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KOMPLEKSOWE WYPOSAŻENIE SPRZĘTU DIAGNOSTYCZNEGO DLA KLUBÓW PIŁKARSKICH, OŚRODKÓW SPORTOWYCH I REHABILITACYJNYCH

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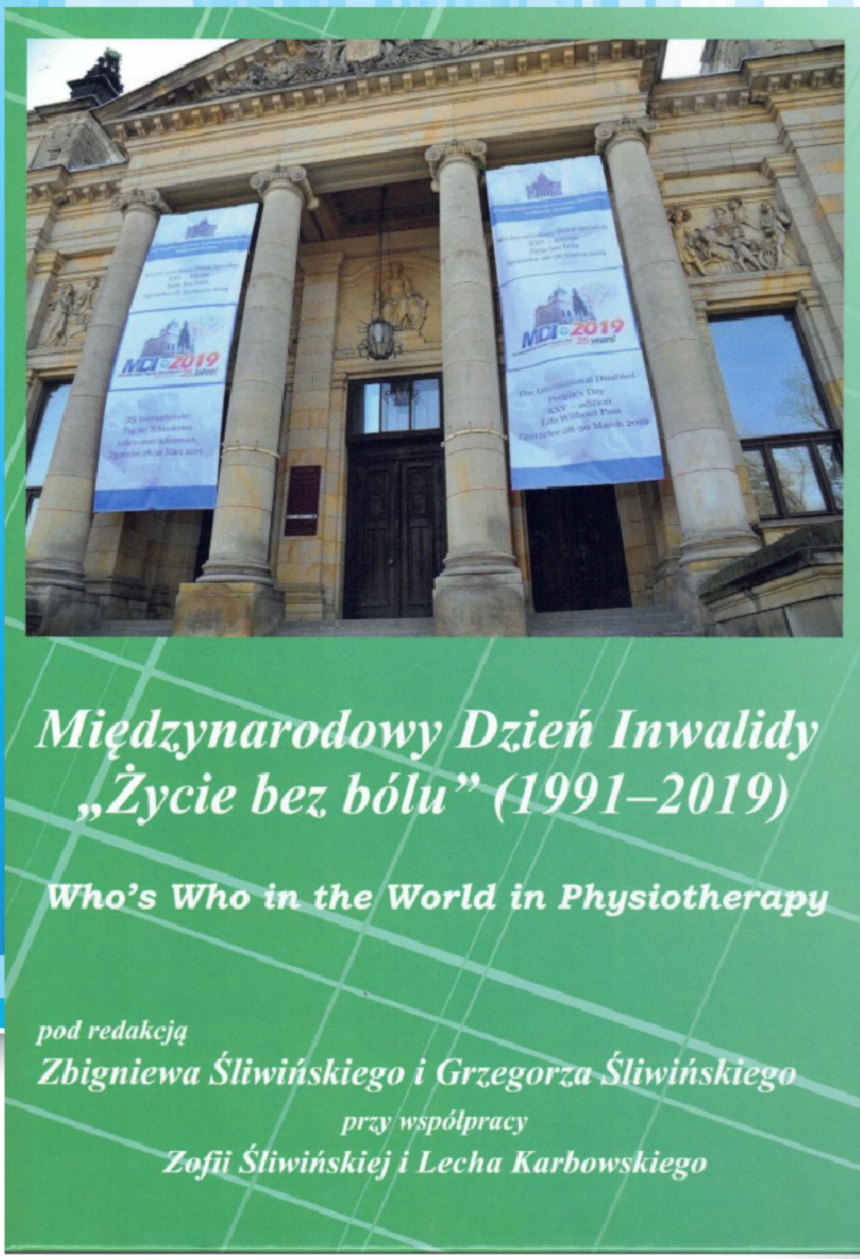
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Impact of lung boost exerciser on lung compliance and quality of life in elderly

Wpływ urządzenia do ćwiczeń na wzmocnienie płuc na podatność płuc i jakość życia u osób starszych

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Abstract

Purpose. To assess the effect of lung boost exerciser on lung compliance, aerobic functional capacity and quality of life in elderly. Materials and methods: sixty subjects of both sexes (31 women and 29 men) participated in this study with age group from 7080 years. Subjects assigned randomly into two equal groups. Group A received a conventional physical therapy programme for the chest in form of diaphragmatic breathing exercise, pursed-lip breathing exercise and upper limb Exercises connected with respiration, while Group B received Lung boost exerciser in addition to conventional physical therapy programme for the chest. Received three sessions a week for the next 12 weeks. The treatment was applied for 12 weeks, three sessions per week. Variables were assessed before and after intervention for each subject and statistically analyzed: (forced vital capacity (FVC), forced expiratory volume in one second (FEV1), maximum inspiratory pressure (MIP) were assessed by spirometry), diaphragmatic excursion (was assessed by percussion), quality of life (was assessed by quality of life score (QoL) and aerobic functional capacity (was assessed by six-minute walk test). Results: statistical analysis using mixed MANOVA showed that there was no significant difference in all parameters between both groups before treatment ($p > 0.05$). Comparison between groups after treatment revealed a significant increase in FVC, FEV1, MIP, and 6MWD of the group B compared with that of the group A ($p < 0.001$). Also, there was a significant decrease in QoL score ($p < 0.001$) and a significant increase in diaphragmatic excursion of the group B compared with that of group A after treatment. Conclusions: Lung boost exerciser is an effective modality that can be added to traditional physical therapy protocols and revealed a positive impact on lung compliance and quality of life in elderly.

Key words:

elderly, respiratory exercises, lung boost exerciser, spirometry

Streszczenie

Cel. Ocena wpływu urządzenia do ćwiczeń na wzmocnienie płuc na podatność płuc, wydolność tlenową i jakość życia osób starszych. Materiał i metody: W badaniu wzięło udział 60 osób obojga płci (31 kobiet i 29 mężczyzn) w wieku 70-80 lat. Osoby przydzielono losowo do dwóch równych grup. Grupa A była poddawana konwencjonalnemu programowi fizjoterapeutycznemu na klatkę piersiową w postaci ćwiczeń oddechowych przeponowych, ćwiczeń oddechowych z zaciśniętymi wargami i ćwiczeń kończyn górnych związanych z oddychaniem, natomiast grupa B wykonywała ćwiczenia na urządzeniu do ćwiczeń na wzmocnienie płuc oprócz konwencjonalnego programu fizjoterapeutycznego na klatkę piersiową. Grupy realizowały trzy sesje tygodniowo przez kolejnych 12 tygodni. Zmienne były oceniane przed i po leczeniu dla każdego pacjenta i analizowane statystycznie: (natężona pojemność życiowa (FVC), natężona objętość wydechowa w ciągu jednej sekundy (FEV1), maksymalne ciśnienie wdechowe (MIP) oceniano za pomocą spirometrii), ruch przepony (oceniano przez opukiwanie), jakość życia (oceniano na podstawie wskaźnika jakości życia (QoL), i wydolność tlenowa (oceniana za pomocą testu 6-minutowego marszu). Wyniki: analiza statystyczna z użyciem mieszanej metody MANOVA wykazała, że nie było istotnej różnicy we wszystkich parametrach między grupami przed leczeniem ($p > 0,05$). Porównanie grup po leczeniu wykazało istotny wzrost FVC, FEV1, MIP i 6MWD w grupie B w porównaniu z grupą A ($p < 0,001$). Istotne obniżenie wyniku QoL ($p < 0,001$) i znaczny wzrost ruchu przepony po leczeniu w grupie B w porównaniu z grupą A. Wnioski: Urządzenie do ćwiczeń na wzmocnienie płuc jest skutecznym narzędziem, które można wprowadzić do tradycyjnych protokołów fizjoterapii, ponieważ wykazało pozytywny wpływ na podatność płuc i jakość życia u osób starszych.

Słowa kluczowe

osoby starsze, ćwiczenia oddechowe, ćwiczenia na wzmocnienie płuc, spirometria

Introduction

In stable older people, respiratory function declines with age, as does respiratory muscle mass and strength. We coined the word "presbypnea" which refers to a reduction in respiratory function as people age [1].
According to a recent real-time morphology analysis in stable elderly people, other features of age-related structural remodeling involve a decrease in alveolar depth and a rise in acinar airway lumen. These changes, combined with a shrinking pulmonary gas exchange region, contribute to a decline in lung function as people get older [2].
The respiratory system changes anatomically, physiologically, and immunologically as people grow older. Deformities of the chest wall and thoracic spine, for example, impede compliance with the entire respiratory system, resulting in increased breathing work. Respiratory muscle strength deteriorates with age, which can hinder effective coughing. Respiratory muscle strength deteriorates with age [3].
Aging is closely connected with a drop in physical activity. Moreover, the primary cause of most chronic diseases is physical inactivity, which means staying healthy as much as possible to be in good life: the 'health cycle [4].
Increasing the health duration of older adults may significantly reduce the individual and social effect of an aging population [5]. indeed, in the elderly, the incidence of multi morbidity (two or more long-term disorders) is even higher: 65 percent of people aged 65 to 84 years and 82 percent of people aged 85 and up have it. Over 85 years [6].
The aging process affects both structure and function of airways, lung parenchyma, and respiratory muscles. This process results in changes of the respiratory flows, with dynamic lung volumes decreasing and residual volume increasing progressively with age. Respiratory system under goes various structural, physiological, and immunological changes with age [7].
The Power and flexibility of respiratory muscles can be enhanced with peripheral muscle exercises. However, when paired with advanced training of the respiratory muscles, these benefits tend to be greater [8].
Physical activity/exercise is recognized as one of the most effective techniques for the elderly to combat frailty-related physical disability. Resistance (strength and power), aerobic, balance, and flexibility work are targeted by exercise interventions. Each kind enhances various aspects of physical functioning. As a result, exercise comes into effect. Exercise intervention services should therefore be administered based on the physical functioning of a person and tailored to the resulting reaction. [9].

Rational of the study

Physical exercise is a powerful way to improve wellness [10]. Since it works on the immune system of the elderly effectively. Physical exercise at moderate intensity has a beneficial influence on the immune system's response to respiratory infections [11].
Regarding routine physical exercise practice, it is well known that regular physical fitness is necessary for the enhancement of cardiorespiratory ability [12], in the elderly [13].
Increased muscle contraction or strength in the respiratory muscles enhances pulmonary functions by balancing airway resistance and increasing lung compliance [14].
Inspiratory muscle training has been commonly used in a number of communities, including older adults in general. In addition to the increase in inspiratory muscle strength. A promising trend in the efficacy of IMT in enhancing the efficiency of inspiratory muscles in elderly subjects. Individuals should use the Lung Boost Exerciser to strengthen their lung capacity and shallow breathing. It also helps to reinforce the muscles of the lungs [15].

Material and Methods

Design of the study

The study was designed as a prospective, randomized, single-blind, pre- post-test, controlled trial.

Participants

Sixty patients were selected as a convenient study of both sexes (31 women and 29 men) was recruited from Dar el-Yasmeen in first settlement. They were enrolled and tested to see if they were qualified to take part in this study. Their ages ranged from 7080 years. To be Included in the present study participants should be Oriented, medically stable and complaining of difficulty in breathing during activity of daily living (modified Borg scale 4-6). The participants excluded from the study if they have any chest diseases, smoker patients, patients with heart failure, patients with neurological disease affecting respiratory muscles or any muscular dystrophy and hemodynamic instability (heart rate > 150 beats per minute, or systolic blood pressure > 140 mmHg, or diastolic blood pressure > 90 mmHg) is present.
Written informed consent was obtained from each participant.

Randomization

All statistical measures were performed through the statistical package for social studies (SPSS) version 25 for windows. Each participant had an identification number. These numbers were assigned into two groups equal in number (n = 30).

Intervention

Group A received a conventional physical therapy programme for the chest in form of diaphragmatic breathing exercise,pursed-lip breathing exercise and upper limb Exercises connected with respiration, while Group B received Lung boost exerciser in addition to conventional physical therapy programme for the chest. Both groups received three sessions a week for the next 12 weeks.
• ***Lung Boost Respiratory Trainer (MD 8000)***: appropriate ventilation is recommended that the room be ventilated for at least 15 minutes and that the equipment be cleaned after each use with Disposable cleaning wipes and 75 percent alcohol for 30 seconds. The patients were trained on the respiratory exercise procedure prior to the exercise. The patient looked at the respiratory exercise devices with a mouthpiece over his mouth and Inhalation was performed. The training starts with the easiest difficulty level 1 (default) and advances one level at a time until the desired difficulty level is achieved. The exercise lasted 520 minutes or 15 deep breaths in three sets, each set breathing five times, with a 1-3 minute break in between sets and a 15-second rest in between manoeuvres.

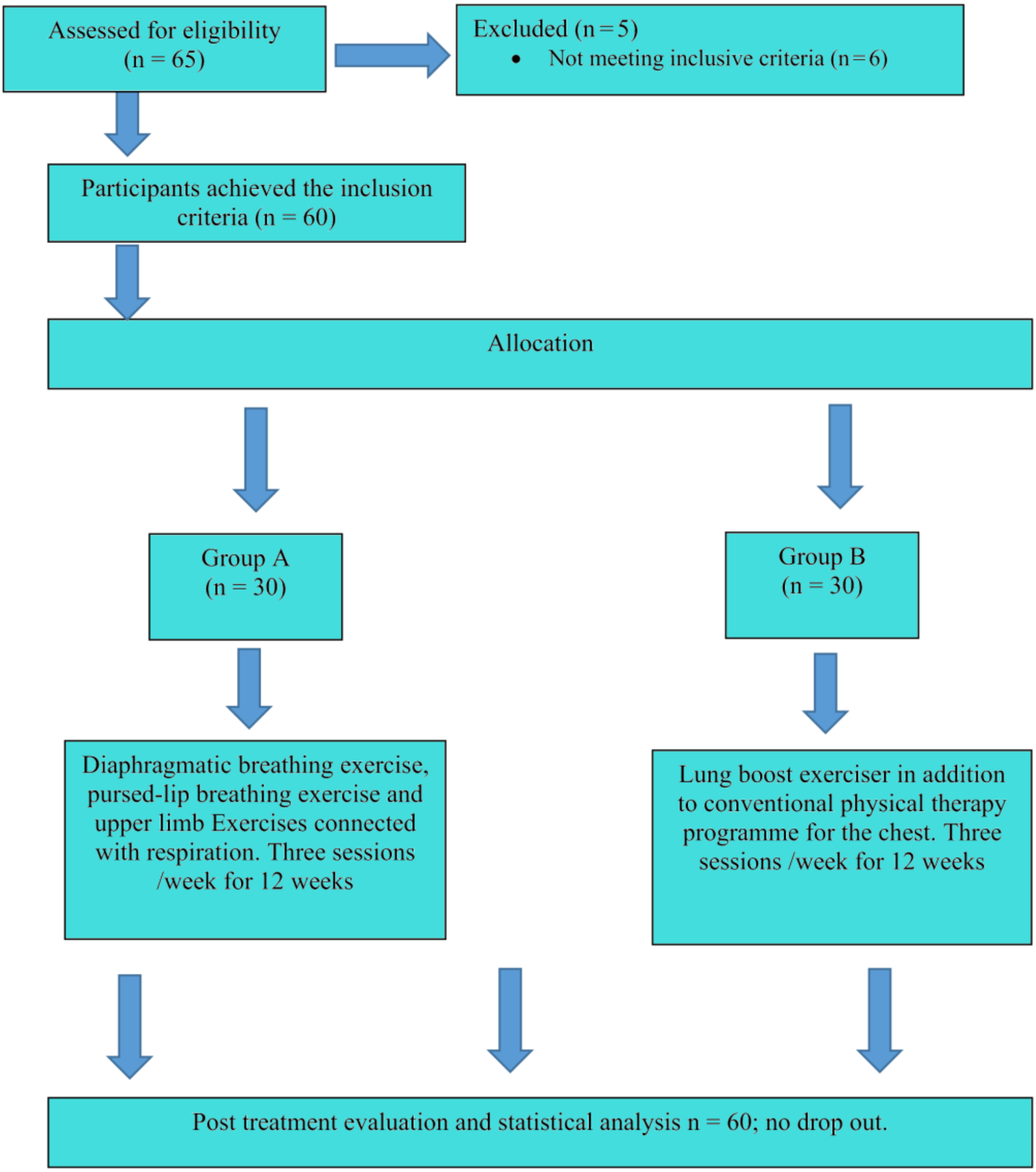

Figure 1. Flow chart of the study

• ***Breathing Exercises***: in the form of (diaphragmatic, pursed-lip breathing) Ten times repetition for each exercise was done and 20 seconds relaxation in between were applied from high supine lying position.

• ***Upper limb Exercises connected with respiration***: These exercises were applied ten times for each exercise and 30 seconds relaxation in between from a standing position and included two shoulder flexion-extension (one aligned with inspiratory time during the concentric process and the other with expiratory time) and two shoulder abduction-adduction.

Outcomes measurements

Pulmonary function test (FVC, FEV1, MIP)

Using Spirometry (CPFS/D USB™spirometer) the subjects in the study had their lung compliance assessed using spirometry to determine the following (FVC, FEV1, MIP). All subjects had their pulmonary function tested before and after 12 weeks of training. The participants were comfortably seated. Before being assessed, they had obtained an adequate education. The participants will be instructed to inhale deeply and blow their entire lung volume through the spirometer. At least three times, this procedure was repeated, and the highest value was chosen. The estimated FEV1 and FVC values will be calculated after the PFT data has been normalized for age, gender, and height (percent). [16].

Quality of life evaluation

Six minute walk test

Each participant was tested individually and was constantly observed. The 6MWT was performed indoors upon a hardened even surface following a circular circuit of 121 m. Participants were instructed to try to cover as much distance as possible within six minutes without running. They wore comfortable shoes and clothing and were allowed to rest or stop when necessary [17].

Quality of life questionnaire

The 15D is a self-administered, generic, comprehensive, standardized measure of health-related quality of life (HRQoL) that incorporates the benefits of a profile and a single index score measure. It is made up of three components: physical, emotional, and social well-being. Breathing, mental function, voice (communication), vision, agility, normal activities, vitality, hearing, feeding, elimination, sleeping, anxiety, pain and symptoms, sexual activity, and depression are among the 15 dimensions included in the current 15D questionnaire. There are five levels of each dimension. The highest score is 1 (no problems in any dimension) and the lowest score is 0 (below average). It is intended for self-administration. Filling in the blanks normally takes 5–10 minutes. The questionnaire was used to test the subjects before and after the experiment. [18].

Evaluating diaphragmatic excursion

Subjects were instructed to "exhale and hold it" while percussing down the left scapular line until the sound changed from resonant to dull. Then make a mark on the area. This determines the diaphragm's height, which separates the lungs from the abdominal viscera. Allow the subject to breathe normally for a few moments. Then instruct the subject to "breathe deeply and keep it." Percussion should be continued down from the first mark to the point where the sound becomes dull. Make a note of the venue. After that Measure the distance between the two points. On the right hand, repeat the process. In adults, it should be similar on both sides and measure between 3–5 cm. [19].

Statistical Analysis

The t test was used to compare numerical data between classes, and the chi-squared test was used to compare categorical data. The Shapiro-Wilk test was used to ensure that the data had a normal distribution. To assess group homogeneity, Levene's test for homogeneity of variances was used. FVC, FEV1, MIP, diaphragmatic excursion, QoL, and 6MWD were compared within and between groups using a mixed MANOVA. For subsequent multiple comparisons, post-hoc experiments with the Bonferroni correction were used. For all statistical analyses, the significance level was set at p less than 0.05. The statistical package for social studies (SPSS) version 25 for Windows was used for all statistical analysis (IBM SPSS, Chicago, IL, USA).

Results

Subject characteristics

The subject characteristics of groups A and B were shown in Table 1. In terms of mean age, heart rate and dyspnea borg scale as well as sex, residency, and chronic disease distribution, there was no substantial difference between groups ($p > 0.05$).

Table 1. Comparison of subject characteristics between the group A and B

	Group A (N = 20)	Group B (N = 20)	p-value
Age [years], mean ± SD	74.6 ± 3.25	75.36 ± 3.44	0.25
Heart rate [beats/min], mean ± SD	86.43 ± 6.48	86.53 ± 5.9	0.47
Dyspnea Borg Scale, mean ± SD	5.06 ± 0.73	4.93 ± 0.9	0.2
Fatigue Borg Scale, mean ± SD	5.3 ± 0.75	5.2 ± 0.71	0.59
Females/Males, n (%)	18 (80%)/12 (40%)	13 (43.3%)/17 (56.7%)	0.19
Urban/ Rural, n (%)	14 (46.7%%)/16 (53.3%)	10 (33.3%)/20 (66.7%)	0.29
Hypertension, n (%)	10 (33.3%)	13 (43.3%)	0.42
Diabetes mellitus, n (%)	16 (53.3%)	19 (63.3%)	0.43
Dyslipidemia, n (%)	16 (53.3%)	16 (53.3%)	1

SD: Standard deviation; p value: Probability value

Effect of treatment on FVC, FEV1, MIP, diaphragmatic excursion, QoL and 6 MWT

An important relationship of care and time was discovered using mixed MANOVA ($F = 50.1$, $p = 0.001$). The key influence of time was important ($F = 375.32$, $p = 0.001$). The key impact of treatment was important ($F = 85.37$, $p = 0.001$). Table 2 illustrated descriptive statistics for FVC, FEV1, MIP, diaphragmatic excursion, QoL, and 6 MWT shifts, as well as the important level of contrast between groups and before and after treatment in each group.

Between group comparison

Before treatment, there was no substantial difference in any of the parameters between the two groups (p > 0.05). When the groups were compared after treatment, the group B had a substantial improvement in FVC, FEV1, MIP, and 6MWD compared to the group A (p less than 0.001). In addition, after therapy, the group B had a significantly lower QoL score (p less than 0.001) and a significantly higher diaphragmatic excursion than the group A.

Within group comparison

Within-group comparisons showed a substantial increase in FVC, FEV1, MIP, diaphragmatic excursion, and 6 MWT in groups A and B after treatment compared to before treatment (p > 0.001), as well as a significant decrease in QoL in both groups after treatment compared to before treatment (p > 0.001).

Table 2. Mean FVC, FEV1, MIP, diaphragmatic excursion, QoL and 6 MWT before and after treatment of the group A and B

		Group A Mean ± SD	Group B Mean ± SD	MD (95% CI)	p value
FVC [%]	Before treatment	79.06 ± 1.68	78.93 ± 1.83	0.13 (−0.77:1.04)	0.77
	After treatment	81.3 ± 2.1	84.9 ± 1.97	−3.6 (−4.65: −2.54)	0.001
	MD (95% CI)	−2.24 (−3.13: −1.33)	−5.97 (6.87: −5.06)		
		p = 0.001	p = 0.001		
FEV1 [%]	Before treatment	78.86 ± 1.81	78.6 ± 1.9	0.26 (−0.69:1.22)	0.58
	After treatment	81.56 ± 1.94	84.6 ± 1.52	−3.04 (3.93:2.13)	0.001
	MD (95% CI)	−2.7 (−3.55: −1.84)	−6 (−6.85: −5.14)		
		p = 0.001	p = 0.001		
MIP [mmHg]	Before treatment	76.4 ± 2.56	77.13 ± 2.24	−0.73 (−1.97:0.51)	0.24
	After treatment	82.26 ± 3.33	85.13 ± 2.34	−2.87 (−4.35:1.37)	0.001
	MD (95% CI)	−5.86 (-7.14: -4.58)	−8 (−9.27: −6.72)		
		p = 0.001	p = 0.001		
Diaphragmatic excursion [cm]	Before treatment	3.77 ± 0.93	3.71 ± 0.94	0.06 (−0.43:0.53)	0.82
	After treatment	5.54 ± 1.13	6.19 ± 1.04	−0.65 (−1.21: 0.08)	0.02
	MD (95% CI)	−1.77 (−2.17: −1.37)	−2.48 (−2.87: −2.07)		
		p = 0.001	p = 0.001		
OoL	Before treatment	44.73 ± 3.02	44.86 ± 3.72	−0.13 (−1.88:1.62)	0.88
	After treatment	37.33 ± 1.91	22.73 ± 1.7	14.6 (13.66:15.53)	0.001
	MD (95% CI)	7.4 (5.93: 8.86)	22.13 (20.66: 23.6)		
		p = 0.001	p = 0.001		
6 MWT [meter]	Before treatment	323.26 ± 61.09	334.33 ± 66.11		
	After treatment	408.73 ± 40.68	447.76 ± 51	−11.07 (−43.96:21.83)	0.5
	MD (95% CI)	−85.47 (−98.8: −72.13)	−113.43 (−126.76: −100.1)	−39.03 (−62.87: −15.2)	0.002
		p = 0.001	p = 0.001		

SD:, Standard deviation; MD: Mean difference; CI: Confidence interval; p-value: Level of significance.

Discussion

Respiratory disorders are the second most common cause of serious impairment in elderly people who live in the city. Respiratory rehabilitation seeks to help people with respiratory conditions reclaim as much independence as possible in their everyday lives. Exercise training can enhance exercise tolerance, functional ability, and quality of life while reducing dyspnea. The aim of this study was to see how a lung boost exerciser affected lung compliance and quality of life in the elderly.

The results of this study had shown there was no significant difference in all parameters between both groups before treatment (p > 0.05). Comparison between groups after treatment revealed a significant increase in FVC (from 81.3 ± 2.1 to 84.9 ± 1.97), FEV1 (from 81.56 ± 1.94 to 84.6 ± 1.52), MIP (from 82.26 ± 3.33 to 85.13 ± 2.34), and 6MWD (from 408.73 ± 40.68 to 447.76 ± 51) of the group B compared with that of the group a (p < 0.001). Also, there was a significant decrease in QoL score (from 37.33 ± 1.91 to 22.73 ± 1.7) (p < 0.001) and a significant increase in diaphragmatic excursion (from 5.54 ± 1.13to 6.19 ± 1.04) of the group B compared with that of group (a) after treatment. Moreover, the results are also coincided with Mariana, et al. [20]. Which revealed that IMT can contribute to an increase in inspiratory muscle strength and diaphragm thickness in older adults (ie, more than 60 years old). Moreover, it seems that this training modality can contribute to improve exercise and functional capacity, physical activity level, and cardiac autonomic control. IMT prescriptions based on sets and repetitions, from mild to moderate intensity, 5–7 times per week, for at least 4 weeks were more frequently used in the studies.

In addition to Ferraro, et al. [21]. Agreed with results of this study when they found after 8 weeks with healthy older adults, After 8 weeks of IMT, the IMT community increased MIP by 66 percent (d = 1.4), which is a greater increase than previous trials of stable older adults (68 3 years) (34 43 percent; d = 0.8). The increase in MIP was also accompanied by an increase in peak inspiratory capacity, as planned.

Another study the by Kai Liu, et al. [22]. Also showed that after six weeks of respiratory rehabilitation, the experimental group showed substantial changes in respiratory function (FEV1 (L), FVC (L), FEV1/FVC percent, DLCO percent), 6-min walk test, QoL, and anxiety. Within the intervention group and between the two groups of elderly patients with COVID-19, the SF-36 scores in eight dimensions were statistically important.
Another study by Kim, et al. [23]. Proves that a long-term (ten week) breathing exercise programme has beneficial effects on pulmonary functions. FVC value had increases of 5.19%, FEV1 had increase of 6.11% respectively, and 10.58% increase for MVV. Cardiopulmonary endurance and quality of life are two things to remember. To prevent respiratory disease and improve lung function and quality of life in respiratory patients, a number of respiratory training programmes and long-term implementations are needed.
In contrast with these findings another study by Rinaldo et al., [24]. Approved that endurance exercise has positive effects on pulmonary functions and no significant difference outcomes on FVC, FEV1, and FEV1/FVC% in healthy subjects.

Limitations

Despite the strength of this study, the weak side of the current study is that only little researches were done on lung boost exerciser especially on different age level. More research is required to decide how successful it is.

Conclusion

This study found that Lung Boost Exerciser, in addition to routine chest physiotherapy methods such as breathing exercises (diaphragmatic breathing and pursed-lip breathing), is an important modality for enhancing lung compliance and quality of life in normal elderly people.

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