

EFFECT OF DIAPHRAGMATIC BREATHING EXERCISE VERSUS BRISK WALKING ON CARDIOVASCULAR ENDURANCE AND PULMONARY FUNCTION IN OBESE MALE PATIENTS WITH BRONCHIAL ASTHMA: A QUASI-EXPERIMENTAL STUDY

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Abstract

Background — Obesity is a well-documented modifier of asthma severity, contributing to reduced aerobic capacity, altered chest-wall mechanics, and diminished exercise tolerance. Because drug therapy alone does not correct these deficits, physiotherapy-based strategies that target cardiorespiratory fitness deserve closer study. **Objective** — This quasi-experimental trial compared a structured diaphragmatic breathing programme with a brisk-walking regimen for their effects on cardiovascular endurance and pulmonary function in obese men with bronchial asthma. **Methods** — Thirty obese male patients (19–30 years; BMI 30.0–34.9 kg/m²) attending a tertiary-care hospital were assigned by simple random sampling to two equal groups of fifteen. Group A performed brisk walking for 20 minutes daily, six days a week, for six weeks; Group B practised diaphragmatic breathing three times daily on the same schedule. Estimated maximal oxygen uptake (VO₂max, derived from the six-minute walk test), peak expiratory flow rate (PEFR), the FEV₁/FVC ratio, and the Modified Borg Dyspnoea Scale score were recorded before and after the intervention. As Shapiro–Wilk testing showed non-normal distributions for most variables, the Wilcoxon signed-rank test was applied for within-group comparisons and the Mann–Whitney U test for between-group comparisons. **Results** — Both groups improved significantly on VO₂max, PEFR, and FEV₁/FVC ($p < 0.05$). Perceived exertion, measured by the Borg scale, rose in Group A but fell in Group B. Between-group analysis showed Group B improved significantly more than Group A on every outcome ($p < 0.05$). **Conclusion** — A structured breathing programme produced larger gains in cardiovascular endurance, pulmonary function, and exercise tolerance than walking alone, suggesting it may serve as a useful physiotherapy adjunct for this population.

Keywords — bronchial asthma; obesity; diaphragmatic breathing; cardiovascular endurance; six-minute walk test; VO₂max; peak expiratory flow rate.

I. Introduction

Cardiovascular endurance reflects how efficiently the heart and lungs deliver oxygenated blood to working muscle during sustained activity, and this capacity is shaped from an early age by body composition. Excess adiposity hastens the appearance of cardiovascular and metabolic risk factors well before adulthood: overweight and obese individuals, whether children or adults, tend to show a less favourable lipid profile, higher blood pressure, and greater left ventricular mass than their leaner counterparts [7], [8].

Bronchial asthma is a chronic inflammatory airway condition marked by wheeze, cough, chest tightness, and breathlessness, and it affects a considerable share of the global population. Obesity ranks among the strongest and most consistent risk factors for both the onset and the worsening of asthma: prospective cohorts show that weight gain often precedes new-onset asthma, obese patients tend to experience more severe, harder-to-control disease, and their response to inhaled corticosteroids and combination controller therapy is frequently blunted [1], [2], [5], [24]. The overlap between obesity-driven systemic inflammation and airway inflammation is thought to explain much of this relationship, and obese patients with asthma as a group face disproportionately high rates of hospitalisation and reduced quality of life [3], [22].

Cardiorespiratory fitness — most commonly quantified as maximal oxygen uptake (VO₂max) — is a key marker of health across the lifespan and a useful proxy for cardiovascular and metabolic risk. Poor fitness accounts for a substantial share of premature mortality, largely through cardiovascular disease, diabetes, and certain cancers, underscoring the value of interventions that preserve or restore it [8], [9], [25]. In respiratory practice, spirometric indices such as forced expiratory volume in one second (FEV₁), forced vital capacity (FVC), the FEV₁/FVC ratio, and peak expiratory flow rate (PEFR) remain the standard means of tracking airway function and disease severity [21], [29].

Patients with asthma were once routinely counselled to limit physical exertion for fear of triggering exercise-induced bronchoconstriction. Current evidence instead suggests that supervised aerobic activity offers real cardiovascular and pulmonary benefit in this group [10], [16]. Breathing-retraining approaches, including diaphragmatic breathing, have likewise been studied as a way to lower the work of breathing, improve ventilatory efficiency, and ease dyspnoea — an approach that may be especially relevant when chest-wall mechanics are already compromised by excess abdominal adiposity [13], [19], [20], [27], [30]. What is less established is how a dedicated breathing-retraining programme performs against a conventional walking

programme when both are tested in the same group of obese, asthmatic men, a comparison this study was designed to make directly.

A. Aim of the Study

To examine the effect of two physiotherapy interventions — diaphragmatic breathing and brisk walking — on cardiovascular endurance in obese male patients with bronchial asthma.

B. Objectives

- 1) To determine the effect of a brisk-walking programme on cardiovascular fitness in obese patients with bronchial asthma.
- 2) To determine the effect of diaphragmatic breathing exercise on cardiovascular fitness in the same population.
- 3) To compare the relative effectiveness of the two interventions on cardiovascular fitness.

C. Need for the Study

Obesity intensifies airway inflammation in asthma, contributing to greater disease severity, a blunted response to standard treatment, and higher morbidity than is typically seen in normal-weight asthmatics [1], [2], [23]. Establishing how different physiotherapy strategies affect cardiovascular endurance across this population can help clinicians choose more targeted, evidence-based interventions.

D. Hypotheses

Null hypothesis (H0): There is no significant difference in cardiovascular endurance among obese asthmatic patients following intervention.

Alternative hypothesis (H1): There is a significant difference in cardiovascular endurance among obese asthmatic patients following intervention.

II. Methodology

A. Study Design and Setting

A quasi-experimental design was used at a tertiary-care hospital. Eligible participants were enrolled over a defined recruitment window and followed through a six-week intervention period.

B. Sampling

Thirty male patients who met the eligibility criteria were selected by simple random sampling and then allocated into two equal groups of fifteen (Group A and Group B) by purposive randomised allocation.

C. Inclusion Criteria

Age 19–30 years; recruitment from the hospital setting; normal resting vital parameters (blood pressure, respiratory rate, heart rate, temperature); a clinical diagnosis of bronchial asthma with coexisting obesity (BMI 30.0–34.9 kg/m²); and no other pre-existing medical condition.

D. Exclusion Criteria

Abnormal blood pressure; recent cardiac surgery; comorbid diabetes mellitus or hypertension; female sex; lower-limb injury; and inability to provide informed consent.

E. Outcome Measures and Instrumentation

Cardiovascular fitness was evaluated using estimated VO₂max derived from the six-minute walk test, the Modified Borg Dyspnoea Scale, spirometric FEV₁/FVC ratio, and peak expiratory flow rate [4]. Equipment used included a sphygmomanometer, stopwatch, marker cones, a computerised spirometer, a pulse oximeter, and a stethoscope.

F. Procedure

After obtaining informed consent, baseline assessment was completed for all thirty participants. The six-minute walk test was conducted along a flat, unobstructed 30-metre walkway marked with cones at each end, with a chair available should rest be needed; participants were asked to cover as much distance as possible in six minutes at a self-selected pace, turning at the cones, and the distance covered was used to estimate VO₂max [4]. Spirometry was performed with the participant seated, breathing through a mouthpiece connected to the spirometer while performing forced inhalation and exhalation manoeuvres; the manoeuvre was repeated as needed for reproducibility, and the best of the available trials was used for analysis. The Modified Borg Dyspnoea Scale — an 11-point scale ranging from 0 (no difficulty breathing) to 10 (maximal difficulty) — was self-completed by each participant to rate perceived breathlessness.

Group A (control) performed brisk walking for 20 minutes, twice daily, six days a week, for six weeks, beginning with a gentle warm-up and a shorter walking duration that was progressively built up to the full 20 minutes as tolerated; participants continued their prescribed asthma medication throughout, including pre-exercise use of a rescue bronchodilator where indicated. Group B (experimental) practised diaphragmatic breathing three times daily, six days a week, for six weeks, completing five breath cycles per session. Participants sat comfortably with feet flat on the floor and shoulders relaxed, one hand resting on the upper chest and the other on the abdomen; they were coached to inhale through the nose so that the abdominal hand rose while the chest hand stayed still, then to exhale through the mouth over roughly two to three times the duration of inhalation [13], [20]. All outcome measures were reassessed at the end of the six-week intervention using the same protocols.

G. Statistical Analysis

Descriptive statistics (mean and standard deviation) were calculated for VO₂max, PEFR, FEV1/FVC, and Borg scale scores in each group. The Shapiro–Wilk test was used to check normality; because most variables departed from a normal distribution, non-parametric tests were applied throughout — the Wilcoxon signed-rank test for within-group (pre- versus post-intervention) comparison, and the Mann–Whitney U test for between-group comparison of change scores. A p-value below 0.05 was considered statistically significant.

During data verification, one Group B participant showed a post-intervention VO₂max change (an approximate 20-unit rise) markedly inconsistent with the 1–2-unit change observed in every other participant across both groups. As no plausible physiological explanation was identified and the value could not be re-confirmed against source records, this participant's VO₂max data were treated as a probable recording error and excluded from the VO₂max analysis alone (Group B, n = 14 for this variable). No comparable irregularity was found for PEFR, FEV1/FVC, or Borg score, so all fifteen participants per group were retained for those analyses.

III. Results

Table I summarises the baseline and post-intervention descriptive statistics for both groups (see the note on Group B's VO₂max sample size). Group A showed modest gains in VO₂max, PEFR, and FEV1/FVC, alongside a rise in Borg dyspnoea score, indicating greater perceived exertion after six weeks of walking. Group B showed comparatively larger gains in VO₂max, PEFR, and FEV1/FVC, together with a fall in Borg score, indicating improved exercise tolerance.

table i. descriptive statistics of outcome measures (mean ± sd)

Variable	Group A – Pre	Group A – Post	Group B – Pre	Group B – Post
VO ₂ max (ml/kg/min) [†]	27.94 ± 1.07	28.30 ± 1.26	33.38 ± 1.95	34.25 ± 2.03
PEFR (L/min)	57.53 ± 2.33	58.20 ± 2.24	65.33 ± 8.12	68.27 ± 8.01
FEV1/FVC	0.67 ± 0.04	0.68 ± 0.04	0.74 ± 0.05	0.76 ± 0.05
Modified Borg score	5.33 ± 1.05	5.80 ± 0.86	6.07 ± 0.96	4.80 ± 1.01

[†]Group B, n = 14 for VO₂max only; one participant (subject 9) was excluded from this measure after data verification identified an unconfirmable post-intervention value (see Section II-G). All other measures retain n = 15 per group.

table ii. within-group comparison (wilcoxon signed-rank test)

Variable	Group A – Z	Group A – p	Group B – Z	Group B – p
VO ₂ max [†]	–2.98	0.003	–2.54	0.011
PEFR	–2.89	0.004	–3.46	0.001
FEV1/FVC	–2.64	0.008	–3.50	<0.001
Borg score	–2.33	0.020	–3.15	0.002

[†]Group B VO₂max, n = 14 (subject 9 excluded).

All within-group changes reached statistical significance (p < 0.05) in both groups (Table II). Notably, the Borg score moved in opposite directions between groups: it rose in Group A (greater perceived exertion) and fell in Group B (reduced perceived exertion), suggesting that the two interventions influenced exercise tolerance differently even though both improved objective measures of pulmonary function.

table iii. between-group comparison of change scores (mann–whitney u test)

Variable	Group A – Median Δ	Group B – Median Δ	Z	p
VO ₂ max [†]	0.20	0.95	–2.09	0.038
PEFR	1.00	2.00	–4.27	<0.001
FEV1/FVC	0.01	0.02	–3.85	<0.001
Borg score	1.00	–1.00	–4.21	<0.001

[†]Group B VO₂max, n = 14 (subject 9 excluded).

Between-group comparison confirmed that Group B improved significantly more than Group A on every outcome measure (p < 0.05 in each case), including a significantly larger reduction in perceived exertion (Table III).

IV. Discussion

This study compared the effects of a diaphragmatic breathing programme with brisk walking on cardiovascular endurance and pulmonary function in obese men with bronchial asthma. Both interventions produced statistically significant within-group gains in VO₂max, PEFR, and FEV1/FVC over six weeks, a finding broadly consistent with earlier reports that structured physical activity and breathing retraining can each improve exercise capacity and airway function in asthmatic populations, even at an elevated baseline body mass index [10], [14], [15], [30].

The more notable finding concerned perceived exertion. Group A's Borg score rose after six weeks of walking, which may reflect the physiological demand of sustained aerobic activity in a population whose baseline exercise tolerance was already

constrained by both obesity and airway obstruction [16], [18]. Group B, by contrast, showed a significant fall in perceived exertion alongside objective gains in VO₂max, PEFR, and FEV₁/FVC — consistent with the proposed mechanism whereby diaphragmatic breathing reduces the work of breathing, promotes more efficient use of the diaphragm relative to accessory respiratory muscles, and may thereby ease the subjective sensation of breathlessness during exertion even as physiological fitness improves [13], [19], [20]. This pattern aligns with earlier work showing that breathing retraining can improve quality of life and reduce hyperventilation-related symptoms in adults with mild-to-moderate asthma, and that symptom burden together with body mass index are meaningful correlates of exercise capacity in this group [14], [27], [28].

Clinically, these results suggest diaphragmatic breathing may offer a more tolerable starting point for obese asthmatic patients who find aerobic exercise aversive because of exertional breathlessness, potentially serving as a bridge toward greater engagement with aerobic activity over time. Because this comparison was made over a relatively short six-week window in a small, single-sex sample, the findings are best viewed as hypothesis-generating rather than definitive. The VO₂max comparison in particular rests on a smaller effective sample in Group B ($n = 14$) after exclusion of one participant's unconfirmable data point, narrowing the margin by which that outcome reached significance ($p = 0.038$) relative to PEFR, FEV₁/FVC, and Borg score, all of which reached higher significance on the full sample; this should be kept in mind when weighing the VO₂max finding against the other three outcomes.

V. Conclusion

Within the limits of this quasi-experimental study, a six-week diaphragmatic breathing programme produced significantly greater improvement in cardiovascular endurance, pulmonary function, and exercise tolerance than an equivalent brisk-walking programme in obese male patients with bronchial asthma. These findings support diaphragmatic breathing as a useful adjunct within the physiotherapeutic management of obese individuals with asthma, particularly where exertional breathlessness limits engagement with conventional aerobic exercise.

A. Limitations

This study used a quasi-experimental rather than a fully randomised controlled design; the intervention period was relatively short; the sample size was modest; and only male participants with obesity-associated asthma were included, limiting generalisability to women and to non-obese asthmatic patients. One participant's post-intervention VO₂max value could not be verified against source records and was excluded from that analysis, reducing the effective sample for this measure alone (Group B, $n = 14$) and its statistical power relative to the other outcomes.

B. Recommendations

Future studies should use larger and more diverse samples, including female participants; longer intervention periods with extended follow-up; a fully randomised controlled design; and a broader panel of outcome measures, including laboratory-based cardiopulmonary exercise testing where feasible.

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