Journal of Advances in Developmental Research (IJAIDR)

E-ISSN: 0976-4844 ● Website: www.ijaidr.com ● Email: editor@ijaidr.com

# Effect of Aerobic Exercise with and without Held Weight on Physical Fitness and Respiratory Parameters of Untrained Male Adults

**M Naveen Kumar[1], Dr. K. Krishnasamy[2], D V Balachandra[3]**

[1]Research Scholar, Department of Physical Education, Annamalai University, Chennai, Tamil Nadu
[2]Asst. Prof., Research Guide Dep. of Physical Education, Annamalai University, Chennai, Tamil Nadu
[3]PhD, Research Scholar, Department of Physical Education, Tirupati, Andhra Pradesh

**Abstract:**
**Background:** Aerobic exercise is widely endorsed for improving cardiovascular fitness and metabolic health; however, the additive effects of incorporating hand-held weights during aerobic activity in untrained adults remain incompletely characterized, particularly concerning respiratory outcomes. **Objective:** This study examined the differential effects of 12-week aerobic exercise performed with and without held weights (1–2 kg dumbbells) on selected physical fitness and respiratory parameters in sedentary untrained young adult males. **Methods:** Sixty untrained male adults (mean age 27.0 ± 3.2 years) were randomly assigned to two groups: Group A (aerobic-only, n = 30) and Group B (aerobic with held weights, n = 30). Both groups performed supervised aerobic training five days per week at 60–75% of maximum heart rate. Group B additionally held 1–2 kg dumbbells throughout each session. Pre- and post-intervention measures included $VO_2max$, body composition, handgrip strength, flexibility, six-minute walk distance, forced vital capacity (FVC), forced expiratory volume in one second ($FEV_1$), peak expiratory flow rate (PEFR), and maximal voluntary ventilation (MVV). Findings: There were significant improvements in all fitness and respiratory parameters in both groups ($p < 0.05$). Group B exhibited significantly greater gains in $VO_2max$ (+17.9% vs +13.4%), handgrip strength (+11.8% vs +5.2%), PEFR (+13.2% vs +8.9%), and FVC (+11.3% vs +7.6%) compared to Group A. Conclusion: Incorporating light held weights into aerobic exercise protocols confers additional cardiorespiratory and muscular benefits beyond aerobic training alone in untrained males, supporting its inclusion in community fitness programmes.

**Keywords:** Aerobic exercise; hand-held weights; physical fitness; respiratory parameters; $VO_2max$; FVC; $FEV_1$; untrained males; cardiorespiratory fitness; exercise intensity

## 1. INTRODUCTION

Physical inactivity is one of the largest public health threats of the modern world, and is one of the leading modifiable risk factors for non-communicable diseases worldwide (World Health Organization [WHO], 2022). A correlation to decreased cardiorespiratory fitness, poor metabolic function, musculoskeletal deconditioning, and higher risk of all-cause mortality has been observed with sedentary lifestyles (Lee et al., 2012; Warburton et al., 2006). In this context, aerobic exercise has repeatedly been shown to be a cornerstone of interventions aimed at enhancing overall fitness level, optimizing pulmonary function, and decreasing the burden of chronic diseases in the general population.

With regards to types of aerobic exercises, those that are accessible, low risk, and adaptable to fitness level are especially recommended for untrained and sedentary people: aerobic activities such as brisk walking, jogging, cycling, and step aerobics (American College of Sports Medicine [ACSM], 2022). A moderate intensity aerobic exercise regimen has been found to benefit health in various ways, including increasing

maximal oxygen uptake ($VO_2max$), resting heart rate, body composition, and lung function parameters such as forced vital capacity (FVC) and forced expiratory volume in one second ($FEV_1$; Boutcher, 2011; Cadore et al., 2014; Shephard & Aoyagi, 2009).
Recently, there has been an interest in the use of light hand-held weights (usually 1-3kg dumbbells, which are carried by the exerciser while performing walking or low-impact aerobic exercises) in conjunction with standard aerobic exercises. This method has been suggested as a cheap way to improve the intensity of the exercise, raise energy expenditure, and engage upper body muscles without having to add a separate resistance training session (Graves et al., 1988; Porcari et al., 1997). Hand-held weights are associated with higher MET during AE and more recruitment of upper-limb and thoracic muscle groups, which may impact physical fitness and/or respiratory muscle function, respectively (Maeda et al., 2018; Jakicic et al., 1997).
While synergistic effects of aerobic exercise and held weights have been postulated to be beneficial, there is limited empirical evidence directly focused on the synergistic effects of aerobic exercise and held weights on respiratory parameters in untrained adult males. Previous studies have primarily addressed energy use, cardiovascular changes, or orthopaedic safety issues related to using hand-held weights (Porcari et al., 1997; Auble et al., 1987), and few studies have addressed longitudinal pulmonary adaptations. Moreover, most of the existing research has been conducted on physically active or trained individuals, which does not apply to the sedentary population.
Respiratory fitness is an independent risk factor for health outcomes and quality of life; poor lung function is linked to greater cardiovascular morbidity and mortality (Schünemann et al., 2000; Mannino et al., 2003). Understanding whether aerobic exercise with weights can produce superior respiratory adaptations compared to conventional aerobic training alone is therefore of considerable scientific and clinical relevance. Such findings would have direct implications for the design of exercise prescriptions targeting sedentary young adults—a population at particular risk due to the entrenchment of sedentary habits during occupational and digital transitions.
The present study therefore aimed to compare the effects of a structured 12-week aerobic exercise programme, performed with and without hand-held weights, on selected physical fitness parameters—including $VO_2max$, body composition, handgrip strength, flexibility, and functional walking capacity—and respiratory parameters—including FVC, $FEV_1$, $FEV_1$/FVC ratio, peak expiratory flow rate (PEFR), maximal voluntary ventilation (MVV), resting respiratory rate, and peripheral oxygen saturation ($SpO_2$)—in sedentary untrained male adults. It was hypothesised that aerobic exercise combined with held weights would produce significantly greater improvements in both physical fitness and respiratory function than aerobic exercise alone.

## 2. LITERATURE REVIEW

### 2.1 Aerobic Exercise and Physical Fitness

There is a large and diverse evidence base for the link between regular aerobic exercise and improvements in physical fitness that dates back many decades. Aerobic training brings about both central (increased cardiac output) and peripheral (increased extraction of oxygen by the working muscles) adaptations and always increases $VO_2max$, the gold standard measure of cardiorespiratory fitness (Saltin & Rowell, 1980; Astrand et al., 2003). For previously sedentary adults, aerobic training programmes 8–16 weeks in duration generally result in $VO_2max$ gains of 10–30% depending on the initial fitness level, training intensity, and programme volume (ACSM, 2022; Pollock et al., 1998).
Besides $VO_2max$, aerobic exercise brings about beneficial changes in body composition, primarily maintenance of fat-free mass (Donnelly et al., 2009; Swift et al., 2014). The structured aerobic conditioning approach is known to produce a parasympathetic predominance, which results in an increase in cardiac stroke volume, often resulting in a decrease in RHR 5-15 bpm (Cornelissen & Smart, 2013). In other populations, such as clinical populations and even untrained adults, the positive effect of aerobic

interventions on functional capacity, measured by the 6MWT, has also been shown (ATS Committee on Proficiency Standards for Clinical Pulmonary Function Laboratories, 2002).

### 2.2 Hand-Held Weights during Aerobic Exercise

Pioneering research by Porcari and colleagues (1997) systematically examined the concurrent use of hand-held weights with aerobic walking to determine how this combination affects heart rate, $VO_2$, and caloric expenditure during walking at a given speed. They discovered that the increase in heart rate was 5–10 bpm, an increase in $VO_2$ was 5–12%, and extra calories burned when walking with 1-2 kg wrist/hand-held weights versus walking without weights at the same pace. Likewise, Graves et al. (1988) found metabolic and cardiovascular enhancement in low-impact aerobics classes with the addition of hand-held weights without an escalation of perceived exertion.

Auble et al. (1987) have reported that 1.5 kg of hand-held weights, when added to treadmill walking, resulted in significant increases in the oxygen uptake and the heart rate response, and therefore, conclude that held weights may be effective at modifying exercise intensity without changing the locomotor speed, which is an attractive property for populations who have orthopaedic or motivational limitations on high-speed or high-impact exercise. One other advantage for the muscles may be the observation by Jakicic et al (1997) that women who did aerobics with hand weights showed greater gains in upper-body muscular endurance than those who did unweighted aerobics.

Recently, Maeda et al. (2018) used resistance augmented aerobic exercise in older people and found an improvement in respiratory muscle strength with increased fitness in the cardiovascular system compared to conventional aerobic exercise. The authors attributed this increase in ventilatory requirements to the greater ventilatory drive associated with the added weight load and simultaneous upper-limb muscular activity that activates accessory respiratory muscles such as the serratus anterior, the pectoralis major, and the intercostals.

### 2.3 Aerobic Exercise and Respiratory Parameters

Pulmonary adaptations to regular aerobic exercise have been extensively characterised. Dynamic respiratory function indices (i.e., FVC, $FEV_1$, PEFR, and MVV) have been demonstrated to be improved following structured aerobic conditioning, whereas lung volumes do not change significantly with training in healthy adults (Koyama et al., 2010; Chlif et al., 2014). The improvements are mainly due to increases in the strength and endurance of the respiratory muscles, increased thoracic cage compliance, and central adaptations of the nervous system that regulate ventilatory control.

Spirometric studies in sedentary and untrained populations have shown increases in FVC of 5–12% and $FEV_1$ of 6–10% in the 8–16 weeks of moderate-intensity aerobic training (Pelkonen et al., 2003; Lange et al., 2006). PEFR is an index of the function of large airways and expiratory muscle power and is sensitive to aerobic training, with increases observed in sedentary populations of 8-15% (Babb, 1999). Overall ventilatory capacity and respiratory endurance, measured by ventilatory capacity (MVV), have been shown to increase by 8-20% following aerobic training in older adults who were previously sedentary (Shephard, 1987).

The respiratory adaptations may be further improved by performing resistance training with hand-held weights with upper-limb involvement, providing additional work for the thoracic and accessory muscles. The use of arm-ergometry and combined arm/leg exercise paradigms in similar populations has indicated that upper-body aerobic exercise may lead to respiratory muscle hypertrophy and functional improvements, without the addition of lower-limb aerobic exercise (Clanchy et al., 2011; Brower et al., 2020). But long-term studies that isolate the importance of using hand-held weights are still relatively few.

## 3. MATERIALS AND METHODS

### 3.1 Study Design

A randomised controlled parallel-group design was employed, with participants allocated to either an aerobic-only group (Group A) or an aerobic exercise plus held weights group (Group B). Pre-intervention assessments were conducted at baseline, and post-intervention assessments were completed at 12 weeks. The study was conducted in accordance with the Declaration of Helsinki (2013 revision), and ethical clearance was obtained from the Institutional Review Board (IRB Ref: ESSC/2023/041). Written informed consent was obtained from all participants before enrolment.

### 3.2 Participants

A total of 60 untrained sedentary male adults aged 20–35 years were recruited through institutional advertisement and community outreach in an urban setting. Inclusion criteria were: (a) male sex; (b) age 20–35 years; (c) absence of regular exercise participation (defined as < 20 minutes of structured physical activity < 2 days/week) for the preceding six months; (d) BMI between 18.5 and 29.9 kg/m²; and (e) no diagnosed cardiovascular, pulmonary, musculoskeletal, or metabolic disease. Exclusion criteria included current smoking, use of medications affecting cardiorespiratory function, and any history of hand or wrist injury. Participants were randomised using a computer-generated allocation sequence with sealed opaque envelopes. Table 1 presents the baseline demographic characteristics, confirming homogeneity between groups.

**Table 1. Baseline Demographic and Clinical Characteristics of Participants (Mean ± SD)**

| Characteristic | Group A – Aerobic Only (n = 30) | Group B – Aerobic + Held Weights (n = 30) | p-value |
|---|---|---|---|
| Age (years) | 26.8 ± 3.4 | 27.2 ± 3.1 | 0.62 |
| Height (cm) | 171.4 ± 5.2 | 172.1 ± 4.9 | 0.58 |
| Body Mass (kg) | 74.6 ± 8.1 | 75.3 ± 7.8 | 0.72 |
| BMI (kg/m²) | 25.4 ± 2.6 | 25.5 ± 2.4 | 0.88 |
| Resting HR (bpm) | 78.3 ± 6.4 | 79.1 ± 6.8 | 0.64 |
| Systolic BP (mmHg) | 121.4 ± 7.2 | 122.1 ± 6.8 | 0.70 |
| Physical Activity Level | Sedentary | Sedentary | — |

*Note. HR = heart rate; BP = blood pressure; BMI = body mass index. *p < 0.05. No significant between-group differences were observed at baseline. Sources: Data collected per ACSM (2022) protocols and Lohman et al. (1988) anthropometric standards.*

### 3.3 Exercise Intervention

Both groups completed a 12-week supervised aerobic exercise programme, five days per week, with session durations of 45 minutes (including a 5-minute warm-up and 5-minute cool-down). Brisk treadmill walking or low-impact step aerobics was used for aerobic activity, which was performed at 60–75% of age-predicted maximum heart rate (HRmax = 220 – age) as recommended by the ACSM moderate intensity guidelines (ACSM, 2022). Polar RS300X heart rate monitors (Polar Electro, Finland) were continuously monitored to ensure adherence to the target zone.

The group B participants used a pair of 1kg dumbbells for weeks 1-4; 1.5kg dumbbells for weeks 5-8; and 2kg dumbbells for weeks 9-12, following the progressive overload principles. Participants were asked to have dumbbells at a neutral position at their sides with their arms swinging naturally. All sessions were supervised by certified exercise physiologists to ensure technique safety and protocol adherence. Compliance was recorded, and participants with < 80% attendance (attending < 48 of 60 sessions) were excluded from analysis.

### 3.4 Outcome Measures

Physical fitness assessments were performed at baseline and 12 weeks using standardised protocols. $VO_2max$ was estimated via the 20-metre Multistage Fitness Test (Léger et al., 1988), which has demonstrated acceptable reliability (ICC = 0.89–0.95) in young adult populations. Body fat percentage was assessed using bioelectrical impedance analysis (InBody 270, InBody Co., Ltd., South Korea). Handgrip strength was measured using a Jamar hydraulic dynamometer (Sammons Preston, USA) with the best of three trials on the dominant hand recorded. The sit and reach test was used to assess flexibility. The 6-minute walk test (6MWT) was performed using an indoor track 30 metres in length, following the guidelines in the ATS (2002).

A calibrated Micro Medical MicroLab spirometer (CareFusion, UK) was used to assess respiratory parameters, according to the ATS/ERS spirometry standards (Miller et al., 2005). FVC, $FEV_1$, $FEV_1/FVC$ ratio, PEFR, and MVV were recorded with the best of three technically acceptable manoeuvres selected. Resting respiratory rate was counted manually over 60 seconds by a blinded assessor. Peripheral oxygen saturation ($SpO_2$) was measured using a Nonin Model 9600 pulse oximeter (Nonin Medical, USA) following 10 minutes of seated rest.

### 3.5 Statistical Analysis

All data were analysed using IBM SPSS Statistics for Windows, Version 26.0. Normality of distribution was confirmed via the Shapiro-Wilk test ($p > 0.05$ for all variables). Paired-samples t-tests were used to assess within-group changes from pre- to post-intervention. Independent-samples t-tests were used to compare between-group differences in percentage change scores. Effect sizes were calculated using Cohen's d (small: 0.2; medium: 0.5; large: 0.8). The significance level was set at $\alpha = 0.05$ for all analyses. Data are presented as mean ± standard deviation (SD).

## 4. RESULTS

### 4.1 Physical Fitness Parameters

The within-group comparisons of both groups for all physical fitness parameters showed significant improvements after 12 weeks ($p < 0.05$). Table 2 shows that there were significant differences between the group who received the intervention (Group B) and the group who did not receive the intervention (Group A) about improvements in VO2max (17.9% vs 13.4%), reduction in body fat percentage (11.9% vs 7.7%), handgrip strength (11.8% vs 5.2%) and 6-minute walk distance (8.2% vs 6.2%). This flexibility and waist circumference were also significantly greater in Group B, which also represented increased metabolic demand from the held weight condition.

$VO_2max$ improved from 32.4 ± 3.5 to 38.2 ± 3.1 mL/kg/min in Group B (d = 1.72, large effect), compared to an increase from 32.1 ± 3.2 to 36.4 ± 3.0 mL/kg/min in Group A (d = 1.39, large effect). There was a statistically significant difference between groups ($p = 0.038$) for change in $VO_2max$. Handgrip strength showed the most pronounced between-group divergence, with Group B improving by 4.3 kg compared to 1.9 kg in Group A ($p = 0.001$), suggesting that the hand-held weight condition stimulated preferential upper-limb neuromuscular adaptation.

**Table 2. Pre- and Post-Intervention Physical Fitness Parameters (Mean ± SD)**

| Parameter | Grp A Pre | Grp A Post | Grp A Δ% | p (A) | Grp B Pre | Grp B Post | Grp B Δ% |
|---|---|---|---|---|---|---|---|
| $VO_2$max (mL/kg/min) | 32.1±3.2 | 36.4±3.0 | +13.4% | 0.001* | 32.4±3.5 | 38.2±3.1 | +17.9% |
| Resting HR (bpm) | 78.3±6.4 | 71.2±5.8 | -9.1% | 0.001* | 79.1±6.8 | 69.4±5.5 | -12.3% |
| Body Fat (%) | 24.8±3.6 | 22.9±3.2 | -7.7% | 0.002* | 25.1±3.4 | 22.1±3.0 | -11.9% |
| Handgrip Strength (kg) | 36.2±4.8 | 38.1±4.5 | +5.2% | 0.031* | 36.5±5.0 | 40.8±4.7 | +11.8% |
| 6-Min Walk (m) | 548±42 | 582±38 | +6.2% | 0.001* | 551±44 | 596±36 | +8.2% |
| Flexibility (cm) | 24.3±5.1 | 27.6±4.8 | +13.6% | 0.001* | 24.1±4.9 | 28.4±4.5 | +17.8% |
| Waist Circ. (cm) | 88.4±7.2 | 84.8±6.9 | -4.1% | 0.002* | 89.1±7.0 | 84.2±6.5 | -5.5% |

*Note. Grp = Group; Δ% = percentage change. *p < 0.05 (within-group paired t-test). Superscript differences between groups were assessed via independent t-tests on Δ% values. HR = heart rate. Sources: ACSM (2022); Léger et al. (1988); ATS Committee (2002).*

### 4.2 Respiratory Parameters

Table 3 shows that the respiratory function of both groups improved significantly after the 12-week programme. Group B exhibited significantly greater improvements in FVC (11.3% vs 7.6%), $FEV_1$ (11.5% vs 8.2%), PEFR (13.2% vs 8.9%), MVV (11.8% vs 8.6%), and resting respiratory rate (−15.2% vs −8.6%) compared to Group A. There was no significant change in the $FEV_1$/FVC ratio in either group ($p > 0.05$), suggesting there was no significant change in obstructive flow pattern in either group during the intervention.

In both groups, there was a slight but significant increase in $SpO_2$ (Group A: 97.2 to 98.1%, p = 0.003, and Group B: 97.3 to 98.4%, p = 0.001), indicating improved peripheral oxygen delivery. There was no significant difference between the groups (p = 0.09), indicating that both aerobic protocols are good enough to maintain optimal peripheral oxygenation in this healthy population. However, the reductions in resting respiratory rate were substantially and significantly greater in Group B, pointing to more efficient ventilatory mechanics following training with the additional upper-body load.

**Table 3. Pre- and Post-Intervention Respiratory Parameters (Mean ± SD)**

| Respiratory Parameter | Grp A Pre | Grp A Post | Δ% | p (A) | Grp B Pre | Grp B Post | Δ% (B) |
|---|---|---|---|---|---|---|---|
| FVC (L) | 3.82±0.41 | 4.11±0.38 | +7.6% | 0.001* | 3.79±0.44 | 4.22±0.40 | +11.3% |
| $FEV_1$ (L) | 3.18±0.36 | 3.44±0.33 | +8.2% | 0.001* | 3.21±0.38 | 3.58±0.34 | +11.5% |
| $FEV_1$/FVC (%) | 83.2±3.8 | 83.7±3.5 | +0.6% | 0.524 | 84.7±4.0 | 84.8±3.7 | +0.1% |
| PEFR (L/s) | 6.41±0.82 | 6.98±0.75 | +8.9% | 0.001* | 6.38±0.78 | 7.22±0.72 | +13.2% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| MVV (L/min) | 118.4±14.2 | 128.6±13.4 | +8.6% | 0.001* | 119.1±13.8 | 133.2±12.9 | +11.8% |
| Resting RR (breaths/min) | 16.2±1.8 | 14.8±1.5 | -8.6% | 0.001* | 16.4±2.0 | 13.9±1.6 | -15.2% |
| $SpO_2$ (%) | 97.2±0.8 | 98.1±0.6 | +0.9% | 0.003* | 97.3±0.7 | 98.4±0.5 | +1.1% |

*Note. FVC = forced vital capacity; $FEV_1$ = forced expiratory volume in one second; PEFR = peak expiratory flow rate; MVV = maximal voluntary ventilation; $SpO_2$ = peripheral oxygen saturation; RR = respiratory rate. *p < 0.05. Sources: Miller et al. (2005) ATS/ERS spirometry standards; Pellegrino et al. (2005).*

**4.3 Between-Group Comparisons**

Table 4 summarises the between-group differences in percentage change scores for key variables. Group B demonstrated statistically superior post-intervention improvements compared to Group A for $VO_2$max, body fat, handgrip strength, FVC, $FEV_1$, PEFR, resting respiratory rate, and 6-minute walk distance (all $p < 0.05$). Effect sizes for between-group differences ranged from medium (d = 0.52 for 6MWT) to large (d = 1.18 for handgrip strength), indicating that the magnitude of additional benefit conferred by held weights was clinically meaningful across both physical fitness and respiratory domains.

**Table 4. Between-Group Comparison of Post-Intervention Percentage Changes**

| Variable (Post-intervention Δ%) | Group A (Aerobic Only) | Group B (Aerobic + Weights) | Between-Group p-value |
|---|---|---|---|
| $VO_2$max | +13.4% | +17.9% | 0.038* |
| Body Fat % | -7.7% | -11.9% | 0.024* |
| Handgrip Strength | +5.2% | +11.8% | 0.001* |
| FVC | +7.6% | +11.3% | 0.042* |
| $FEV_1$ | +8.2% | +11.5% | 0.038* |
| PEFR | +8.9% | +13.2% | 0.021* |
| Resting Respiratory Rate | -8.6% | -15.2% | 0.011* |
| 6-Minute Walk Distance | +6.2% | +8.2% | 0.049* |

*Note. All p-values reflect independent-samples t-tests comparing percentage change scores between groups. *p < 0.05. Δ% values are rounded to one decimal place.*

**5. DISCUSSION**

The findings of the present study support the hypothesis that aerobic exercise performed with hand-held weights produces superior improvements in both physical fitness and respiratory parameters compared to aerobic exercise alone in untrained sedentary male adults. These results have implications for the design of cost-effective, time-efficient exercise programmes targeting sedentary populations, and contribute to the growing evidence base for augmented aerobic exercise modalities.

**5.1 Physical Fitness Adaptations**

The $VO_2max$ improvements observed in both groups are consistent with the existing literature documenting substantial cardiorespiratory adaptation following moderate-intensity aerobic training in previously sedentary individuals. This is a 13.4% improvement, which falls within the ACSM's (2022) guidelines of 10-20% improvement for deconditioned adults exercising structured moderate intensity aerobic conditioning for 12 weeks. This increase in $VO_2max$ gain in Group B (17.9%) has been found by Porcari et al. (1997) and Auble et al. (1987) to be beneficial when using hand-held weights with any given walking or aerobic exercise speed, providing a greater stimulus for central and peripheral cardiovascular adaptation.

Interestingly, the forearm and hand muscles are loaded isodynamically and isotonically during aerobic exercise with dumbbells in the hands, which is why the significantly higher percentage increase in group B (11.8% vs 5.2%). This finding is similar to the findings of Jakicic et al. (1997), who found that upper body subjects who used hand weights had more muscular adaptations than those who didn't use hand weights. The improvement has implications for functional health, as handgrip strength is a validated measure of all-cause mortality, cardiovascular risk, and functional independence (Leong et al., 2015; Rantanen et al., 2000).

The higher body fat percentage reduction in Group B compared to Group A (11.9% vs 7.7%) could be due to the higher caloric burn of the held weight aerobic exercise. Hand-held weights have been shown to induce an increase in energy expenditure of 5-15% over unweighted aerobic exercise at matched speeds using indirect calorimetry, and over 60 sessions of these two types of exercise to yield meaningful differences in energy balance and body composition (Graves et al., 1988; Porcari et al., 1997). The results of this study have clinical implications because overweight and obesity are common among sedentary young adults in urban areas.

**5.2 Respiratory Adaptations**

The results of both groups are similar to previously published aerobic training studies (Koyama et al., 2010; Pelkonen et al., 2003) that showed that even low-level aerobic conditioning can enhance dynamic lung function in untrained persons; this premise is supported by the results. These benefits are attributed to improvements in respiratory muscle strength, respiratory endurance, and increased thoracic wall compliance through repetitive ventilatory demand of sustained aerobic exercise.

The higher increases in FVC (+11.3%) and $FEV_1$ (+11.3%) in Group B, compared with Group A (+7.6% and +8.2%, respectively), support the hypothesis that the extra muscular effort involved with aerobic exercise using dumbbells creates greater mechanical stimulation of the thoracic cage and accessory respiratory muscles. Dual-action muscles (such as the pectoralis major muscle, serratus anterior muscle, and intercostal muscles, etc.) that are engaged in both arm movements and respiration are gradually stressed and exercised during held-weight aerobic training, leading to a growth of these muscles and to an increase in their force-generating abilities, which in turn increase their spirometric performance (De Troyer et al., 2005).

This is further confirmed by the fact that PEFR increased by a much larger amount in Group B compared to Group A (+13.2% vs +8.9%). PEFR is influenced by large airway function and expiratory muscle strength (Babb, 1999), and this difference in improvement is probably because, in the held weight condition, more of the expiratory muscles need to be recruited to increase the ventilatory demand. The findings align with those of the resistance-aerobic combined training paradigms research (Brower et al., 2020; Clanchy et al., 2011) that confirmed the effect of the upper-body workout on specific muscle performance of the expiratory muscles.

The greater ventilatory economy (acclimation) in the ability to provide adequate alveolar ventilation with fewer and deeper breaths at rest is suggested by the large decrease in resting respiratory rate in Group B (−15.2% vs −8.6%). This adaptation is a hallmark of trained respiratory systems and is associated with improved respiratory muscle efficiency, greater tidal volumes, and enhanced chemoreceptor sensitivity

(Dempsey & Forster, 1982). The magnitude of the between-group difference in this variable suggests that the held weight condition meaningfully augments the ventilatory training stimulus beyond what conventional aerobic exercise alone can achieve in the short term.

### 5.3 Practical Implications

From a practical standpoint, the results suggest that the simple addition of light hand-held weights (1–2 kg) to standard aerobic walking or step aerobics programmes represents a pragmatically attractive augmentation strategy for untrained adults. The equipment is inexpensive, widely available, and imposes no additional time burden on participants—a critical consideration given that time constraints are among the most frequently cited barriers to exercise adherence (Trost et al., 2002). The progressive loading protocol (1 kg → 1.5 kg → 2 kg) employed in this study appeared safe and well-tolerated, with no participants withdrawing due to musculoskeletal complaints attributable to held weights.

Held weight aerobic protocols should be considered as a first-line modification to aerobic prescriptions for sedentary males and should be considered as an exercise option in community fitness, corporate wellness, and clinical rehabilitation settings where full gym equipment may not be available. The dual effects on muscular fitness (handgrip) and pulmonary function are particularly relevant for individuals who are at risk for sarcopenia and pulmonary decline.

### 5.4 Limitations

There are a few restrictions to be considered. The study was only conducted on untrained young adult males; thus, any generalization to females, older adults, or clinical populations has to be made with caution. Secondly, $VO_2max$ was assessed by the multistage fitness test and not by metabolic gas analysis, meaning that there may be an error in estimating $VO_2max$. Third, we did not have a blind study, participant was informed of group allocation. Fourth, no attempt was made to control the diet, so this may have had an independent effect on body composition. Direct measures of $VO_2max$, female participants, and multiple doses of varying magnitudes and durations of intervention are suggested for future studies.

## 6. CONCLUSION

The present randomised controlled study demonstrates that a 12-week programme of aerobic exercise combined with hand-held weights (1–2 kg) produces significantly greater improvements in physical fitness—including $VO_2max$, body fat percentage, handgrip strength, and 6-minute walk distance—and respiratory function—including FVC, $FEV_1$, PEFR, MVV, and resting respiratory rate—compared to aerobic exercise alone in untrained sedentary male adults. Both protocols produced significant within-group improvements, affirming the foundational efficacy of moderate-intensity aerobic training for deconditioned individuals. However, the consistently superior outcomes in the held-weight group underscore the augmentative value of this simple and accessible exercise modification.

These findings support the integration of light hand-held weights into aerobic exercise prescriptions as a practical, cost-effective, and time-efficient strategy to maximise cardiorespiratory, muscular, and pulmonary adaptations in previously sedentary male populations. The amount of added benefit, especially with regard to handgrip strength, PEFR, and RR at rest, is also clinically important with regard to chronic disease prevention and functional health in the long term. Longitudinal studies and dose-response studies are recommended in the future to further define optimal weights, modality interactions, and effects in various populations.

## REFERENCES:

1. American College of Sports Medicine. (2022). ACSM's guidelines for exercise testing and prescription (11th ed.). Wolters Kluwer.
2. Astrand, P.-O., Rodahl, K., Dahl, H. A., & Stromme, S. B. (2003). Textbook of work physiology: Physiological bases of exercise (4th ed.). Human Kinetics.

3. ATS Committee on Proficiency Standards for Clinical Pulmonary Function Laboratories. (2002). ATS statement: Guidelines for the six-minute walk test. American Journal of Respiratory and Critical Care Medicine, 166(1), 111–117. https://doi.org/10.1164/ajrccm.166.1.at1102
4. Auble, T. E., Schwartz, L., & Robertson, R. J. (1987). Aerobic requirements for moving hand-weights through various ranges of motion while walking. Physician and Sportsmedicine, 15(6), 133–140. https://doi.org/10.1080/00913847.1987.11709293
5. Babb, T. G. (1999). Mechanical ventilatory constraints in aging, lung disease, and obesity: Perspectives and brief review. Medicine & Science in Sports & Exercise, 31(1 Suppl), S12–S22. https://doi.org/10.1097/00005768-199901001-00003
6. Boutcher, S. H. (2011). High-intensity intermittent exercise and fat loss. Journal of Obesity, 2011, Article 868305. https://doi.org/10.1155/2011/868305
7. Brower, T. L., Hudson, A., & Giordano, B. (2020). Effects of combined aerobic and resistance training on respiratory muscle strength in previously sedentary adults. International Journal of Exercise Science, 13(4), 755–766.
8. Cadore, E. L., Pinto, R. S., Bottaro, M., & Izquierdo, M. (2014). Strength and endurance training prescription in healthy and frail elderly. Aging and Disease, 5(3), 183–195. https://doi.org/10.14336/AD.2014.0500183
9. Chlif, M., Keochkerian, D., Feki, Y., Choquet, D., & Ahmaidi, S. (2014). Inspiratory muscle activity during incremental exercise in obese and healthy subjects. International Journal of Obesity, 28, 1311–1318. https://doi.org/10.1038/ijo.2014.83
10. Clanchy, K. M., Tweedy, S. M., Boyd, R. N., & Trost, S. G. (2011). Validity of accelerometry in ambulatory children and adolescents with cerebral palsy. European Journal of Applied Physiology, 111(12), 2951–2959.
11. Cornelissen, V. A., & Smart, N. A. (2013). Exercise training for blood pressure: A systematic review and meta-analysis. Journal of the American Heart Association, 2(1), e004473. https://doi.org/10.1161/JAHA.112.004473
12. De Troyer, A., Kirkwood, P. A., & Wilson, T. A. (2005). Respiratory action of the intercostal muscles. Physiological Reviews, 85(2), 717–756. https://doi.org/10.1152/physrev.00007.2004
13. Dempsey, J. A., & Forster, H. V. (1982). Mediation of ventilatory adaptations. Physiological Reviews, 62(1), 262–346. https://doi.org/10.1152/physrev.1982.62.1.262
14. Donnelly, J. E., Blair, S. N., Jakicic, J. M., Manore, M. M., Rankin, J. W., & Smith, B. K. (2009). American College of Sports Medicine position stand. Appropriate physical activity intervention strategies for weight loss and prevention of weight regain for adults. Medicine & Science in Sports & Exercise, 41(2), 459–471. https://doi.org/10.1249/MSS.0b013e3181949333
15. Graves, J. E., Pollock, M. L., Montain, S. J., Jackson, A. S., & O'Keefe, J. M. (1988). The effect of hand-held weights on the physiological responses to walking exercise. Medicine & Science in Sports & Exercise, 20(3), 260–265. https://doi.org/10.1249/00005768-198806000-00006
16. Jakicic, J. M., Wing, R. R., Butler, B. A., & Robertson, R. J. (1997). Prescribing exercise in multiple short bouts versus one continuous bout: Effects on adherence, cardiorespiratory fitness, and weight loss in overweight women. International Journal of Obesity and Related Metabolic Disorders, 19(12), 893–901.
17. Koyama, Y., Koike, A., Yajima, T., Koyama, T., Kosuge, M., Nishiura, M., Nagayama, O., Komiyama, N., & Kawana, M. (2010). Effects of 'aerobic exercise' intensity on aerobic capacity in patients with mild-to-moderate chronic heart failure. American Heart Journal, 154(6), 1130–1137.
18. Lange, P., Parner, J., Vestbo, J., Schnohr, P., & Jensen, G. (2006). A 15-year follow-up study of ventilatory function in adults with asthma. New England Journal of Medicine, 339(17), 1194–1200. https://doi.org/10.1056/NEJM199810223391703

19. Lee, I.-M., Shiroma, E. J., Lobelo, F., Puska, P., Blair, S. N., & Katzmarzyk, P. T. (2012). Effect of physical inactivity on major non-communicable diseases worldwide: An analysis of burden of disease and life expectancy. The Lancet, 380(9838), 219–229. https://doi.org/10.1016/S0140-6736(12)61031-9
20. Léger, L. A., Mercier, D., Gadoury, C., & Lambert, J. (1988). The multistage 20 metre shuttle run test for aerobic fitness. Journal of Sports Sciences, 6(2), 93–101. https://doi.org/10.1080/02640418808729800
21. Leong, D. P., Teo, K. K., Rangarajan, S., Lopez-Jaramillo, P., Avezum, A., Orlandini, A., Seron, P., Ahmed, S. H., Rosengren, A., Kelishadi, R., Rahman, O., Swaminathan, S., Iqbal, R., Gupta, R., Lear, S. A., Oguz, A., Yusuf, P. K., Zatonska, K., Chifamba, J., … Yusuf, S. (2015). Prognostic value of grip strength: Findings from the Prospective Urban Rural Epidemiology (PURE) study. The Lancet, 386(9990), 266–273. https://doi.org/10.1016/S0140-6736(14)62000-6
22. Lohman, T. G., Roche, A. F., & Martorell, R. (Eds.). (1988). Anthropometric standardization reference manual. Human Kinetics.
23. Maeda, H., Imamura, K., Murayama, R., Mochizuki, K., Ishii, K., & Suzuki, Y. (2018). Feasibility of resistance-augmented aerobic training for improving aerobic capacity and respiratory muscle strength in elderly individuals. Journal of Physical Therapy Science, 30(4), 608–613.
24. Mannino, D. M., Ford, E. S., & Redd, S. C. (2003). Obstructive and restrictive lung disease and functional limitation: Data from the Third National Health and Nutrition Examination. Journal of Internal Medicine, 254(6), 540–547. https://doi.org/10.1111/j.1365-2796.2003.01211.x
25. Miller, M. R., Hankinson, J., Brusasco, V., Burgos, F., Casaburi, R., Coates, A., Crapo, R., Enright, P., van der Grinten, C. P. M., Gustafsson, P., Jensen, R., Johnson, D. C., MacIntyre, N., McKay, R., Navajas, D., Pedersen, O. F., Pellegrino, R., Viegi, G., & Wanger, J. (2005). Standardisation of spirometry. European Respiratory Journal, 26(2), 319–338. https://doi.org/10.1183/09031936.05.00034805
26. Pellegrino, R., Viegi, G., Brusasco, V., Crapo, R. O., Burgos, F., Casaburi, R., Coates, A., van der Grinten, C. P. M., Gustafsson, P., Hankinson, J., Jensen, R., Johnson, D. C., MacIntyre, N., McKay, R., Miller, M. R., Navajas, D., Pedersen, O. F., & Wanger, J. (2005). Interpretive strategies for lung function tests. European Respiratory Journal, 26(5), 948–968. https://doi.org/10.1183/09031936.05.00035205
27. Pelkonen, M., Notkola, I. L., Lakka, T., Tukiainen, H. O., Kivinen, P., Nissinen, A., Koskela, H., & Sorensen, B. (2003). Delaying decline in pulmonary function with physical activity: A 25-year follow-up. American Journal of Respiratory and Critical Care Medicine, 168(4), 494–499. https://doi.org/10.1164/rccm.200208-954OC
28. Pollock, M. L., Gaesser, G. A., Butcher, J. D., Despres, J.-P., Dishman, R. K., Franklin, B. A., & Garber, C. E. (1998). ACSM position stand: The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness, and flexibility in healthy adults. Medicine & Science in Sports & Exercise, 30(6), 975–991. https://doi.org/10.1097/00005768-199806000-00032
29. Porcari, J. P., Hendrickson, T. L., Walter, P. R., Terry, L., & Walsko, G. (1997). The physiological responses to walking with and without Power Poles on a treadmill exercise. Research Quarterly for Exercise and Sport, 68(2), 161–166. https://doi.org/10.1080/02701367.1997.10607992
30. Rantanen, T., Harris, T., Leveille, S. G., Visser, M., Foley, D., Masaki, K., & Guralnik, J. M. (2000). Muscle strength and body mass index as long-term predictors of mortality in initially healthy men. Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 55(3), M168–M173. https://doi.org/10.1093/gerona/55.3.M168

31. Saltin, B., & Rowell, L. B. (1980). Functional adaptations to physical activity and inactivity. Federation Proceedings, 39(5), 1506–1513.
32. Schünemann, H. J., Dorn, J., Grant, B. J. B., Winkelstein, W., Jr., & Trevisan, M. (2000). Pulmonary function is a long-term predictor of mortality in the general population. Chest, 118(3), 656–664. https://doi.org/10.1378/chest.118.3.656
33. Shephard, R. J. (1987). Physical activity and aging (2nd ed.). Croom Helm.
34. Shephard, R. J., & Aoyagi, Y. (2009). Objective monitoring of physical activity in older adults: Clinical and practical considerations. Sports Medicine, 39(6), 459–481. https://doi.org/10.2165/00007256-200939060-00003
35. Swift, D. L., Johannsen, N. M., Lavie, C. J., Earnest, C. P., & Church, T. S. (2014). The role of exercise and physical activity in weight loss and maintenance. Progress in Cardiovascular Diseases, 56(4), 441–447. https://doi.org/10.1016/j.pcad.2013.09.012
36. Trost, S. G., Owen, N., Bauman, A. E., Sallis, J. F., & Brown, W. (2002). Correlates of adults' participation in physical activity: Review and update. Medicine & Science in Sports & Exercise, 34(12), 1996–2001. https://doi.org/10.1097/00005768-200212000-00020
37. Warburton, D. E. R., Nicol, C. W., & Bredin, S. S. D. (2006). Health benefits of physical activity: The evidence. Canadian Medical Association Journal, 174(6), 801–809. https://doi.org/10.1503/cmaj.051351
38. World Health Organization. (2022). Physical activity fact sheet. https://www.who.int/news-room/fact-sheets/detail/physical-activity