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# Effect of lower torso training on asthma patients

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## Abstract

**Purpose:** the researchers see that this project is significant for asthma patients to help them improve. Therefore, this study hypothesizes that lower torso muscle endurance may affect 6MWT in asthma patients. To test this hypothesis, we examined the effect of decreased thoracic muscular endurance on asthma patients' 6-minute walk test (6MWT).

**Material & Methods:** this study included two groups (experimental and control), and they used a quantitative descriptive technique and achieved Pre – Post tests research design. The researcher began by administering a pre-test to the two groups. Researchers then carried out the therapy to experiment group, whereas the control group used the hospital protocol. Following the conclusion of the treatment, the researcher conducted a post-test for both groups. The program of the treatment's impact may be determined precisely by comparing the pre-and post-test findings. The trial lasted 24 meetings, with training occurring three times a week. On many occasions, twenty asthmatic patients from Imam Sadiq Hospital who had been hospitalized at a pulmonary rehabilitation center were assessed. Patients were included if they met the global effort for asthma recommendations for asthma diagnosis. The current study employed an experimental design. This study evaluated the maximal inspiratory pressure (PI, max), the pulmonary function test, the baseline dyspnea index (BDI), and the six-minute walk test (6MWT). Each exercise (leg extension and leg press) on gymnasium equipment was assigned a one-minute repetition. Additionally, the St. George Respiratory Questionnaire (SGRQ) was used to determine a person's quality of life.

**Results:** the researchers discovered that a training program had statistically significant favorable impacts on the 6MWT and body weight.

**Conclusion:** this study's findings demonstrated the critical role of lower torso training in achieving submaximal exercise tolerance. Additionally, they may pave the way for new avenues for training programs aimed at increasing functional activity in asthma patients.

**Keywords:** lower-torso muscles, 6-min walk distance, asthma.

## Анотація

**Вплив тренування нижньої частини тулуба на пацієнтів з астмою. Мета:** дослідники вважають, що цей проект має важливе значення для хворих на астму, оскільки допомагає їм оздоровитися. Таким чином, це дослідження припускає, що витривалість м'язів нижньої частини тулуба може впливати на 6MWT у пацієнтів з астмою. Щоб перевірити цю гіпотезу, ми дослідили вплив зниження витривалості грудних м'язів на тест 6-хвилинної ходьби (6MWT) пацієнтів з астмою. **Матеріал і методи:** це дослідження включало дві групи (експериментальну та контрольну), і вони використовували кількісну описову техніку та досягли дизайну дослідження до та після тестів. Дослідник почав із проведення попереднього тесту для двох груп. Потім дослідники провели терапію в експериментальній групі, тоді як контрольна група використовувала лікарняний протокол. Після завершення лікування дослідник провів пост-тест для обох груп. Програму впливу лікування можна точно визначити шляхом порівняння результатів до і після тестування. Випробування тривало 24 зустрічі, тренування проходили тричі на тиждень. У багатьох випадках було оцінено двадцять пацієнтів з астмою з лікарні Імама Садіка, які були госпіталізовані в легеневий реабілітаційний центр. Пацієнтів включали, якщо вони відповідали рекомендаціям глобальних зусиль щодо астми щодо діагностики астми. У поточному дослідженні використовувався експериментальний дизайн. У цьому дослідженні оцінювали максимальний тиск на вдиху (PI, max), тест легеневої функції, вихідний індекс задишки (BDI) і тест шестихвилинної ходьби (6MWT). Кожній вправі (розгинання ніг і жим ногами) на тренажерах призначалася одна хвилина повторення. Крім того, для визначення якості життя людини використовувався респіраторний опитувальник Святого Георгія (SGRQ). **Результати:** дослідники виявили, що програма тренувань мала статистично значущий сприятливий вплив на 6MWT і масу тіла. **Висновок:** результати цього дослідження продемонстрували критичну роль тренування нижньої частини тулуба в досягненні субмаксимальної толерантності до фізичних навантажень. Крім того, вони можуть прокласти шлях до нових шляхів для навчальних програм, спрямованих на підвищення функціональної активності пацієнтів з астмою.

**Ключові слова:** м’язова частина туловища, дистанція 6-хвилинної ходьби, бронхіальна астма.

### Abbreviations :

| | |
|---|---|
| ATS | American Thoracic Society |
| B.E. | Breathing Exercise |
| BDI | Baseline Dyspnea Index |
| LTST | Lower Torso Sports Training |
| LTE | Exercises for The Lower Torso |
| 6MWT | 6-min walk test |
| Pi,max | Maximal Inspiratory Mouth Pressures |
| FEV1 | Force Expiratory Ventilation at the First Second |
| Spo2 | Peripheral Oxygen Saturation |
| SGRQ | George Respiratory Questionnaire |
| QoL | quality of life |

## Introduction

The six-minute walking test (6MWT) is a simple objective that determines a patient’s capacity to walk as far as feasible. It is a low-cost, dependable instrument to measure functional activity and submaximal exercise competence. The 6MWT can be carried out by elderly persons and perform daily life activities for patients with severe conditions like asthma (Sami et al., 2020).

The test is conducted on an undeveloped route. It does not require highly qualified personnel, the intensity of the 6MWT is self-determined, and thousands of individuals, including asthma patients, have participated in the test (Hussien et al., 2022). In patients with severe diseases, the 6MWT component of a multidimensional scale known as the bode index predicts mortality better than other traditional indicators of disease severity, such as FEV1 (Force Expiratory Ventilation at the First Second); reductions in 6MWT occurred independently of changes in FEV1; and, while FEV1 is the most likely respiratory system marker, including in asthma, the 6MWT may reflect the disease’s systemic effects (Corlateanu et al., 2021).

The 6MWT should be included in the assessment of asthma patients, and its determinants should be thoroughly discussed (Esteban et al., 2020). Numerous factors may affect the 6MWT in asthma patients. For example, age, body weight, mental health, and comorbidities can all impact test findings in senior individuals. In addition, Dyspnea and malnutrition are also asthma indicators, resulting in a drop in 6MWT (Abdelbasset et al., 2022).

Previously, muscle endurance in the lower limbs was critical in defining the 6MWT (Nyberg et al., 2016). However, data on the lower torso’s effect on 6MWT are few and confined to those obtained from research testing handgrip endurance and maximum inspiratory pressure (Pimax) (Roldán et al., 2016).

The researchers discovered just one study examining the effect of big chest and upper-limb muscles on maximal exercise capacity in individuals with pulmonary illnesses. They could not locate any studies examining the impact of lower torso muscles on the 6MWT (Li et al., 2020).

Also, no study has investigated the effect of limp muscle endurance on 6MWT, so the researchers see that this project is significant for asthma patients to help them improve. Therefore, this study hypothesizes that lower torso muscle endurance may affect 6MWT in asthma patients. To test this hypothesis, we examined the effect of decreased thoracic muscular endurance on asthma patients’ 6-minute walk test (6MWT). In addition, the researchers also estimated the influence of other aspects that impede the 6WMT, such as age, the sensation of Dyspnea, nutritional state, pulmonary function, and lower-limb muscle endurance.

## Material and methods of research

*Participants*

This study included two groups (experimental and control) and they used a quantitative descriptive technique and achieved pre- and Post-test research design. The researchers began by administering a pre-test to the two groups. Researchers then carried out the therapy on the experiment group, whereas the control group used the hospital protocol. Following the conclusion of the treatment, the researchers conducted a post-test. The program of the treatment's impact may be determined precisely by comparing the pre-and post-test findings. The trial lasted 24 meetings, with training occurring three times a week 30 to 40 minutes duration with 50% intensity was used low torso training for rehabilitation. Medical professionals referred Twenty thoracic outpatients presenting a follow-up clinic at a regional medical centre in Al-Hillah City/ Babylon government hospital and volunteered to participate in this study.

Twenty asthma patients hospitalized in a pulmonary rehabilitation facility on many occasions were assessed and divided into two groups (experimental and control). Patients were included if they met the Global Initiative for Asthma's asthma criteria (Global Initiative for Asthma guidelines, 2008) (Van Weel et al., 2008). FEV1/FVC ratio of 65%. Patients were included in the trial only if they were in a clinically stable state with no history of illness or aggravation of respiratory symptoms, no medication changes over the preceding two months, and no clinical signs of edema. Patients with cardiovascular or osteoarticular disease were excluded. All patients were informed of the intended research protocols and consented voluntarily. Table 1 summarizes the research population's baseline characteristics.

*Methods*

The researchers conducted a series of tests, as detailed below.

**1. Pulmonary Function**

A spirometer (type German) (as reported by The American Thoracic Society's 2002) used to measure value of forced expiratory volume in 1 second (FEV1). The spirometer is a simple test and an essential tool in the diagnoses of airway obstruction and respiratory muscles. Variability of spirometry measurements is greater than in most other clinical laboratory tests because the result is highly dependent on the consistency of the efforts made by patients and technicians. In addition, each subject tested according to the criteria of the American Thoracic Society which recommended the use of FEV1 to diagnose the severity of airway obstruction to detect respiratory patients (ATS & ERS, 2002a).

**2. Nutritional evaluation:**

Body mass index (BMI) [weight/height squared] was determined after height and Weight was measured. First, following the procedure outlined, resistance was measured on the right side of the body in the flat position (Ahmadizad et al., 2014). Next, LBM was computed in kilograms using a group-specific regression equation devised by the researchers (Kyle et al., 1998). Finally, the LBM index (LBMI) [LBM/height squared] was also calculated.

**3. Quality of life and baseline dyspnea**

A validated version of the St. George Respiratory Questionnaire (SGRQ) for usage in Iraq was utilized to measure patient quality of life (QoL) (Jones et al., 1992). The baseline dyspnea index (BDI) was also adjusted in this way, was used to estimate baseline dyspnea. Type of questionnaire-description, interviewer-administered rating of severity of dyspnea at a single state. It provides a multidimensional measurement of dyspnea based on 3 components that evoke dyspnea in activities of daily living, in symptomatic individuals. Nomber of Items is 24 and number of domains and categories are 3. The scale includes the absence of dyspnea (a score of 1), mild shortness of breath (a score of 2), moderate shortness of breath (a score of 3), severe shortness of breath (a score of 4) and the worst possible shortness of breath (a score of 5) (Mahler et al., 1984).

**4. Inspiratory pressures and Peripheral muscle endurance**

The researchers examined the Maximum inspirato-

**Table 1.** Baseline Characteristics of the Study Population

| Variables | Unite | Mean | SD |
|---|---|---|---|
| Age | year | 58.27 | 7.42 |
| Weight | kg | 72.41 | 9.17 |
| FEV1 | % of predicted | 55.00 | 6.12 |
| Spo2 | % | 90.05 | 8.59 |
| BMI, | kg/m2 | 23.14 | 2.70 |
| BDI | score | 3.01 | 1.2 |
| Total SGRQ | score | % 48.64 | 6.42 |
| Pimax, | Kpa | 14.98 | 2.13 |
| Leg extension, | 1 min in kg | 19.02 | 2.84 |
| Leg press, | 1 min in kg | 22.15 | 3.32 |
| 6MWT | M | 520.00 | 82.04 |

BDI – Baseline Dyspnea Index; 6MWT – 6-min walk test; FEV1 – Force Expiratory Ventilation at the First Second; Pimax – Maximal Inspiratory Mouth Pressures; Spo2 – Peripheral Oxygen Saturation; SGRQ – George Respiratory Questionnaire.

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ry pressure (PImax) by a respiratory pressure meter (type British, MD diagnostics LTD) as described by Volianitis et al. (2001) that a patient can generate the mouth (MIP). These measurements require patient cooperation and are known as volitional tests of respiratory muscle strength. Handheld devices displaying the measurement achieved in Kpa and the pressure trace created, allow quick patient testing away from the traditional pulmonary laboratory and are useful for ward based, out patient, and preoperative assessment as well as for use by pulmonologists and physiotherapists.

The principal advantage of volitional tests is that they give an estimate of inspiratory muscle strength, are simple to perform, and are well tolerated by patients (Society, 2002). In addition, repeated maximum grip motions were used to test peripheral muscle endurance (1-min bouts) (Capodaglio et al., 1997). The established rule for 1-minute bouts is the average Weight that can be lifted over the range of specified movement. Four workouts performed on gymnasium equipment were evaluated using a one-minute repetition. The following exercises were needed of the patients: lat pulls down (latissimus dorsi, trapezius, rhomboids), bench press (pectorals and triceps), leg extension (quadriceps), and leg press (quadriceps, gluteus, hamstrings, and calf muscles). To lessen learning effects, a warm-up of 12 repetitions with a lightweight was completed before the test. All contestants completed the one-minute time limit in two attempts. Rest periods of one to two minutes were given between repetitions. The Valsalva maneuver was avoided, and each muscle group's proper workout performance method was stressed.

**5. 6MWT**

The 6MWT was performed following American Thoracic Society recommendations by the researchers (Nici et al., 2006; ATS & ERS, 2002b). Patients were advised to walk for 6 minutes, covering as much ground as possible. A study assistant timed the walk, and each patient received standardized verbal support. Before and after the test, data for Spo2, inspiratory rate, and Borg scale dyspnea score, were collected. The distance traveled was calculated in meters.

*Procedure*

Low intensity interval training method with 50% intensity and 10 weeks of training, 3 sessions per week, and 90 minuts per session was used in present study. Participants with asthma was randomized into two groups (experimental and control). Participants attended a 1 hour familiarization session where the specific training protocol was instructed and the necessary training equipment and exercise adherence diary distributed. Exercise training performed on an out-patient basis. All sessions started with treadmill. In the experimental group the target training intensity was 50%. In the experimental group, total treadmill was 30 min and the speed of the treadmill was 4 miles pe hour (mph). Our intervention included different exercises for lower torso such (flexibility and resistance exercises for legs). Flexibility exercises consisted of (The butterfly stretch, short bridge stretch, and standing calf stretch hold for 10 to 15 seconds started with 2 sets and finshed with 4 sets), whereas, resistance exercises consisted of (Lateral Band Steps, One and One-Quarter Squats, Single-Leg Stands, Standing Glute Kickbacks, Clamshells, Runner's Extensions, Side-Lying Leg Lifts, Squat Jacks, Monster Walk, and Hip Bridges) started with 8-12 repetitions, 2-3 sets, at about 50% of 1 RM.

While control group won't take place any training program but continuous with their normal life style and medication.

*Statistical analysis*

Data are presented as mean ± standard deviation (SD). Data analysis was performed using SPSS (23 Amonk, NY: IBM Corp).

A paired-samples t-test measures analysis was used to compare measures between Control and experimental groups when parametric assumptions were the data normally distributed at pre- and post-tests for age, FEV, Spo, LBMI, SGRQ, BP, LPD, LE, Lp and MWT. However, if data could not be normalised (Wei, Pao, BMI, LBM, BDI and Pimax) then non-parametric tests were used (Friedman test with post hoc Wilcoxon Matched Pairs tests when necessary).

This is an example for parametric data (with t)
$t=-4.56$, $p=0.002$.
But this is an example for non-parametric data (with z)
$z=-2.71$, $p=0.007$

**Table 2.** The normality of the data distribution

| | Wei_Con – Wei_Ex | Pao_Con – Pao_Ex | BMI_Con – BMI_Ex | LBM_Con – LBM_Ex | BDI_Con – BDI_Ex | Pimax_Con – Pimax_Ex |
|---|---|---|---|---|---|---|
| Z | −0.351[b] | −1.473[c] | 0.000[d] | −0.614[c] | −0.277[b] | −0.574[c] |
| Asymp. Sig. (2-tailed) | 0.726 | 0.141 | 1.000 | 0.539 | 0.782 | 0.566 |

a. Wilcoxon Signed Ranks Test.

b. Based on negative ranks.

c. Based on positive ranks.

d. The sum of negative ranks equals the sum of positive ranks.

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## Results of the study

**Table 3.** The Normal Average test

| Variables | Unite | Normal Average |
|---|---|---|
| BDI | Score | 1 |
| 6MWT | Minute | 400-700 m |
| FEV1 | % of predicted | 80-120 |
| Pimax | kPa | 9-11 |
| Borg scale | **Score** | 0-10 |
| Spo2 | % | 90-99 |
| Total SGRQ | score | 1-100, where 0 indicates best health and 100 indicates worst health |

BDI – Baseline Dyspnea Index; 6MWT – 6-min walk test; FEV1 – Force Expiratory Ventilation at the First Second; Pi,max – Maximal Inspiratory Mouth Pressures; Spo2 – Peripheral Oxygen Saturation; SGRQ – George Respiratory Questionnaire.

**Table 4.** The Mean, SD, T-test, signal, and Significant of Pre and post-tests for the experiment group

| Variables | | Pre-test | | Post-test | | T-test | | Significant |
|---|---|---|---|---|---|---|---|---|
| | Unite | Mean | SD | Mean | SD | Accountable | Signal | |
| BDI | Score | 4.01 | 1.04 | 2.17 | 0.64 | 4.02 | 0.005 | S |
| Weight | kg | 72.41 | 9.17 | 73.83 | 10.31 | 2.11 | 0.000 | S |
| Leg press | 1 min in kg | 22.15 | 3.32 | 25.6 | 1.14 | 2.7 | 0.000 | S |
| Leg extension | 1 min in kg | 19.02 | 2.84 | 23.6 | 0.2 | 3.01 | 0.003 | S |
| 6MWT | m | 520.00 | 82.04 | 584 | 90.02 | 4.91 | 0.003 | S |
| FEV1 | % of predicted | 40.16 | 22.91 | 55.02 | 14.28 | 5.43 | 0.000 | S |
| Pimax | Kpa | 15.01 | 1.04 | 9.13 | 0.71 | 3.12 | 0.000 | S |
| Borg scale | Score | 5.80 | 1.03 | 2.61 | 0.27 | 3.6 | 0.005 | S |
| Spo2 | % | 90.05 | 8.59 | 92.68 | 8.24 | 7.52 | 0.000 | S |
| Total SGRQ | score | % 48.64 | 6.42 | 52.36 | 9.71 | 4.78 | 0.004 | S |

Size of the study population (10) and significant level (0.05).
BDI – Baseline Dyspnea Index; 6MWT – 6-min walk test; FEV1 – Force Expiratory Ventilation at the First Second; Pi,max – Maximal Inspiratory Mouth Pressures; Spo2 – Peripheral Oxygen Saturation; SGRQ – George Respiratory Questionnaire.

Our findings suggested that reduced muscular endurance predicts 6MWT in asthma patients for the first time. In addition, our results further support the influence of Dyspnea, maximum inspiratory pressure (Pimax), and body weight on these patients' 6MWT.

Table 4 shows the mean of **BDI**, the before the implementation of the experimental group was 4.01 and SD 1.04, respectively. Post the performance of experiments, the mean is 2.17 and SD 0.64. The difference between the pre-test and post-test is 4.02, showing a significant difference between the pre and post-test scores.

Before the implementation of experimental programs, the mean body weight of the Experimental pre-test group was 72.41 kg, respectively. Post-test and the experiments, the mean was 73.83 kg. However, sd., a pre-test was 82.04, post-test SD was 90.02, and the t-test between pre-test and post-test was Further 2.11 is a significant difference between pre and post-test under a significant level (0.05).

Before the implementation of experimental programs, the mean of the Leg press pre-test was 22.15 and sd 3.32. Post the performance of experiments. The mean is 25.60, and sd is 1.14. Further, Based on the analysis, a comparison between the pre and post-test shows 2.7 differences and which is significant at a 0.05 level of significant

The mean of Leg extension before the experiment pre-test was 19.02, and sd was 2.84. However, the post-test mean is 23.6, and sd is 0.2. Further, the experimental group's pre and post-test scores were compared using a t-test. The deferent is 3.01, and Based on the analysis, a comparison between the groups shows that Leg Press is significant at 0.05.

The pre-test mean of 6MWT experiments is 520.00, and sd is 82.04. The posttest mean for 6MWT is 584, and sd is 90.02. Further, the pre-and post-test scores of the experimental group were compared using a t-test based on the analysis; a comparison between both tests shows that in the case of 6MWT is 91.40, which shows a significant difference between the pre-test scores and post-test data. Howe other variables (FEV1, % of predicted, Pimax, BorgF-6MWT, Spo2 and TheSGRQ score) also has been a significant deferent between pre

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**Table 5.** The Mean, SD, T-test, signal, and Significant of Pre and post-tests for the control group

| Variables | | Pre-test | | Post-test | | T-test | | Significant |
|---|---|---|---|---|---|---|---|---|
| | Unite | Mean | SD | Mean | SD | Accountable | Signal | |
| BDI | Score | 4.52 | 1.67 | 4.23 | 1.57 | 0.12 | 0.004 | No S |
| Weight | kg | 72.11 | 9.19 | 72.33 | 9.21 | 0.11 | 0.000 | No S |
| Leg press | number of repetitions | 21.16 | 2.82 | 22.3 | 3.01 | 1.05 | 0.000 | No S |
| Leg extension | number of repetitions | 20.4 | 3.24 | 21.03 | 3.56 | 0.02 | 0.002 | No S |
| 6MWT | m | 515.00 | 81.02 | 518.0 | 81.73 | 0.61 | 0.004 | No S |
| FEV1 | % of predicted | 39.88 | 21.71 | 40.01 | 22.08 | 1.33 | 0.000 | No S |
| Pimax\ | Kpa | 14.91 | 1.84 | 13.95 | 1.61 | 0.45 | 0.000 | No S |
| Borg scale | Score | 5.15 | 1.04 | 4.51 | 1.02 | 0.17 | 0.004 | No S |
| Spo2 | % | 91.03 | 9.06 | 91.68 | 9.24 | 0.62 | 0.000 | No S |
| Total SGRQ | score | % 47.24 | 6.22 | 48.26 | 7.21 | 1.12 | 0.003 | No S |

Size of the study population (10) and significant level (0.05).
BDI – Baseline Dyspnea Index; 6MWT – 6-min walk test; FEV1 – Force Expiratory Ventilation at the First Second; Pi,max – Maximal Inspiratory Mouth Pressures; Spo2 – Peripheral Oxygen Saturation; SGRQ – George Respiratory Questionnaire.

**Table 6.** The Mean, SD, T-test, signal, and Significant of post-tests for the experiment and control group

| Variables | | Experiment | | Control | | T-test | | Significant |
|---|---|---|---|---|---|---|---|---|
| | Unite | Mean | SD | Mean | SD | Accountable | Signal | |
| BDI | Score | 2.17 | 0.64 | 4.23 | 1.57 | 6.19 | 0.004 | S |
| Weight | kg | 73.83 | 10.31 | 72.33 | 9.21 | 2.11 | 0.000 | S |
| Leg press | 1 min in kg | 25.6 | 1.14 | 22.3 | 3.01 | 3.15 | 0.000 | S |
| Leg extension | 1 min in kg | 23.6 | 0.2 | 21.03 | 3.56 | 2.22 | 0.002 | S |
| 6MWT | m | 584 | 90.02 | 518.0 | 81.73 | 4.31 | 0.004 | S |
| FEV1 | % of predicted | 55.02 | 14.28 | 40.01 | 22.08 | 5.13 | 0.000 | S |
| Pimax | Kpa | 9.13 | 0.71 | 13.95 | 1.61 | 2.25 | 0.000 | S |
| Borg scale | **Score** | 2.61 | 0.27 | 4.51 | 1.02 | 2.17 | 0.004 | S |
| Spo2 | % | 92.68 | 8.24 | 91.68 | 9.24 | 2.12 | 0.000 | S |
| Total SGRQ | score | 52.36 | 9.71 | 48.26 | 7.21 | 3.42 | 0.003 | S |

Size of the study population (20) and significant level (0.05).
BDI – Baseline Dyspnea Index; 6MWT – 6-min walk test; FEV1 – Force Expiratory Ventilation at the First Second; Pi,max – Maximal Inspiratory Mouth Pressures; Spo2 – Peripheral Oxygen Saturation; SGRQ – George Respiratory Questionnaire.

and post-test.

Table 5 shows the Mean, SD, T-test, signal, and Significant of Pre and post-tests for the control group wish is not significant test between pre and post-test in (BDI, Weight Leg extension, leg press,6MWT, FEV1, % of predicted, Pimax, BorgF-6MWT, Spo2 and TheSGRQ score). Again, the comparison between the pre-test and post-test is less than 0.05.

Table 6 presents the compar defenses Mean, SD, T-test, and Significant of post-tests between the experiment and control group for the variables (BDI (6.19), Weight (2.11), Leg press (3.15), leg extension (2.22), 6MWT (31.4), FEV1, % of predicted (13.5), Pimax (2.25), Borg scale (17.2), Spo2 (2.12),and TheSGRQ (3.42), so that from the statistical defenses comparing between experimental and control are significant for experimental groups.

## Discussion

Data from the literature on lower torso muscular endurance on the 6MWT are linked to Pimax. The current study’s findings back up prior results with people living with asthma (Chung et al., 2021; Severin et al., 2022). They indicated the influence of Pimax on 6MWT. They were implying Pimax's impact on 6MWT. Pimax, QoL, pulmonary function, and sensation of Dyspnea were all found to influence exercise capacity in 40 asthma patients, with Pimax and diffusing ability accounting for 54% of the total variation in 6MWT (Boutou et al., 2020). Pimax affected asthma patients' submaximal exercise capacity, according to the study. Although Pimax represents the pressure exerted by the inspiratory muscles, it is modified by other factors, such as the respiratory system's passive elastic recoil pressure, including the lungs and chest wall (ATS, & ERS, 2002b). Furthermore, estimating accessory respiratory muscle endurance using a protocol unaffected by lung capacity and elastic recoil might give further information on these muscles' effect on the 6MWT.

The impact of decreased muscular endurance on the 6MWT reported in this study has never been mentioned before (Trudelle-Jackson et al., 2020). The authors assessed the influence of thoracic and upper limb muscular endurance on individuals with respiratory illness. However, they did not quantify the 6MWT (Silva et al., 2018; Amin et al., 2022). Nonetheless, multiple writers have reported the influence of lower-limb peripheral muscle function on exercise capacity in individuals with respiratory illness (Li et al., 2020). The vast number of accessory respiratory muscles required in executing the lat pulldown exercise may explain the impact of reduced muscular endurance on 6MWT. The muscles for the exercise are required for the rhomboids, trapezius, latissimus dorsi, pectoralis major, and biceps (Lee et al., 2020). When the primary respiratory muscles malfunction or cannot match the ventilator's requirements, some of these muscles may feel they are performing an auxiliary respiratory role (Oczkowski et al., 2022).

This agrees with earlier studies (Enright et al., 2003), which showed a strong positive influence of decreased muscle endurance on 6MWT in patients with respiratory problems, and designated this specific muscular endurance as a predictor of 6MWT in healthy aged people Because lower limb endurance is a direct measure of skeletal muscle endurance in the leg and distal lower-torso muscles, our findings back up the assertion that lower-torso muscle endurance impacts walking distance (Tamulevičiūtė-Prascienė et al., 2021).

Identifying body weight as a predictor of 6MWT was another sign that systemic symptoms of asthma influenced exercise capacity in our study. In line with previous research, our findings showed a statistically significant favorable influence of body weight on 6MWT (Mizrahi et al., 2020). According to the study, overweight and underweight patients walked fewer distances than eutrophic adults. Low body weight is frequently associated with loss of LBM and decreased muscular endurance. Obesity also increases the amount of energy expended at a particular workout intensity. As a result, any circumstance may result in a reduced ability to walk great distances. As measured by the BDI, the baseline sensation of Dyspnea was likewise a predictor of 6MWT in our patients, as previously reported (Elliott-Button et al., 2020). They discovered that the essential factors of 6MWT were the scores from three different dyspnea instruments and the dyspnea domain of the Chronic Respiratory Disease Questionnaire (Ng & Hui-Chan, 2012). The sensation of Dyspnea, on the other hand, was a predictor of 6MWT, maximal oxygen uptake, and endurance time in asthma patients (Vermeulen et al., 2016).

The researchers found a statistically significant effect of lower torso training on 6MWT and QoL, as measured by the total score of the SGRQ activity domain. 6MWT was identified as a predictor of SGRQ activity and influence domains in research that evaluated pulmonary function, 6MWT, respiratory muscle endurance, body composition, and peripheral muscle endurance (Russell & Saketkoo, 2021). In addition, there was a statistically significant association between QoL markers and exercise ability in asthma patients (Kubincová et al., 2018). These findings imply that exercise ability is a key factor of QoL in asthma patients. Lower-limb muscular endurance impacts submaximal and maximal exercise capacity in asthma patients, a crucial indication (Huzmeli et al., 2022).

Control group data didn't appear to improve 6MWT and other variables because they used medication without exercise. No study concluded that medication improves 6MWT. Our study found that lower torso training improves 6MWT and other variables in the present study.

## Conclusion

Our investigation shows that the impact of lower-torso muscular endurance suggests a causative influence. More research will be needed to determine the effect of therapies, such as particular muscle reconditioning, on submaximal exercise capacity in individuals with respiratory illness. However, physical training is the most effective component of lung rehabilitation. As a result, endurance training with free weights is viable for muscle rebuilding in asthma patients.

The findings of this study emphasize the critical role of the skeletal musculature in asthmatic patients' exercise ability. Peripheral muscle endurance, body weight, dyspnea feeling, and respiratory muscle endurance affect an asthma patient's capacity to perform workouts. As a result, there is an urgent need to create therapeutic options that, while considering individual goals and requirements, are targeted at halting Dyspnea, the dyspnea cycle, and a sedentary lifestyle in these individuals.

### Author's contribution

Conceptualization, S.H.H.; methodology, S.H.H., A.H.H.; software, S.H.H., B.A.A.; check, S.H.H.; formal analysis, A.H.H.; investigation, B.A.A., A.H.H.; resources, A.H.H., S.H.H., B.A.A.; data curation, A.H.H.,; writing – rough preparation, A.H.H., S.H.H.; writing – review and editing, S.H.H.; visualization,A.H.H., B.A.A.; supervision, A.H.H. project administration, S.H.H.

**Conflicts of Interest**

The authors declare no conflict of interest.

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