their families and whether it can take the burden off the treatment system or not? To answer this question, this study was conducted to investigate the effect of acupressure on the pulmonary function of Rafsanjan Sarcheshmeh Copper Complex workers.

## Materials and Methods

This study was a double-blind, randomized clinical trial (IRCT2016112615965N10), which was done in 2016. The double-blinded method helped us to reduce the error caused by allocating the participants into two groups. In this clinical trial, 82 participants from Rafsanjan Sarcheshmeh Copper Complex who had abnormal spirometry results, according to the confirmation of a specialist, were selected with a convenience sampling method. After obtaining informed consent from the participants, they were randomly divided into intervention and control groups (each 41 participants). The two groups were matched using spirometry results (that were categorized into poor, moderate, and severe condition). During the intervention period, 6 participants were excluded from the study due to miscellaneous reasons, and finally, the study finished with 76 valid data (each group ended with 38 valid data) (Fig. 1).

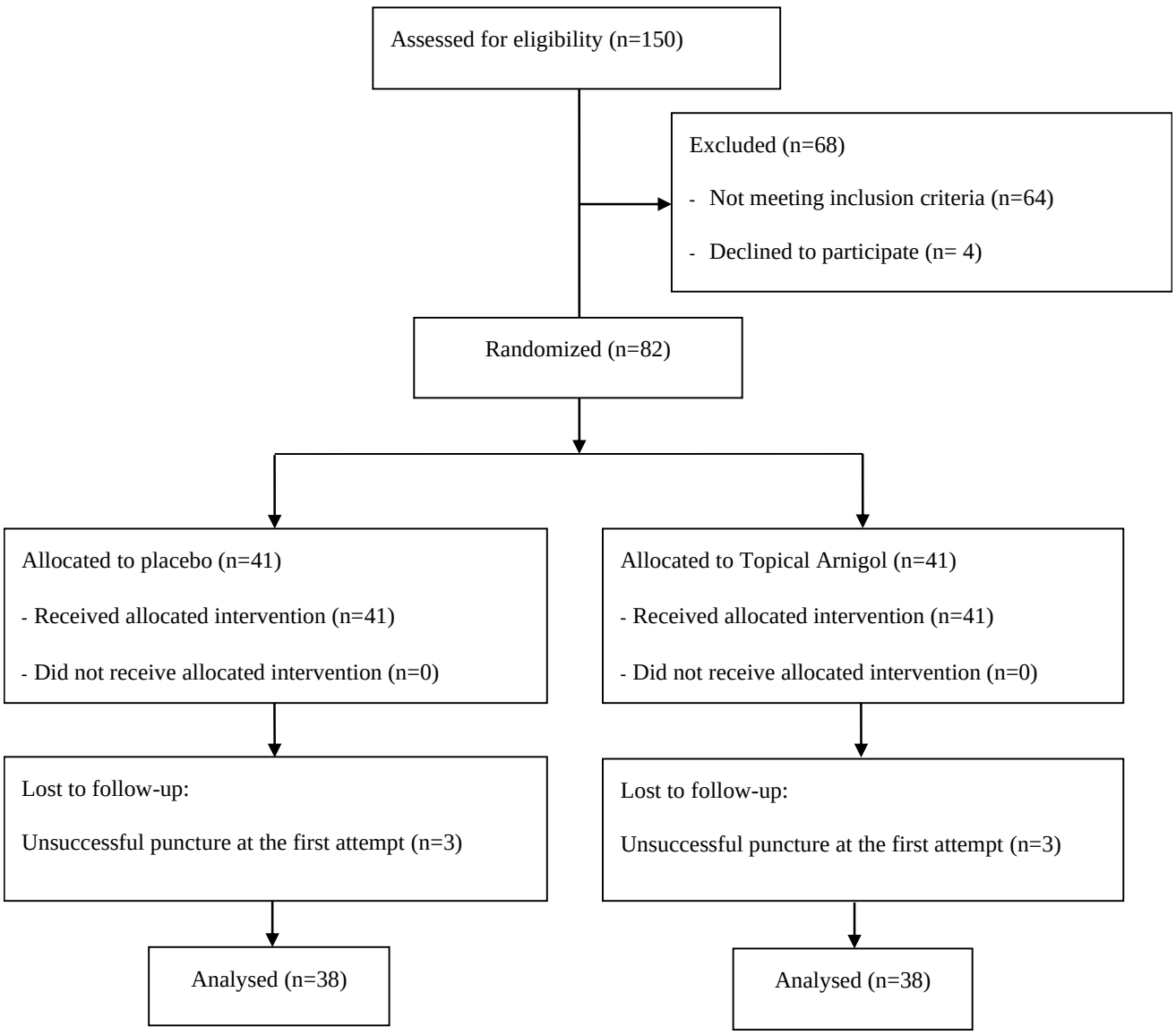


**Fig. 1.** Consort flowchart of the study's sampling

Inclusion criteria were working in Rafsanjan Sarcheshmeh Copper Complex, having abnormal spirometry, having no other diseases, not using acupuncture/acupressure recently, signing the informed consent form, being able to communicate effectively, having no abnormality in the site of acupressure, and having no neurological impairment.

Exclusion criteria were being unwilling to continue the research, experiencing pain during intense activity, being infected with respiratory diseases one month before the study, getting any disease during the study period, taking bronchodilators 12 before collecting data, and consumption of alcohol and narcotics. The tools used in this study were a checklist created by the author, the Ref spirometry III color spirometry made in Italia, and the six-minute walk test (6MWT). The checklist gathered some information such as age, height, weight, education level, marital status, working experiences, cigarette smoking history, FVC, FEV1, FEV1/FVC, FVC%, FEV1%, FEV1/FVC%, 6MWT results.

The trained researcher taught the intervention group how to perform the acupressure technique at two points, they performed the acupressure by themselves and were given illustrated brochures which showed them the exact points to apply the pressure. The first acupressure point in our study was the Lung 07 (LU7) point which is located above the styloid process of the wrist on the inside of the arm on the radius bone. In other words, it is 3.5 cm above the Transverse carpal ligament. The other point in our study was Lung 09 (LU 9) located at the radial end of the transverse crease of the wrist or in the depression of the lateral side of the radial artery (Fig. 2).

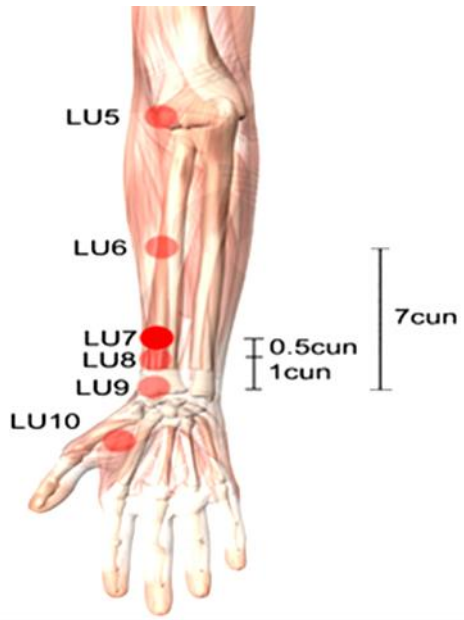


**Fig. 2.** LU7 & LU9 Locations

The pressure was applied first at one side of the body (first at LU7 point and then at LU9 point) and then at the other. The pressure is applied gently, constantly in a back-and-forth motion for 2 minutes at each point. This technique was done at 6:00 PM each day for five successive days. While the intervention group did the technique at the correct points, the control group did it at the false points. Both groups' participants did the spirometry and six-minute walk test (6MWT). The researcher was blinded to who was in what group.

In this study, FVC, FEV1 indices in spirometry, and distance traveled in 6 minutes in both groups, before and after intervention, were measured and compared. The spirometry test was performed in a local clinic in Rafsanjan Sarcheshmeh Copper Complex. All the spirometry tests were performed by one person, and performing all the spirometry took 3 months. The patients were asked to do the spirometry 3 times, and then the highest score of FVC and FEV1 was recorded. The FEV1/FVC more than 75% was considered normal.

All participants gave their full informed consent to participate in the study. The research team obtained the ethical approval code from the ethics committee of Rafsanjan University of Medical Sciences (Code: IR.RUMS.REC.1396.62).

At the end of the study, all the data were analyzed with SPSS 18 software. We used the frequency, percentage, mean, and standard deviation for showing the descriptive data. As the results of the Kolmogorov–Smirnov test showed that data follow a normality pattern, we used an independent T-test and a dependent T-test to test the study's objectives. In all these tests, a P-value less than 0.05 was considered meaningful.

## Results

A total of 76 valid data was analyzed at the end of the study. The mean age of the participants was 42.36 ± 4.56 years (the minimum was 33 and the maximum was 52 years). In terms of smoking, 22 participants (28.9%) were smoking. The average work experience of the participants in the study was 17.63±4.70 years, which ranged from a minimum of 7 to a maximum of 28 years. In the comparison between the two groups in terms of variables of age, height, weight, working experience, and smoking, the independent t-test showed no difference (P>0.05) (Table 1).

**Table 1.** Comparison of age, height, weight, work experience, and daily cigarette consumption between the control and test groups

| Variable | The groups of study | | The P-value of independent T-test |
|---|---|---|---|
| | Intervention | Control | |
| | Mean ± SD | Mean ± SD | |
| **Age (year)** | 42.00 ± 4.33 | 42.73 ± 4.81 | 0.485 |
| **Height (cm)** | 173.13 ± 6.20 | 170.39 ± 6.94 | 0.074 |
| **Weight (kg)** | 81.71 ± 16.63 | 77.94 ± 13.40 | 0.281 |
| **Working experience (year)** | 17.07 ±4.36 | 18.18 ± 5.02 | 0.310 |
| **Number of cigarettes consumed per day** | 1.36 ± 2.47 | 1.63 ± 2.67 | 0.658 |

Because the data distribution was statistically normal, we used parametric tests. The independent t-test showed that the difference in the mean of none of the spirometric indices, as well as the six-minute walk test (6MWT) between the two groups, was not statistically significant before the study (P>0.05). Also, the paired t-test showed that in the control group, the difference between the variables before and after the intervention was not statistically significant (P>0.05) (Table 2).

**Table 2.** Comparison of the indicators measured before and after the intervention in the control group

| Variables | Time of measuring | Mean | SD | The P-value of dependent T-test |
|---|---|---|---|---|
| **6MWT** | Before the intervention | 409.02 | 40.54 | 0.079 |
| | After the intervention | 409.94 | 41.40 | |
| **FVC** | Before the intervention | 3.51 | 0.68 | 0.252 |
| | After the intervention | 3.56 | 0.66 | |
| **FVC %** | Before the intervention | 80.05 | 11.50 | 0.360 |
| | After the intervention | 80.76 | 11.26 | |
| **FEV1** | Before the intervention | 2.69 | 0.49 | 0.887 |
| | After the intervention | 2.69 | 0.48 | |
| **FEV1%** | Before the intervention | 74.07 | 10.25 | 0.696 |
| | After the intervention | 74.52 | 10.70 | |
| **FEV1 / FVC** | Before the intervention | 77.33 | 11.74 | 0.458 |
| | After the intervention | 76.35 | 10.44 | |
| **FEV1% / FVC%** | Before the intervention | 97.02 | 14.44 | 0.358 |
| | After the intervention | 95.52 | 12.93 | |

However, in the intervention group, the mean of FEV1 and the FEV1 to FVC ratio after the intervention were significantly higher than the values before the intervention ($P<0.05$), but the differences between FVC and 6MWT before and after the intervention were not significant ($P>0.05$) (Table 3).

**Table 3.** Comparison of the indicators measured before and after the intervention in the intervention group

| Variables | Time of measuring | Mean | SD | The P-value of dependent T-test |
|---|---|---|---|---|
| **6MWT** | Before the intervention | 403.18 | 57.40 | 0.241 |
| | After the intervention | 409.68 | 45.22 | |
| **FVC** | Before the intervention | 3.72 | 0.71 | 0.643 |
| | After the intervention | 3.74 | 0.60 | |
| **FVC %** | Before the intervention | 82.00 | 13.90 | 0.759 |
| | After the intervention | 82.25 | 11.44 | |
| **FEV1** | Before the intervention | 2.71 | 0.46 | 0.001 |
| | After the intervention | 2.80 | 0.46 | |
| **FEV1%** | Before the intervention | 73.15 | 11.33 | 0.024 |
| | After the intervention | 74.86 | 10.87 | |
| **FEV1 / FVC** | Before the intervention | 73.65 | 11.56 | 0.043 |
| | After the intervention | 75.51 | 11.48 | |
| **FEV1% / FVC%** | Before the intervention | 92.05 | 14.92 | 0.037 |
| | After the intervention | 94.67 | 14.18 | |

## Discussion

In recent years, many types of research have been conducted to investigate the effect of acupressure in various fields, including on the pain of cancer patients [13], pain after cesarean section [14], nausea in pregnancy [15], and also nausea and vomiting after chemotherapy [16], but no study was found regarding the effect of acupressure on the lung function of workers with occupational lung disease.

Our research was conducted as a clinical trial study to determine the effect of acupressure at LU7 and LU9 points on the lung function of Rafsanjan Sarcheshmeh copper complex workers. The samples were matched in terms of pulmonary dysfunction (spirometry). Also, the samples were not significantly different before the intervention regarding age, height, weight, work experience, and the number of daily cigarettes.

In the present study, the amount and percentage of FEV1 and its ratio to vital capacity (VC) increased significantly after the acupressure intervention, and acupressure had a healing effect on the pulmonary function of these people.

Vyas et al. showed the positive effects of performing 45 minutes of transcutaneous electrical nerve stimulation (TENS) at the EX-B1 point on the forced expiratory volume in the first second (FEV1) and FVC in patients with COPD [17]. Zhang et al. also showed the positive effect of acupuncture at points L11, LU7, LU10, PC6, ST36, SP6, and KI3 (for 12 days) on increasing the values of FEV1, Forced Expiratory Flow (FEF) and the maximum expiratory flow (MEF) of patients with asthma. Given the fact that asthma patients have abnormal spirometry just like the patients in our study, and using the LU7 point in Zhang et al study, we can say that their results have similar results with ours [18].

Vinod et al.'s study also indicates increased spirometry indices in COPD patients after receiving TENS and stimulating at EXB1 point [19]. The research of Rahmani et al. also showed that acupressure at LU9 point can decrease the breathing problem from chemical agents and increase the FVC and FEV1 [20]. The

present study's results are consistent with this study's findings too. A review done by Nagi et al. [21] also proved the positive effect of stimulating the acupuncture points (using needles, lasers, pressure, and transcutaneous electrical stimulation) on improving the lung function of COPD patients. Although the type of stimulation, the stimulated points, and the duration of intervention in previous research are different, the findings of all these studies showed the positive effect of acupressure on improving the pulmonary function of these patients.

In this study, acupressure was associated with an increase in the result of the 6MWT, but the difference obtained was not statistically significant. However, in the study of Vyas et al., doing 45 minutes of TENS was associated with an increase in 6MWT in patients with COPD (17). The results of a similar study that used acupuncture showed an improvement in 6MWT outcomes in patients with COPD [22]. This difference can be attributed to the number of stimulated points, the number of intervention times in one day, or the duration of intervention in the present study. Conducting future studies considering the increase of stimulation points and a longer duration of intervention may show positive results.

This study was also accompanied by some limitations. For example, the stimulation of the points in our study was done by the participants themselves, and they may not have done it quite right.It is suggested to perform acupressure on lung function by the interventionist in future research.

## Conclusion

This study showed that acupressure at UL7 and UL9 points in workers with abnormal spirometry can improve lung function by increasing the FEV1 and its ratio to vital capacity (VC). Therefore, acupressure can be suggested as a complementary, non-invasive, simple, effective, and without side effects for improving lung function in patients with occupational lung diseases.

## Acknowledgement

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**Conflict of interest:** None declared.

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This study had been funded by the Rafsanjan University of Medical Sciences.

## Ethical Considerations

All participants gave their full informed consent to participate in the study.

## Code of Ethics

The research team obtained the ethical approval code from the ethics committee of Rafsanjan University of Medical Sciences (Code: IR.RUMS.REC.1396.62).

## Authors' Contributions

Hossein Raesiantzerji implemented the intervention and gathered the data. Majid Kazemi proposed the initial idea of the study, supervised the study and analysed the study. Mahdi Karimi and Maryam Shahabi Nedjad designed the methodological aspect of the study and intervention and assisted in implementing the study, Hadi Hasani drafted revised the manuscript.

## References

1. Benjamin I, Griggs RC, Fitz JG, Wing EJ. Andreoli and Carpenter's Cecil essentials of medicine. 9th ed. New York, United States: Elsevier; 2016.
2. Hinkle JL, Cheever KH. Brunner & Suddarth's Textbook of Medical-Surgical Nursing. 14th ed. Philadelphia, Pennsylvania, United States: Lippincott Williams & Wilkins; 2017.
3. Miller MR, Hankinson J, Brusasco V, Burgos F, Casaburi R, Coates A, et al. Standardisation of spirometry. Eur Respir J. 2005;26(2):319-38.
4. Holland AE, Spruit MA, Troosters T, Puhan MA, Pepin V, Saey D, et al. An official European Respiratory Society/American Thoracic Society technical standard: field walking tests in chronic respiratory disease. Eur Respir J. 2014;44(6):1428-46.
5. Bassampour SH, Nasrabadi Nasrabadi A, Mehran A, Poresmaeil Z, Valiee S. Effect of acupressure on patients' anxiety and vital sign before abdominal surgeries. J Hayat. 2008;14(2):23-34.
6. Hanfy HM, Awad MA, Gharieb HO. Effect of Acupressure on Postmenopausal Hypertension. Bull Fac Phys Ther. 2011;16(2):1-7.
7. Lau KS, Jones AY. A single session of Acu-TENS increases FEV1 and reduces dyspnoea in patients with chronic obstructive pulmonary disease: a randomised, placebo-controlled trial. Aust J Physiother. 2008;54(3):179-84.
8. Chen LL, Su YC, Su CH, Lin HC, Kuo HW. Acupressure and meridian massage: combined effects on increasing body weight in premature infants. J Clin Nurs. 2008;17(9):1174-81.
9. Abakay A, Gokalp O, Abakay O, Evliyaoglu O, Sezgi C, Palanci Y, et al. Relationships between respiratory function disorders and serum copper levels in copper mineworkers. Biol Trace Elem Res. 2012;145(2):151-7.
10. Ghyath Al-Din M, Feizbakhsh K, Lotfalikhani M. The effect of pollutants from power plant chimneys

on human health from an economic perspective. Paper presented at: The first conference on air pollution and its effects on health; 2006 Sep 6; Tehran, Iran.
11. Heger M, Sarraf M. Air pollution in Tehran: health costs, sources, and policies. Washington, United States: The World Bank; 2018.
12. Hejazian SH, Dashti Rahmatabadi MH, Fallahzadeh H, Aminipour Gh. Comparison of respiratory volumes of copper mining workers with expected values. J Toloo-e-Behdasht. 2004;2(4):14-9.
13. Sharifi Rizi M, Shamsalinia A, Ghaffari F, Keyhanian S, Naderi Nabi B. The effect of acupressure on pain, anxiety, and the physiological indexes of patients with cancer undergoing bone marrow biopsy. Complement Ther Clin Pract. 2017;29:136-41.
14. Ahn NY, Park HJ. Effects of Korean hand acupressure on opioid-related nausea and vomiting, and pain after caesarean delivery using spinal anaesthesia. Complement Ther Clin Pract. 2017;28:101-7.
15. Can Gürkan O, Arslan H. Effect of acupressure on nausea and vomiting during pregnancy. Complement Ther Clin Pract. 2008;14(1):46-52.
16. Eghbali M, Yekaninejad MS, Varaei S, Jalalinia SF, Samimi MA, Sa'atchi K. The effect of auricular acupressure on nausea and vomiting caused by chemotherapy among breast cancer patients. Complement Ther Clin Pract. 2016;24:189-94.
17. Vyas BM, Shah S, Tiwari H, Singh A. The effect of Acu-TENS on FEV1, six-minute walk distance and dyspnoea in patients with chronic obstructive pulmonary disease: A randomised trial. Int J Biomed Adv Res. 2013;4(7):448.
18. Zhang WP. [Effects of acupuncture on the pulmonary function and heart rate variability in different state of bronchial asthma]. Zhen Ci Yan Jiu. 2007;32(1):42-8.
19. Vinod Babu K, Akalwadi A, Sai Kumar N, Brahmbhatt MD. Short term effect of acupuncture-tens on lung functions and dyspnea for subjects with moderate copd. Int J Physiother. 2015;2(5):868-75.
20. Rahmani R, Mohammadian M, Ghaneei M, Salari M, Tadrisi SD. Effect of Accupressure on Decreased Breathing Problem From Chemical Agents. Kowsar Med J. 2004;9(Part 2):143-8.
21. Ngai SP, Jones AY, Cheng EK. Lung meridian acupuncture point skin impedance in asthma and description of a mathematical relationship with FEV1. Respir Physiol Neurobiol. 2011;179(2-3):187-91.
22. Suzuki M, Muro S, Ando Y, Omori T, Shiota T, Endo K, et al. A randomized, placebo-controlled trial of acupuncture in patients with chronic obstructive pulmonary disease (COPD): the COPD-acupuncture trial (CAT). Arch Intern Med. 2012;172(11):878-86.