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Effects of Home-Based Exercise Training Systems, Combined with Diet, on Cardiometabolic Health

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ABSTRACT

International Journal of Exercise Science 12(2): 871-885, 2019. The efficacy of exercise training systems designed to be used in the home on cardiometabolic outcomes remains largely unknown. This investigation included two studies. Study 1 tested the effects a multi-exercise pulley system (NordicTrack Fusion CST with video trainer) and Study 2 an incline trainer (NordicTrack X22i with video trainer), both combined with daily food provision, for 12-weeks on indices of cardiometabolic health. Study 1 enrolled 27 adults (11 men, 16 women, 33.8±4.4 years of age) and Study 2 enrolled 29 adults (11 men, 18 women, 40.8±12.5 years of age). Pre- and post-intervention measurements were performed for body weight, fat mass, lean tissue mass, and visceral fat by dual energy x-ray absorptiometry, blood pressure, aerobic fitness and body circumferences. For Study 1, there were significant decreases in body weight, fat mass, visceral fat, diastolic blood pressure (DBP), resting heart rate (RHR), and all circumference sites, while there was an increase in aerobic fitness (all $p<0.001$). Both males and females exhibited significant improvement in all these outcomes. For Study 2, there were significant decreases in body weight, fat mass, visceral fat, DBP, RHR, all circumference sites (all $p<0.001$), and lean tissue mass (LTM) ($p=0.006$), and an increase in aerobic fitness ($p<0.001$). Both males and females exhibited significant changes in all these outcomes, except LTM which did not change in females. Both studies exhibited high exercise session attendance and high dietary adherence. Overall these data indicate the potential efficacy of home-based training systems, when combined with diet, on selected cardiometabolic outcomes.

KEY WORDS: Physical activity, cardiovascular disease, aerobic training, resistance training

INTRODUCTION

It is well-understood that chronic diseases linked to physical inactivity and diet are the leading causes of death (3, 4, 17), and the effects of diet and exercise interventions to improve cardiometabolic health and lower chronic disease risk are well-known (16, 17). The positive effects of both aerobic and resistance training to reduce both risk factors for and risk of various chronic diseases such as coronary artery disease, hypertension, type 2 diabetes and other diseases are well understood (3, 4, 17).

For resistance training, much of the research performed to date on the impact of structured programs on cardiometabolic health has been executed in commercial gym settings or in laboratories with access to commercial gym equipment (both stand-alone machines and free weight equipment). For aerobic training, interventions have often utilized conventional treadmills with low-maximum incline capacities (generally 10-15% incline). Recently, treadmills with high-maximum incline capabilities, referred to as incline trainers, with maximum incline capacities of up to 40%, have been developed, in part, to increase caloric expenditure rate during exercise. Additionally, with technology advances, in-home gyms and virtual video trainers are becoming more abundant. However, very little is known regarding the efficacy of home-based exercise equipment and their effects on indices of health.

The present studies investigated the effects of two home-based exercise training devices, using a 12-week progressive exercise program combined with dietary provision, on selected indices of cardiometabolic health. These investigations were conducted in two studies that were designed and carried out separately. *Study 1* tested the effects a multi-exercise pulley system (NordicTrack Fusion CST with video trainer) and *Study 2* an incline trainer (NordicTrack X22i with video trainer). It was hypothesized that the exercise training programs using these training systems, combined with diet would improve variables related to cardiometabolic health, including anthropometrics, aspects of body composition, blood pressure and aerobic fitness.

METHODS

Participants

Study 1 included 28 adults, age 27-61 years of age and Study 2 included 29 adults, age 24-64 years of age. In both studies, subjects participated in a 12-week diet and exercise intervention. Screening was performed by MegaMace Productions (Los Angeles, CA). Enrollment was open to men and women and all ethnicities were eligible. All subjects were consented prior to study enrollment and all study protocols were approved by the BYU-Idaho Institutional Review Board and were performed according to the Declaration of Helsinki. Subjects enrolled were not compensated to participate in the study, however were offered the opportunity to purchase their training system at a discount at the end of the study.

Protocol

Study 1: The 12-week training program was a standardized, progressive exercise program on the NordicTrack Fusion CST multi-exercise pulley system with video trainer (Icon Health and Fitness, Logan, UT), with training bout videos (iFit technology, Icon Health and Fitness, Logan, UT) used to guide the training sessions. The training included two separate workouts, each performed three days per week (M, W, F and T, TH, SA respectively), which incorporated exercises for all major muscle groups as demonstrated by the virtual trainer. Exercise selection was modified weekly and resistance was progressively increased during the program. Each workout was preceded by a warmup period of 5 to 10-minutes (generalized mobility exercises), followed by a workout of approximately 30 minutes duration.

Study 2: The 12-week training program was a standardized, progressive exercise program on the NordicTrack X22i Incline Trainer with video trainer (Icon Health and Fitness, Logan, UT), with training bout videos (iFit technology, Icon Health and Fitness, Logan, UT), used to guide the training sessions. The training program included three phases of four weeks each, with progressions to account for improvements in fitness during the program. Workouts were performed six days per week (M-SA) and incorporated use of the treadmill as well as use of adjustable 2.5-25 lb dumbbells included with the system. Exercise intensity progression was modified in each phase. The workout structure included a warmup period of 5 to 10-minutes (generalized mobility exercises), followed by a workout period including use of both the incline trainer and accompanying dumbbells for 25-50 minutes depending on phase and day.

In both studies, to facilitate compliance, all training sessions were supervised by an on-site certified personal trainer and performed in a group setting to assist in recording compliance and record keeping. If a subject was unable to perform an activity at the prescribed intensity during part of a workout, the trainer allowed slight modifications to the intensity to allow the participant to complete the workout.

Description of Dietary Intervention: The studies were conducted under stringent dietary conditions, utilizing a controlled-feeding model with prepackaged meals to reduce dietary noncompliance and provide a higher degree of precision and accuracy than is possible in human trials using only three-day food records and free eating (19). All meals and snacks were provided by California Chef Inc. (Los Angeles CA) and based on participants basal metabolic rate (14) and daily activity of the training to elicit a net caloric deficit of approximately 500 kcal/day. For beverages, which were not provided, subjects were allowed calorie free beverages such as water, calorie free flavored waters, tea and coffee. All participants were instructed on diets at the outset and these dietary instructions were reinforced weekly by the study coordinator to encourage the study participants to follow the dietary protocol. The prepared meals and snacks had a macronutrient breakdown of approximately 36% carbohydrate, 26% fat and 38% protein, with two males on a vegan diet with a breakdown of 50% carbohydrate, 25% fat and 25% protein. As part of the daily food provision, subjects were provided a post-exercise iFit Nourish beverage (iFit, Icon Health and Fitness, Logan, UT) which was recommended to be consumed upon workout completion and contained 160 kcal, 2 grams of fat, 4 grams of carbohydrate and 30 grams of protein. Dietary compliance was verified by completion of a daily menu checklists in which subjects checked off each item as eaten, recording of discretionary items and additional foods. Additionally, weekly contact with the research coordinator was included to verify compliance, tolerance to the research diet, and to identify any adverse effects from the dietary intervention. Adherence was also estimated using the model of Windhauser et al. (19). In brief, three levels of adherence were estimated, highly adherent (little or no deviation from the study diet), minor nonadherence (less than a full serving of two study foods missed or less than two non-study food servings consumed), and greater than minor nonadherence (more than one full serving, or partial servings of three or more foods were missed or consumed).

Visit Procedures: Measurements were performed for both studies at baseline (pre-intervention) and at the end of week 12 (post-intervention), with each test period consisting of one visit. To control for any acute effects of the training program, the post visits occurred approximately 48 hours after the last training session. All measures were performed in the morning in the fasted state. Verbal confirmation of adherence to the aforementioned criteria was obtained immediately prior to testing.

Anthropometry: Height and weight were determined in duplicate using a Seca 700 (Seca North America, Chino, CA) mechanical scale with stadiometer. For weight, subjects removed all unnecessary clothing, jewelry, glasses, etc., and recorded in pounds to the nearest 0.1 lbs. For height, the stadiometer with a fixed angle was used and height is recorded to the nearest 0.5 cm with the subject instructed to stand as straight as possible with feet flat on the floor. Height and weight were used to calculate body mass index (BMI, in kg/m^2). Circumference measurements were performed at the arm, chest, waist, hips, and thigh on the left side using standard procedures using a Gulick II tape measure (model 67020) (1, 5).

Blood Pressure: Seated blood pressure and resting heart rate were measured in duplicate on the bare left arm after subjects had rested quietly for a minimum of 5 minutes using an Omron HEM-907XL automated cuff system (Vernon Hills, IL). Subjects were asked not to talk, engage their cell phone or cross their legs during this time. Cuff sizes (small adult, adult and large adult) were used as determined by visual arm circumference. The same arm and cuff size were used for all measurements. Based on systolic and diastolic blood pressure, mean arterial pressure was calculated.

Body Composition: Body mass, fat mass, visceral fat, lean tissue mass (LTM) and lean body mass (LBM) were determined via dual energy x-ray absorptiometry scan (Lunar Prodigy from GE) by BodySpec Inc. (Los Angeles, CA) pre- and post-intervention. The scanner was calibrated daily prior to any scans. Subjects were scanned in the morning in the fasted state.

Cardiorespiratory Fitness: The Astrand and Rhyming submaximal exercise test (2), a surrogate for aerobic capacity, was performed using a Monark 828E ergometer (Vansbro, Sweden) pre- and post-intervention. In brief, the subject's weight was used to estimate the load (in kiloponds, kp) by multiplying kp to kg weight (0.04 kp × kg) and rounding to the nearest 0.5 kp. A 6-minute test was performed maintained a pedal cadence of 50 RPM, with the first 2 minutes performed as unloaded cycling. Subsequently, a load was placed to maintain a heart rate between 120 and 170 bpm using a Monark heart rate monitor (1). If the load determined by weight did not allow for a heart rate in this range, the load was adjusted accordingly. Using the heart rate and watts recorded at the 5 and 6-minute time points (or minutes 6 and 7 if the heart rate deviated by >10 beats per minute in minutes 5 and 6), along with the Astrand-Rhyming nomogram and age correction factors, absolute maximum oxygen consumption (Vo_{2max}, L/min) was estimated. From this relative Vo_{2max} (mL/kg/min) was calculated.

Statistical Analysis

Power analyses were conducted for *Study 1* and *Study 2* with G*Power 3.1 (Universitat Kiel, Germany), and for both estimated 19 participants for a power of 0.80, with an effect size of 0.8 and an $\alpha = 0.01$ for the primary outcome of fat mass. Statistical analyses were performed with

Graph Pad Prism (GraphPad, San Diego, CA). Descriptive statistics (mean and standard deviation) for variables were generated by group (entire cohort, males, females). Comparisons within group between pre- vs. post-intervention and change scores between male and females were analyzed using a linear mixed model for repeated measures based on normally distributed data. All data are expressed as mean ± SD unless otherwise noted. A p value of ≤ 0.01 was considered statistically significant.

RESULTS

Study 1: All subjects who completed the study (N=27, 11 men, 16 women, 33.8±4.4 years of age) maintained >85% compliance, as was used by Donnelly et al. (7). One subject was unable to complete the study due to missed sessions. Exercise compliance for those that completed the study was 94.0%. For dietary adherence, self-report was as follows: 92.2% of the days were reported as highly adherent, with 4.1% of days with minor nonadherence and 3.7% with greater than minor nonadherence.

After 12 weeks of diet and exercise, significant decreases in body weight, fat mass, visceral fat and body fat percentage were noted (all p<0.0001, Table 1). There were non-significant changes in LBM (p=0.08) and LTM (p=0.08). Arm, chest, waist, hip and thigh circumference measurements all decreased in response to the intervention (all p<0.0001, Table 1).

Table 1: Effects of NordicTrack Fusion CST Trainer, Combined with Diet on Cardiometabolic Outcomes. Data is

	Pre	Post	Change	p-value
Body Weight (kg)	74.4±11.8	68.3±11.5	6.2±3.9	**<0.0001**
Fat Mass (kg)	24.0±5.7	17.2±5.2	6.8±3.2	**<0.0001**
BMI (kg/m²)	25.0±2.5	22.6±2.8	2.4±1.4	**<0.0001**
Lean Tissue Mass (kg)	47.8±10.1	48.4±10.6	0.6±1.8	0.08
Lean Body Mass (kg)	50.4±10.5	51.0±11.0	0.6±1.8	0.08
Body Fat (%)	32.5±7.1	25.6±7.1	6.9±3.2	**<0.0001**
VAT (gm)	484.1±338.2	301.1±257.7	183.0±160.1	**<0.0001**
Systolic Pressure (mmHg)	117.1±10.9	113.7±9.7	3.4±9.7	0.03
Diastolic Pressure (mmHg)	76.5±9.3	68.6±9.4	7.9±7.5	**<0.0001**
MAP (mmHg)	90.0±9.2	84.5±9.5	5.5±7.6	**0.0004**
Resting Heart Rate (bpm)	69.2±10.8	62.2±10.8	7.0±7.8	**<0.0001**
Vo_{2max} (L/min)	2.64±0.75	3.14±0.92	0.5±0.59	**0.001**
Relative Vo_{2max} (mL/kg/min)	35.4±8.2	45.7±11.0	10.2±8.4	**<0.0001**
Arm Circumference (cm)	31.1±2.9	29.0±3.2	2.1±1.4	**<0.0001**
Chest Circumference (cm)	97.0±7.2	92.6±8.3	4.4±3.9	**<0.0001**
Waist Circumference (cm)	84.8±8.2	76.1±7.7	8.7±4.3	**<0.0001**
Hip Circumference (cm)	103.3±5.3	96.1±5.4	7.2±3.2	**<0.0001**
Thigh Circumference (cm)	60.5±4.3	56.7±4.6	3.8±2.5	**<0.0001**

reported as mean ± SD. Significant p-values are noted in bold. VAT, visceral adipose tissue; MAP, mean arterial pressure; Vo_{2max}, maximum oxygen consumption; BMI, body mass index. Significant effects are noted in bold.

As noted in Table 1, after the intervention, a significant decrease in diastolic blood pressure (p<0.0001) was noted, and there was a trend for a decrease in systolic blood pressure (p=0.03), leading to a decrease in mean arterial pressure (p=0.0004). In addition, there was a significant decrease in resting heart rate ($p<0.0001$). Estimated absolute ($p=0.001$) and relative ($p<0.0001$) Vo_{2max} increased.

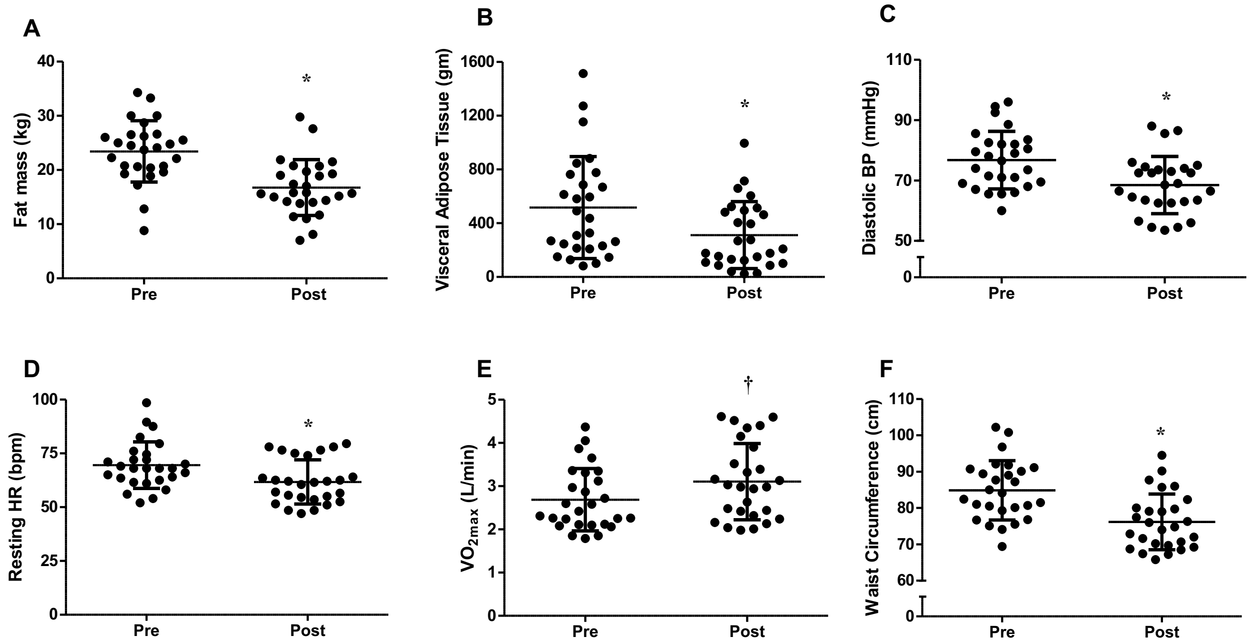

Figure 1: Effects of NordicTrack Fusion CST Trainer, Combined with Diet on Cardiometabolic Outcomes. Data is reported as mean ± SD. Effects of a 12-week home-based resistance exercise and diet intervention on fat mass (Panel A), visceral fat (B) diastolic blood pressure (C), resting heart rate (D), Vo_{2max} (E), and waist circumference (F). p-values for group comparisons are represented as: †p=0.001; *p<0.001.

Gender differences for the entire cohort are displayed in Table 2. Males (N=11, 94.0% of sessions completed; 96.4% of the days were reported as highly adherent, with 1.9% of days with minor nonadherence and 1.6% with greater than minor nonadherence) exhibited significant changes in all phenotypes (all $p\leq0.01$), except for no significant increase in LTM ($p=0.13$) or LBM ($p=0.13$), and a trend for a decrease in systolic blood pressure ($p=0.02$). Females (N=16, 94.1% of sessions completed; 89.4% of the days were reported as highly adherent, with 5.6% of days with minor nonadherence and 5.1% with greater than minor nonadherence) noted similar effects, except for no changes in LTM ($p=0.40$), LBM ($p=0.42$) or systolic blood pressure ($p=0.40$). When comparing the difference in effect between gender, changes in outcomes were not statistically different, however visceral fat loss change trended to decrease more in males than in females ($p=0.02$).

Table 2: Effects of NordicTrack Fusion CST Trainer, Combined with Diet in Males and Females. Data is reported as mean ± SD. Significant p-values are noted in bold. p-value[a], p-value of the group comparison (baseline vs. final) for males and females, respectively; p-value[b], p-value of the between-group comparison for change between males and females. BW, body weight; BMI, body mass index; LTM, lean tissue mass; LBM, lean body mass; VAT, visceral adipose tissue; SBP, systolic blood pressure; DBP, diastolic blood pressure; MAP, mean arterial pressure; RHR, resting heart rate; Vo_{2max}, maximum oxygen consumption; Circ, circumference.

	Males		[a]**p-value**	**Females**		[a]**p-value**	[b]**p-value**
	Pre	**Post**		**Pre**	**Post**		**M vs F**
BW (kg)	84.5±10.5	78.5±10.5	**0.004**	67.2±6.9	61.5±7.8	**<0.001**	0.57
BMI (kg/m²)	25.8±2.6	24.0±2.8	**0.004**	24.1±2.3	21.6±2.7	**<0.001**	0.49
Fat Mass (kg)	23.1±8.4	15.6±6.9	**<0.001**	23.7±4.1	17.8±4.5	**<0.001**	0.12
LTM (kg)	58.2±6.9	59.8±7.2	0.13	41.1±4.9	41.4±5.2	0.40	0.18
LBM (kg)	61.4±7.3	62.9±7.6	0.13	43.5±5.1	43.8±5.4	0.43	0.18
Body Fat (%)	27.0±8.5	19.6±7.1	**<0.001**	35.2±4.4	28.7±5.0	**<0.001**	0.32
VAT (gm)	703.4±436.0	435.8±317.3	**0.003**	334.7±183.1	207.1±175.0	**0.001**	0.02
SBP (mmHg)	122.9±7.3	117.9±7.5	0.02	112.9±8.6	110.8±10.0	0.40	0.17
DBP (mmHg)	81.5±9.7	70.9±8.5	**<0.001**	72.9±8.2	66.2±10.4	**0.004**	0.19
MAP (mmHg)	95.3±8.2	88.0±8.8	**0.005**	86.2±7.7	81.6±9.6	**0.03**	0.23
RHR (bpm)	68.5±9.0	63.1±11.7	**0.01**	68.8±11.7	61.3±10.8	**0.002**	0.85
Vo_{2max} (L/min)	2.97±0.96	3.38±1.02	0.05	2.46±0.57	2.95±0.80	**0.01**	0.48
Vo_{2max} (mL/kg/min)	35.2±10.9	43.4±13.3	**0.01**	36.8±8.4	47.4±10.6	**<0.001**	0.33
Arm Circ (cm)	33.2±3.5	31.5±3.6	**0.002**	29.7±2.0	27.5±2.4	**<0.001**	0.61
Chest Circ (cm)	102.8±5.9	99.3±6.7	**0.004**	93.3±5.7	88.1±6.9	**<0.001**	0.57
Waist Circ (cm)	90.9±9.2	81.9±7.8	**<0.001**	80.7±5.7	72.6±6.0	**<0.001**	0.43
Hip Circ (cm)	102.9±5.7	97.1±5.4	**<0.001**	102.8±5.4	95.1±5.7	**<0.001**	0.40
Thigh Circ (cm)	59.3±4.5	56.2±4.9	**0.007**	60.4±4.2	56.5±4.8	**<0.001**	0.64

Study 2: All subjects who completed the study (N=24, 9 men, 15 women, 40.8±12.5 years of age) maintained >85% compliance, as was used by Donnelly et al. (7). Five subjects (2 men, 3 women) were unable to complete the study; two due to missed sessions, two to job obligations, and one due to reporting an inability to continue the program. Exercise compliance for those that completed the study was 92.6%. For dietary adherence, self-report was as follows: 93.3% of the days were reported as highly adherent, with 4.1% of days with minor nonadherence and 2.6% with greater than minor nonadherence.

After 12 weeks of diet and exercise, significant decreases in body weight, fat mass, visceral fat and body fat percentage were noted (all $p<0.0001$, Table 3). There were also statistically significant decreases in LBM ($p=0.004$) and LTM ($p=0.006$), however leg LTM did not decrease ($p=0.020$). Arm, chest, waist, hip and thigh circumference measurements all decreased in response to the intervention (all $p<0.0001$, Table 3).

Table 3: Effects of NordicTrack X22i Incline Trainer, Combined with Diet on Cardiometabolic Outcomes. Data is reported as mean ± SD. Significant p-values are noted in bold. VAT, visceral adipose tissue; MAP, mean arterial pressure; Vo_{2max}, maximum oxygen consumption; BMI, body mass index. Significant effects are noted in bold.

	Pre	Post	Change	p-value
Body Weight (kg)	91.0±16.1	82.0±12.7	9.1±5.3	**<0.0001**
BMI (kg/m²)	30.5±4.7	27.6±3.9	2.9±1.7	**<0.0001**
Fat Mass (kg)	36.0±9.8	28.1±8.5	7.9±4.2	**<0.0001**
Lean Tissue Mass (kg)	52.2±9.8	51.1±8.9	-1.2±1.9	**0.006**
Leg Lean Tissue Mass (kg)	18.5±3.9	18.2±3.3	-0.2±0.9	0.02
Lean Body Mass (kg)	55.0±10.2	53.8±9.3	-1.2±1.9	**0.004**
Body Fat (%)	39.1±6.8	34.0±7.5	5.1±2.5	**<0.0001**
VAT (gm)	1249.6±783.3	848.9±579.9	400.8±344.7	**<0.0001**
Systolic Pressure (mmHg)	117.2±12.8	115.5±10.9	1.7±7.8	0.03
Diastolic Pressure (mmHg)	78.7±8.8	72.6±6.3	6.1±6.7	**0.0002**
MAP (mmHg)	91.5±9.6	87.9±7.6	3.6±5.8	**0.005**
Resting Heart Rate (bpm)	71.3±12.1	63.1±11.5	8.2±9.0	**0.0002**
Vo_{2max} (L/min)	2.41±0.54	2.84±0.53	0.4±0.4	**<0.0001**
Relative Vo_{2max} (mL/kg/min)	26.9±6.8	35.0±7.9	8.1±6.1	**<0.0001**
Arm Circumference (cm)	35.2±4.4	32.2±3.7	3.0±1.5	**<0.0001**
Chest Circumference (cm)	109.0±9.0	102.7±8.0	6.3±3.7	**<0.0001**
Waist Circumference (cm)	99.9±12.3	89.2±9.5	10.7±5.7	**<0.0001**
Hip Circumference (cm)	113.7±9.6	105.5±7.9	8.2±3.8	**<0.0001**
Thigh Circumference (cm)	66.0±6.6	61.6±5.5	4.4±2.6	**<0.0001**

As noted in Table 3, after the intervention, a significant decrease in diastolic blood pressure ($p=0.0002$) was noted, and there was a trend for a decrease in systolic blood pressure ($p=0.03$), leading to a decrease in mean arterial pressure ($p=0.005$). In addition, there was a significant decrease in resting heart rate ($p=0.0002$). Estimated absolute ($p<0.0001$) and relative ($p<0.0001$) Vo_{2max} increased.

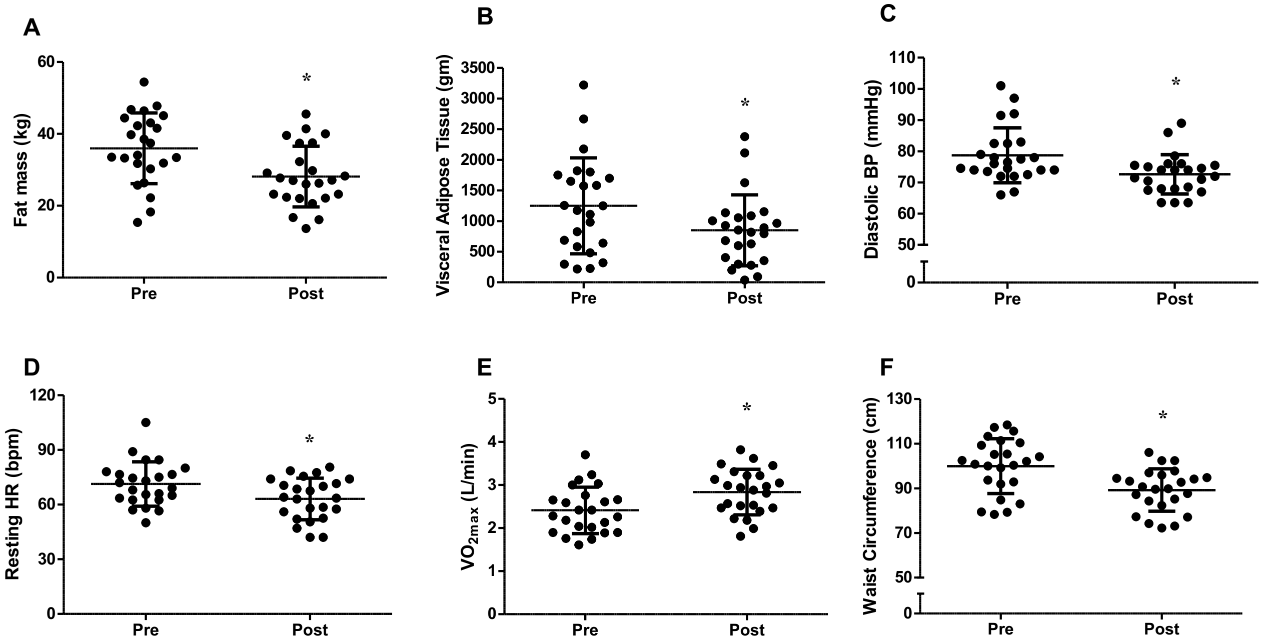

Figure 2. Effects of NordicTrack X22i Incline Trainer, Combined with Diet on Cardiometabolic Outcomes. Data is reported as mean ± SD. Effects of a 12-week home-based incline trainer and diet intervention on fat mass (Panel A), visceral fat (B) diastolic blood pressure (C), resting heart rate (D), Vo_{2max} (E), and waist circumference (F). p-values for group comparisons are represented as: *p<0.001.

Gender differences for the entire cohort are displayed in Table 4. Males (N=9, 93.4% of sessions completed; 95.6% of the days were reported as highly adherent, with 2.8% of days with minor nonadherence and 1.6% with greater than minor nonadherence) exhibited significant changes in all phenotypes (all p≤0.01), except for systolic blood pressure (p=0.078). Females (N=15, 92.2% of sessions completed; 94.8% of the days were reported as highly adherent, with 2.2% of days with minor nonadherence and 2.9% with greater than minor nonadherence) noted similar effects, except did not exhibit decreases in LTM (p=0.31) or LBM (p=0.24) noted in males or decreases in systolic blood pressure (p=0.40) and mean arterial pressure (p=0.15). When comparing the difference in effect between gender, males exhibited greater decreases body weight (p<0.001), fat mass (p=0.003), LTM (p=0.01), body fat percentage (p=0.001), VAT (p<0.001), waist girth (p=0.001) and BMI (p=0.006), as well as a trend for a greater decrease in leg LTM (p=0.02).

Table 4: Effects of NordicTrack X22i Incline Trainer, Combined with Diet in Males and Females. Data is reported as mean ± SD. Significant p-values are noted in bold. p-value[a], p-value of the group comparison (baseline vs. final) for males and females, respectively; p-value[b], p-value of the between-group comparison for change between males and females. BW, body weight; BMI, body mass index; LTM, lean tissue mass; LBM, lean body mass; VAT, visceral adipose tissue; SBP, systolic blood pressure; DBP, diastolic blood pressure; MAP, mean arterial pressure; RHR, resting heart rate; Vo_{2max}, maximum oxygen consumption; Circ, circumference.

	Males		**[a]p-value**	**Females**		**[a]p-value**	**[b]p-value**
	Pre	**Post**		**Pre**	**Post**		**M vs F**
BW (kg)	101.3±12.0	88.0 ± 9.1	**<0.001**	84.9±15.4	78.4±13.5	**<0.001**	**<0.001**
BMI (kg/m²)	31.5±3.0	27.4±2.2	**<0.001**	29.9±5.5	27.7±4.7	**<0.001**	**0.006**
Fat Mass (kg)	35.6±6.8	24.6±4.5	**<0.001**	36.3±11.5	30.2±9.7	**<0.001**	**0.003**
LTM (kg)	62.5±6.8	60.2±5.7	**0.003**	46.0±4.6	45.6±5.1	0.31	**0.01**
Leg LTM (kg)	22.1±3.0	21.3±2.2	0.06	16.3±2.6	16.4±2.5	0.63	0.02
LBM (kg)	65.7±7.2	63.4±6.1	**0.003**	48.6±4.9	48.1±5.4	0.24	0.02
Body Fat (%)	34.9±4.0	27.9±3.2	**<0.001**	41.7±7.0	37.7±6.8	**<0.001**	**0.001**
VAT (gm)	1797.5±731.6	1061.1±580.6	**<0.001**	920.9±627.2	721.5±560.0	**0.003**	**<0.001**
SBP (mmHg)	124.2±11.62	119.7±11.52	0.078	113.0±11.9	113.1±10.1	0.99	0.17
DBP (mmHg)	81.06±11.85	70.78±7.886	**0.006**	77.3±6.5	73.7±5.1	**0.005**	0.014
MAP (mmHg)	95.4±11.6	88.5±8.9	0.015	89.2±7.6	87.6±7.0	0.15	0.025
RHR (bpm)	66.1±9.2	55.7±10.7	**0.002**	74.5±12.9	67.6±9.7	**0.018**	0.38
Vo_{2max} (L/min)	2.51±0.47	3.15±0.46	**<0.001**	2.35±0.58	2.65±0.49	**0.028**	0.07
Vo_{2max} (mL/kg/min)	25.0±4.5	35.5±6.7	**<0.001**	28.1±7.8	34.7±8.7	**0.002**	0.14
Arm Circ (cm)	37.2±2.7	33.5±2.7	**<0.001**	34.0±4.9	31.4±4.1	**<0.001**	0.08
Chest Circ (cm)	111.9±6.0	103.6±4.6	**<0.001**	107.3±10.2	102.2±9.6	**<0.001**	0.03
Waist Circ (cm)	108.0±7.7	92.8±6.7	**<0.001**	95.1±12.1	87.0±10.5	**<0.001**	**0.001**
Hip Circ (cm)	111.5±6.7	103.2±5.0	**<0.001**	115.1±10.9	106.9±9.1	**<0.001**	0.93
Thigh Circ (cm)	65.8±5.4	60.2±4.7	**<0.001**	66.1±7.4	62.4±5.9	**<0.001**	0.08

DISCUSSION

The effects of exercise programs utilizing equipment designed for home use is largely unknown. The present investigation set out to determine changes in selected indices of cardiometabolic health in two separate investigations using training systems designed for home use, a multi-exercise pulley system (NordicTrack Fusion CST) and an incline trainer (NordicTrack X22i Incline Trainer), combined with video trainer and dietary provision for 12 weeks. The primary findings of both *Study 1* and *Study 2* demonstrate that the 12-week interventions improve variables related to cardiometabolic health, including fat mass and visceral fat, diastolic and mean blood pressure, resting heart rate and aerobic fitness. Although not powered for gender effects, the effects of the intervention were largely noted in both males and females. Overall, these data indicate the potential efficacy of home-based training systems equipped with video trainers, when combined with diet, on selected cardiometabolic outcomes.

Study 1: Studies using home-based exercise resistance training systems are limited. Plotnikoff et al. (15) did note in that obese subjects with type 2 diabetes who performed a supervised resistance training program three days per week on a multi-gym apparatus at home did not result in changes in body weight, BMI, waist circumference and blood pressure, despite increases in muscle strength. It is possible that the lack of effect for these variables was associated, in part, with the lack of dietary intervention, suggesting that to maximize the effects of lifestyle modification both exercise and diet intervention is needed. Furthermore, these subjects did not lose fat mass or gain lean mass (15), which differed from the present study, where decreases in total and visceral fat were noted, despite much lower baseline fat mass, while LTM was maintained. The present study incorporated six, ~30 min training sessions per week, while subjects in the Plotnikoff et al. study performed three training sessions per week (duration was not reported). Other studies have also investigated the effects of home-based training, although these training programs have often used dumbbells and/or ankle weights to provide the training stimulus, rather than a multi-component training system, which may not have allowed a training overload necessary to maximize the training effects. In a pair of studies, Dunstan et al. (8, 9) investigated the effects of both gym-based and home-based training in subjects with type 2 diabetes. In the first, home-based training after a period of supervised gym-based training was not sufficient to induce changes in body weight, fat mass or glycemic indices (8). The lack of effects may have been, at least in part, due to a lack of adequate dietary control (dietary prescription in the gym-based phase, no control in home-based phase). In the second (9), home-based training (using a single dumbbell with weight plates) after a period of laboratory-based training was not sufficient to maintain modest HbA1c effects in subjects with type 2 diabetes. Thus, in the present study, several factors, including the continued supervision throughout, the higher training stimulus and the dietary control likely contributed to the effects noted.

The decreases in fat mass and visceral fat with resistance exercise-type training are not surprising, although it often also results in an increase in LTM. Phillips' group has demonstrated that higher protein intakes during energy deficits facilitate maintenance (12) and potentially even an increase in LBM (13) when combined with training. Additionally, for visceral fat, which is highly correlated with greater risk of cardiometabolic diseases (18), the >30% decrease may be of clinical significance. Furthermore, the circuit-based nature of the training videos suggests a greater cardiovascular stimulus than conventional resistance training programs. The increase in aerobic fitness noted in the present study supports this contention.

Study 2: Studies using high-elevation treadmills are very limited, as previous research has focused on incline exercise on conventional treadmills that typically allow grades of up to 10-15%. A major rationale for the use of incline trainers is the increased caloric expenditure associated with increased inclines. This may be related to the increased activation of leg muscle groups at higher inclines, secondary to the increased intensity of exercise. Franz and Kram (10) noted that activation of hip, knee and ankle extensor muscle groups increased as treadmill grade increased from 0% to 9%, an effect that was enhanced as walking speed increased. It is possible that these effects are enhanced with increased treadmill grades up to 40% as employed in this study.

Regarding specific outcomes related to the intervention, the incline trainer program appeared to be efficacious, as noted by the ~18% improvement in the surrogate measure of maximum aerobic fitness. The modest, yet significant decrease in LTM in the whole cohort, driven by the decrease in males, is not surprising given the significant prescribed caloric deficit designed to increase fat mass loss. It is possible that LTM loss may have been greater with a diet containing less protein than that used in the present study. The maintenance of leg LTM despite an overall decrease in whole body LTM suggest that high incline treadmill training may be sufficient to maintain leg LTM during caloric deficit. The fat mass loss that was noted also occurred for VAT, and an ~30% decrease may be of clinical significance, given the aforementioned association with chronic disease risk (18).

As noted, these two interventions included prepared daily meal components, and published results on participant adherence in controlled feeding studies are limited. However, one study suggested that nonadherence was not a problem in outpatient, controlled feeding studies and the investigators considered episodes of nonadherence minor and insufficient to influence the study results (6). Furthermore, adherence scores noted in the present study are comparable to the Dietary Approaches to Stop Hypertension trial (19), which was used as the model for adherence calculations. Minor deviations in compliance were not surprising given that equations used for determination of basal energy requirements are generalized and numerous factors contribute to daily energy requirements. In addition, several subjects went out of town for a variety of reasons, and although the food logs were used to help determine what to consume, without having the meals with them led to greater than minor noncompliance on those days. Overall, it is likely that the high dietary compliance contributed to the efficacy of the intervention.

It is important to note that the effects of these interventions may have been due, in part, to other aspects of the intervention. For example, as discussed above, the provision of all meals and snacks, a practice that is becoming more commonplace in society, may have facilitated adherence to the diet. Additionally, studies suggest that supervised training may enhance training benefits (11). For example, the resistance training study mentioned above suggested home-based training after a period of supervised gym-based training was not sufficient to maintain cardiometabolic changes (8), an effect that may have also been influenced by the removal of a healthy eating plan prescription and dietician advice in home-based phase that had been part of the supervised phase. Furthermore, it is important to note that these interventions included the use of technology through video trainers that were used during each workout. It is unknown to what degree the video components contributed to the effects, and future studies may compare the impact of video trainers on outcomes. Thus, in the present studies, several factors, including the continued supervision throughout, the higher training stimulus, the dietary controls and the video components likely influenced the effects noted.

There are limitations of the current work that warrant consideration. First, these interventions were only for 12 weeks and although demonstrated efficacy, as with any short-term intervention, sustainability can be a major obstacle to long-term efficacy. Although home-based equipment may provide an aspect of convenience, the ability to maintain long-term adherence is unknown. A second limitation is that the training programs were not performed individually in the home, but in group-based settings to facilitate oversight, so it is not known whether performing the training in the home would yield similar effects. Nevertheless, the feasibility in the home, along with the level of interest and cost-benefit analysis (equipment price and home space logistics) of delivering this program compared with clinical and community-based fitness settings appears warranted. Third, as noted, the provision of prepared meals may have contributed to the effects noted, and whether the same effects would be noted when subjects prepare their own meals is unknown. Finally, it should be reiterated that the study was originally designed to be powered for group effects, and therefore it is possible that some outcomes may have been underpowered for gender effects.

Overall these data indicate the potential efficacy of two different home-based exercise training systems with video training technology, when combined with diet, on selected cardiometabolic outcomes. It is not suggested that these home-based programs should replace traditional gym programs, as for some, commercial gyms may be less expensive and provide a social environment for exercise. Rather it may be considered as another potential exercise training strategy to improve cardiometabolic health. Future research should be performed to compare the efficacy of these training systems in a randomized trial, as well as investigate the home-based nature, the effects in the absence of supervision and the impact of a self-selected diet in this context.

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