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Does Step Exercise With Handweights Enhance Training Effects?

Len Kravitz[†], Vivian H. Heyward, Lisa M. Stolarczyk, and Virginia Wilmerding

Center for Exercise and Applied Human Physiology, University of New Mexico, Albuquerque, New Mexico 87131; [†]Dept. of Exercise Science and Leisure Management, University of Mississippi, University, Mississippi 38677.

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ABSTRACT

This study compared the effects of 12 weeks of step aerobic training with and without handheld weights on cardiorespiratory fitness, body composition, muscular strength, and incidence of injury in college women (18–36 yrs). Subjects participated in either a step aerobic training program with handweights (HW) or without handweights (NHW) 3 days a week for 30 min, at 75 to 90% HR max. Resistance for the HW group, who used the handheld weights continuously for 15 min during each 30-min session, progressively increased. MANOVA indicated significant ($p < 0.01$) improvements for both training groups for $\dot{V}O_2$ max, treadmill run time, % body fat, fat-free mass, and muscular strength (peak torque) for shoulder flexion and extension, shoulder horizontal adduction and abduction, and knee flexion. However, these improvements did not differ significantly between groups. No upper body injuries were reported for HW. It is concluded that step aerobic training, with and without HW, has a positive effect on cardiorespiratory fitness, body composition, and muscular strength in healthy women—without additional risk of injury.

Key Words: aerobic dance, handheld weights, step aerobics, injury

Introduction

Since the late 1980s, step training has become a popular mode of aerobic exercise training in health and fitness settings. Participants use a bench ranging from 10.2 to 30.5 cm high (4 to 12 in., respectively) and perform choreographed movements to cadenced music. They execute upper body arm movements simultaneously with the leg stepping patterns. Step exercise is rhythmical and aerobic and provides adequate cardiovascular training in terms of exercise intensity and duration (15, 25).

Exercise intensity is modified by changing bench height, cadence of exercise routine, or upper body involvement. The latter can be increased by vigorous arm-pumping actions without additional weights or by controlled arm movements with handheld weights (HW). Research has shown that exercising with HW (0.45 to 2.27 kg) increases the energy cost of walking (1, 9, 10, 13, 14), especially when accompanied by vigorous arm swings (1, 13). However, use of light HW (0.45 to 0.91 kg) in aerobic dance energy expenditure trials has produced mixed results in terms of metabolic demands (5, 6, 22). In fact, similar improvements in $\dot{V}O_2$ max, body composition, and upper body strength have been noted for both aerobic dance training and step training, with and without light (<0.91 kg) handweights (3, 11, 19).

These findings suggest that perhaps heavier HW are needed to provide additional training stimulus. However, the use of heavier HW (>0.91 kg) in step training has been discouraged because of possible risk of injury and muscle soreness (8). Olson et al. (15) reported subject complaints of acute pain and soreness in the shoulder muscles during handweighted step exercise trials using a 0.91-kg HW.

Given the little research documenting the immediate risks and long-term benefits of step training (11), we compared the effects of step training without HW (NHW) and with heavier (≥0.91 kg) HW on cardiorespiratory endurance, body composition, and upper body strength, as well as the incidence and severity of upper body injury.

Methods

The subjects were 44 women, ages 18 to 36, who were enrolled in two step aerobics classes at the university. They volunteered for the 12-week training study. All were screened to ensure they were not currently taking any medications or undergoing weight loss methods that might alter responses to the program. Subjects had to be free of cardiovascular, pulmonary, and orthopedic disorders that could hinder their participation and testing performance. Prior to their participation in the study, they received explanations of the testing and training procedures and provided written informed consent in accordance with the university's human research review board.

Testing Procedures

Pretests were administered the week preceding the first training session; posttests were conducted the week immediately following the training period. $\dot{V}O_2$ max was assessed using a graded treadmill protocol developed and described by Ben-Ezra and Verstraete (2). Expiratory ventilation ($\dot{V}_E$) gas samples were collected every 30 sec during the treadmill test using an ergo-oxyscreen, open-circuit gas analysis system (Erich Jaeger, Hoechberg, Germany). Fractions of oxygen (F_EO_2) and carbon dioxide (F_ECO_2) in expired gas samples were continuously analyzed every 30 sec with the Jaeger metabolic cart, which was calibrated before each test using standard gas samples.

The rate of oxygen uptake ($\dot{V}O_2$) and carbon dioxide production ($\dot{V}CO_2$) were automatically calculated from $\dot{V}_E$, F_EO_2, and F_ECO_2. $\dot{V}O_2$ max was the highest $\dot{V}O_2$ reached after two of the following criteria were achieved: (a) HR within 10 bpm of age-predicted max (HR max); (b) RER above 1.0; (c) a plateau or decrease in $\dot{V}O_2$ in relation to an increasing workload. During the graded exercise test, HR was monitored continuously with an electrocardiogram unit integrated with the Jaeger metabolic cart. HR max was the highest HR reached during the treadmill test. Treadmill run time was recorded at the point of voluntary exhaustion.

Body density (Db) was estimated from body volume calculated from underwater weight with corrections for measured residual lung volume (RV) and estimated gastrointestinal (GI) tract volume. Three trials of RV were made with the subject seated out of water, using a helium dilution method (Warren E. Collins, Braintree, MA). The two closest readings within 100 ml were averaged, and together with a constant of 100 ml for GI volume (24), were used to correct total body volume estimated from underwater weight.

Subjects were underwater-weighed at RV using a 9-kg Chatillon hydrostatic scale. While seated in a chair suspended from the scale, they were given as many trials as needed to obtain 3 readings within 100 g. The average of the 3 trials within 100 g was used as the underwater weight for calculating body volume, which in turn was used to estimate Db. Db was converted to %BF using the Lohman (12) equation: $\%BF = (5.03/Db - 4.59) \times 100$. Fat-free mass (FFM) was calculated by subtracting fat mass from body weight (BW).

Subjects were also asked whether they tended to retain water or gain weight during their menstrual cycles. The start date of the last menses was recorded for each subject, and posttesting was scheduled to closely match the pretesting menstrual cycle stage in order to control for variability in BW due to water retention.

Muscular strength was assessed with an Omni-tron total body machine (Hydrafitness, Belton, TX). Subjects sat on the Omni-tron bench with thighs and hips stabilized by velcro straps. The distal end of a lever arm was strapped to the subject's dominant leg just proximal to the malleoli of the ankle. Chair incline was adjusted and settings were recorded to facilitate the optimal line of force application for each subject during the upper body strength tests. These same settings were used for posttesting. For the knee extension and flexion test, the dynamometer's axis of rotation was aligned with the subject's anatomical axis of rotation at the knee joint. Each subject was given 2 warm-up trials, after which 5 strength trials for each muscle group were recorded. Peak torque values ($N \cdot m$) for shoulder flexion and extension, shoulder horizontal abduction and adduction, and knee flexion and extension of the dominant leg were measured.

Training Program

Step training consisted of 3 nonconsecutive training sessions a week for 12 weeks; the same instructor taught both step aerobic classes, HW and NHW. Each session lasted 45 min and began with 3 min of daily instructions, a 6-min warm-up, then 30 min of step training. A 3-min abdominal workout followed the 30-min step training period, and each session ended with a 3-min cooldown. The subjects used a 15.2-cm step for the first 2 weeks and chose either the same or a 20.3-cm step for Weeks 3–12. The steps used in this study were 35.6-cm wide (front to back) and 121.9-cm long (STEP Co., Atlanta).

A variety of common steps were employed in the choreography. Step combinations consisted of conventional "up, up, down, down" stepping patterns; alternating step knee-lift sequences; traveling across the top of the step; alternating leg "up, up, down, down" patterns facing and turning away from the step; and lateral lunge propulsion steps. Stepping cadence during the 30 min of step training ranged from 120 to 126 bpm.

The treatment, HW vs. NHW, was randomly assigned to the intact groups. Those in the HW group (n = 22) did not use HW during the first week of the study when step routines were being introduced. Thereafter, the HW group trained with a 0.91-kg HW in each hand for Weeks 2–4, a 1.36-kg HW for Weeks 5–8, and a 1.81-kg HW for Weeks 9–12. Arm movements were concurrent with leg movements and consisted of elbow flexion and extension, shoulder flexion and extension, arm abduction (to shoulder height) and adduction, shoulder elevation, and flexed-arm shoulder horizontal adduction and abduction. Total length of time using HW per session was 12–15 min. The NHW group (n = 22) performed similar arm and leg stepping patterns. Both groups trained to the same music, which was changed regularly throughout the study.

Subjects in both groups were instructed to rate their perceived exertion (RPE) (4) and take pulse readings in order to monitor their exercise intensity during the step training. They trained at 75 to 90% of HR max. Every subject trained with a Polar Favor™ HR monitor (Polar USA, Stamford, CT) at least once a week to make sure exercise HR was within the assigned training limits. All subjects kept training records of exercise HR and RPE. In the event of injury or upper body soreness, a graded scale rating the severity of the discomfort (17) was used to classify the episode. Anyone missing more than 3 training sessions, unexcused, was excluded from the study.

Statistical Analysis

Three MANOVAs (2 × 2) with repeated measures were used to assess the overall differences between training groups over time in (a) cardiorespiratory fitness (absolute $\dot{V}O_2$ max, relative $\dot{V}O_2$ max, and treadmill run time); (b) body composition (%BF and FFM); and (c) muscular strength (shoulder flexion/extension, shoulder horizontal abduction/adduction, and knee flexion/extension). Significant discriminant functions were interpreted by comparing standardized discriminant function coefficients and univariate F-tests. The experimentwise error rate was set at $\alpha = 0.15$ to improve power (20).

Given that separate MANOVAs were used to test 3 different constructs, the type I error rate was controlled by adjusting the alpha level using the Bonferroni method (0.15/3 = 0.05). Also, within each MANOVA the alpha level was adjusted for testing significance of univariate ANOVAs. Statistical power was set at 0.80. With this power level, in combination with $\alpha = 0.05$ and effect sizes for each dependent variable, estimated from pilot data, a required sample size of 22 subjects per group was calculated (20).

Results

The descriptive characteristics of the subjects ($M \pm SD$), HW vs. NHW, were as follows:

- Age (yrs) — 22.8 ± 4.9 vs. 23.0 ± 3.6
- Height (cm) — 164.0 ± 5.1 vs. 161.7 ± 8.2
- Body mass index (kg/m^2) — 22.9 ± 3.0 vs. 21.6 ± 1.6
- Phys. activity index — 34.4 ± 21.7 vs. 43.0 ± 21.2
- Ethnicity — white, 14 vs. 13; black, 0 vs. 1; Hispanic, 8 vs. 6.

There were no significant differences ($p > 0.05$) between groups in height, body mass index, or physical activity level, as measured by the physical activity index (18). All subjects were premenopausal and none were on any special diet during this study. Compliance to training (total no. of sessions attended / total no. of sessions possible) was 94% for both groups. Two subjects were dropped from the NHW group; one withdrew because of a job conflict and the other missed more than 3 training sessions in the first 3 weeks.

Cardiorespiratory Fitness Variables

Pre- and posttraining cardiorespiratory fitness data and combined data for both groups are presented in Table 1. MANOVA results indicated a significant main effect for training (pre vs. post) [Wilks' $\Lambda = 0.38$, $F(3, 37) = 19.4$, $p < 0.01$], demonstrating an improvement in cardiorespiratory fitness over time. However, there was no significant group effect [Wilks' $\Lambda = 0.90$, $F(3, 37) = 1.3$, $p > 0.05$] or group × training interaction [Wilks' $\Lambda = 0.97$, $F(3, 37) = 0.43$, $p > 0.05$]. The main effect of training accounted for 61% of the variance in the discriminant function which combined absolute $\dot{V}O_2$ max, treadmill time, and relative $\dot{V}O_2$ max.

Univariate ANOVAs indicated that training produced significant changes in absolute $\dot{V}O_2$ max [$F(1, 39) = 36.8$, $p < 0.01$], treadmill time [$F(1, 39) = 42.1$, $p < 0.01$], and relative $\dot{V}O_2$ max [$F(1, 39) = 32.7$, $p < 0.01$]. The main effect of training accounted for 48, 52, and 46% of the variance in absolute $\dot{V}O_2$ max, treadmill time, and relative $\dot{V}O_2$ max, respectively. The standardized discriminant function coefficients demonstrated that absolute $\dot{V}O_2$ max ($L \cdot min^{-1}$) and treadmill run time (min) were relatively more important than relative $\dot{V}O_2$ max ($ml \cdot kg^{-1} \cdot min^{-1}$) in characterizing changes in cardiorespiratory fitness from step aerobics.

Body Composition Variables

Pre- and posttraining body composition data are also presented in Table 1. MANOVA indicated a significant main effect for training [Wilks' $\Lambda = 0.60$, $F(2, 38) = 12.5$, $p < 0.01$], demonstrating a decrease in %BF and an increase in FFM over time. However, there was no significant group effect

Table 1
Pre- and Posttesting Measurements

	HW (n = 21)[a]					NHW (n = 20)					Both (n = 41)[b]					
	Pre		Post			Pre		Post			Pre		Post			
	M	±*SD*	*M*	±*SD*	Δ(%)	*M*	±*SD*	*M*	±*SD*	Δ(%)	*M*	±*SD*	*M*	±*SD*	Δ[c]	Δ(%)
Cardiorespiratory Fitness																
$\dot{V}O_2$ ($ml \cdot kg^{-1} \cdot min^{-1}$)	38.1	6.2	40.5	5.9	6.3	36.9	5.2	40.4	4.5	9.5	37.5	5.7	40.5	5.3	3.0*	8.0
$\dot{V}O_2$ ($L \cdot min^{-1}$)	2.33	0.41	2.47	0.37	6.0	2.09	0.36	2.30	0.32	9.8	2.22	0.41	2.39	0.36	0.17*	7.6
Treadmill time (min)	10.2	1.5	10.8	1.5	5.9	10.1	1.3	10.7	1.0	5.9	10.2	1.5	10.8	1.3	0.6*	6.0
HR max (bpm)	198.7	9.0	198.0	10.8	0.3	196.7	7.0	198.3	6.9	0.8	197.8	8.1	198.2	9.1	0.4	0.0
$\dot{V}_E$ ($L \cdot min^{-1}$)	94.9	13.9	98.6	15.7	3.8	90.9	14.0	92.7	16.7	1.9	93.0	13.9	95.8	16.2	2.8	3.0
RER (at $\dot{V}O_2$max)	1.14	0.10	1.16	0.08	1.7	1.18	0.07	1.17	0.06	0.8	1.16	0.09	1.16	0.07	0.0	0.0
Body Composition																
BW (kg)	61.0	8.6	61.0	8.7	0.0	56.6	5.5	56.7	5.7	0.0	58.9	7.5	58.9	7.6	0.0	0.0
%BF (%)	27.1	4.2	26.1	4.3	–3.7	24.4	4.1	22.8	3.6	–6.5	25.7	4.3	24.5	4.3	–1.2*	–4.7
FFM (kg)	44.3	5.5	44.7	5.4	0.9	42.7	4.3	43.7	4.2	2.3	43.5	5.0	44.2	4.8	0.7*	1.6
FM (kg)	16.7	4.3	16.2	4.4	–2.9	13.9	2.9	13.0	2.7	–6.5	15.3	4.0	14.6	4.0	–0.7	–4.5

[a] One univariate outlier removed; [b] Combined data for HW and NHW groups; [c] Absolute difference between pretest and posttest means; *Pretest signif. diff. from posttest, $p < 0.01$.

[Wilks' $\Lambda = 0.85$, $F(2, 38) = 3.3$, $p > 0.05$] or group × training interaction [Wilks' $\Lambda = 0.93$, $F(2, 38) = 1.3$, $p > 0.05$]. The main effect of training accounted for 39% of the variance in the discriminant function which combined %BF and FFM. The standardized discriminant function coefficients showed that %BF and FFM were equally important, but weighted in opposite directions, in the discriminant function. Univariate ANOVAs denoted a significant main effect of training on %BF [$F(1, 39) = 15.9$, $p < 0.01$] and FFM [$F(1, 39) = 12.9$, $p < 0.01$], sharing 29 and 25% of the variance, respectively. These results suggest that %BF and FFM are equally important in characterizing changes in body composition resulting from step aerobics.

Muscular Strength Variables

Pre- and posttraining muscular strength data are presented in Table 2. MANOVA results showed a significant main effect for training [Wilks' $\Lambda = 0.28$, $F(6, 35) = 14.5$, $p < 0.01$], demonstrating an improvement in overall muscular strength over time. However, there was no significant group effect [Wilks' $\Lambda = 0.82$, $F(6, 35) = 1.2$, $p > 0.05$] or group × training interaction [Wilks' $\Lambda = 0.87$, $F(6, 35) = 0.85$, $p > 0.05$]. Thus, changes in muscular strength were similar for both groups. The main effect of training accounted for 71% of the variance in the discriminant function which combined the strength of the shoulder flexors and extensors, shoulder horizontal abductors and adductors, and knee flexors and extensors of the dominant leg.

The standardized discriminant function coefficients denoted that shoulder extension and horizontal abduction strength were most important in the discriminant function, with shoulder flexion and leg flexion strength being moderately important. Univariate ANOVAs denoted a significant effect of training for shoulder flexion [$F(1, 40) = 19.8$, $p < 0.01$], shoulder extension [$F(1, 40) = 66.9$, $p < 0.01$], leg flexion [$F(1, 40) = 38.9$, $p < 0.01$], shoulder horizontal adduction [$F(1, 40) = 31.2$, $p < 0.01$], and shoulder horizontal abduction [$F(1, 40) = 47.4$, $p < 0.01$]. There was no significant change in leg extension strength over time [$F(1, 40) = 2.2$, $p > 0.05$].

The shared variance between training and each strength measure was as follows: shoulder flexion, 33%; shoulder extension, 62%; leg extension, 5.2%; leg flexion, 49%; horizontal shoulder adduction, 44%; and horizontal shoulder abduction, 54%. In short, it appears that upper body strength, especially strength of the shoulder extensors and horizontal abductors, is relatively more important than lower body strength for characterizing changes in strength due to step training.

To document any upper body injuries, a severity level of discomfort grading scale (17) was used. However, no such injuries were reported during the entire study.

Discussion

The results clearly demonstrate that 12 weeks of step training yields significant improvements in cardiovascular endurance, body composition, and upper body strength. The average improvement in relative $\dot{V}O_2$ max for HW (6.3%) and NHW (9.5%) was within the range of 4 to 15% reported in aerobic dance training and step training studies, with and without handweights, for women with similar initial $\dot{V}O_2$ max values (3, 11, 19, 23).

The failure of HW to show a significantly greater improvement in aerobic capacity compared to NHW may be related to the HW training regimen. Typically, pumping the arms energetically during aerobic exercise results in elevated HR (3, 16). Although step training with HW (0.91 kg) increases the energy cost of the activity (15), the average training HR per exercise session of the HW (177 ± 2 bpm) was lower than that of the NHW (183 ± 2 bpm).

This suggests that either the intensity of the HW exercises was not enough to tax the cardiovascular system more than for the NHW group, or the HW subjects maintained their training HR by decreasing leg activity. In this study the HW exercises were controlled, full-range movements instead of vigorous, dynamic arm pumping actions as used in other studies (1). Apparently, these controlled arm movements were not vigorous enough to increase energy expenditure or relative intensity of the aerobic training.

Table 2
Pre- and Posttraining Muscular Strength (N · m) of Training Groups

	HW ($n = 22$)					NHW ($n = 20$)					Both ($n = 42$)[a]					
	Pre		Post			Pre		Post			Pre		Post			
	M	±*SD*	*M*	±*SD*	Δ(%)	*M*	±*SD*	*M*	±*SD*	Δ(%)	*M*	±*SD*	*M*	±*SD*	Δ[b]	Δ(%)
Shoulder																
Horizontal adductors	139.0	30.7	147.7	31.6	6.2	133.8	21.9	143.3	24.3	7.1	136.5	26.7	145.6	28.2	9.1*	6.7
Horizontal abductors	117.2	21.3	128.1	25.1	9.3	117.3	15.9	127.5	18.4	8.6	117.3	18.7	127.8	21.9	10.5*	9.0
Extensors	102.9	23.5	112.2	20.6	9.0	95.6	19.6	108.8	19.1	13.8	99.5	21.8	110.6	19.7	11.1*	11.1
Flexors	72.0	18.2	75.68	17.5	5.1	67.4	15.3	73.5	15.9	9.0	69.8	16.8	74.6	16.6	4.8*	6.9
Knee																
Flexors	64.0	14.1	68.1	12.5	6.4	59.4	12.5	66.6	12.7	12.1	61.8	13.4	67.4	12.4	5.6*	9.1
Extensors	85.6	20.7	86.1	19.6	0.0	79.0	18.6	81.4	15.4	3.0	82.5	19.8	83.9	17.7	1.4	1.7

[a]Combined data for HW and NHW groups; [b]Absolute difference between pretest and posttest means; *Pretest signif. diff. from postttest, $p < 0.01$.

On average, the overall improvement in treadmill run time due to training was 0.6 min. Although the average treadmill run time increased significantly, the relative improvement (6.0%) was less than values of 12 to 14.5% reported for aerobic dance training with and without HW (19), and step aerobic training (23). Lack of standardized treadmill protocols, differences in initial cardiorespiratory fitness levels, and variations in training regimens may account for the disparity in the reported improvements for treadmill run performance.

Interestingly, improvement in cardiorespiratory fitness due to step aerobic training with and without HW was best characterized by changes in treadmill run time and absolute $\dot{V}O_2$ max ($L \cdot min^{-1}$). This may be explained by examining the degree of multicollinearity among the 3 variables included in this construct. Variables that are highly related ($r \geq 0.70$) share a large amount of overlapping variance and therefore are statistically redundant (21). In the present study, treadmill run time was highly related to relative $\dot{V}O_2$ max ($r = 0.82$) but only moderately related to absolute $\dot{V}O_2$ max ($r = 0.51$). Therefore, treadmill run time and absolute $\dot{V}O_2$ max were statistically selected as the most representative variables for characterizing improvements in cardiorespiratory fitness due to step training.

Results from this investigation indicated that changes in body composition were similar for both groups. Overall, there was a small but significant reduction in %BF (–4.7%) due to training. But overall absolute changes were quite small (–1.2% BF and 0.7 kg FFM) and well within the measurement error (±1 to 2% BF) associated with hydrostatic weighing (12). Thus, step aerobic training for 12 weeks, with or without handweights, is not likely to evoke significant changes in body composition.

Step training significantly improved muscular strength in both groups. MANOVA indicated that changes in upper body strength, particularly the shoulder extensors and horizontal abductors, were relatively more important than those in lower body strength for characterizing the effect of step training on overall body strength, regardless of whether handweights were used. The arm choreography in both groups during step aerobics involved shoulder extension and horizontal abduction quite regularly, thereby eliciting a training effect for the upper and lower back muscles. There were no significant differences in average strength gains for the knee extensors and knee flexors of either group. Since the leg choreography was virtually the same for both groups, this result was expected.

However, the lack of significant differences in strength gains in the upper body musculature of both groups was unexpected. Although the use of HW during aerobic activity has been advocated for increasing upper body strength (1), the degree of strength improvement in the horizontal adductors (6 to 7%), horizontal abductors (8 to 9%), extensors (9 to 14%), and flexors (5 to 9%) of the shoulder joint was similar for both groups. The resistance training stimulus for the HW group progressed from 0.91 kg for Weeks 2–4 to 1.36 kg for Weeks 5–8, and to 1.81 kg for Weeks 9–12. This HW resistance was greater than that used in a previous step training study (0.23–0.68 kg), which also reported similar strength gains for both HW and NHW (11).

The lack of a significant difference in strength gains between groups may be due in part to specificity of training and testing. Even though the same muscles may be involved, the transfer of new strength to other movements is not fully substantiated (7). The strength tests in this study involved maximal, isokinetic contractions and therefore may not accurately reflect the effects of low intensity resistance training on muscular function. In addition, although the progression of HW (0.91–1.81 kg) was challenging to the subjects during the step training exercise, the HW stimulus may not have been enough to elicit large strength gains. Perhaps the benefits from the HW regimen would have been better reflected by assessing changes in muscular endurance instead of muscular strength.

This study was the first to systematically document the incidence of upper body injury during step aerobic training with HW. After each training session, subjects reported their level of discomfort. In the course of 12 weeks, training 3 days a week for 30 continuous minutes each session, no upper body injuries were reported for either group.

The use of HW in step training has been discouraged because of the risk of upper body injury and muscle soreness (8). Some subjects have complained of acute pain and soreness in the shoulder muscles during HW energy trials (15) and in initial sessions of aerobic dance with HW (3). Unlike the pumping and swinging movements of the arms used in walking and jogging studies with HW (1), the arm movements in the present study were steady, controlled, and performed in a manner similar to upper body resistance exercise.

This investigation demonstrated that step aerobic training with HW may be effective and safe for healthy women of varying fitness levels. One important concern we addressed was the carefully planned progressive overload of the resistance stimulus, from 0.91 to 1.36 to 1.81 kg. The risk of injury might be increased if an inappropriate progression of HW resistance were prescribed or if heavier loads were used. The fact that all training sessions were closely supervised perhaps also contributed to the lack of injuries. Participants in unsupervised activity would not be afforded this advantage and therefore could be at greater risk of injury. Further study of the risks and benefits of step training with HW is warranted to substantiate the findings of this study.

Based on our observations, we conclude that 12 weeks of step aerobic training, with or without HW, has a positive effect on cardiorespiratory fitness, body composition, and overall muscular strength in healthy women. Also, step training with HW (0.91 to 1.81 kg) does not appear to increase the risk of injury, provided that the upper body exercises are performed in a steady and controlled manner.

Practical Application

Step aerobic training with handweights that do not exceed 2 kg per hand may be effective and safe for healthy women of varying fitness levels. The resistance stimulus should be progressively applied using correct exercise techniques. Slow and controlled arm movements are recommended, minimizing any pumping and swinging motions.

The results of this study reveal that the physiological benefits from step training with handweights compared to without handweights were similar. However, there were no deleterious effects associated with the use of handweights. Therefore, exercise leaders should consider the periodic use of handweights in step training programs to add variety. This may enhance the participants' adherence to an exercise program.

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