Journal of Physical Activity Research, 2017, Vol. 2, No. 2, 85-94
Available online at http://pubs.sciepub.com/jpar/2/2/4

DOI:10.12691/jpar-2-2-4

Effects of a 16-week Worksite Exercise Program on Physical Activity, Sedentary Behavior, and Fitness Variables

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Abstract The purpose of this investigation was to assess effectiveness of a 16-week worksite exercise intervention on subjective and objective measures of physical activity, sedentary behavior, and changes in fitness-related variables in employees at a major university. Employees enrolled in either a 16-week, 3d/week exercise Intervention (N= 47, n = 38 females), or a Control group (N = 15, n = 11 females). Groups wore a validated physical activity monitor which provided visual feedback regarding physical activity behavior. Participants completed surveys assessing subjective physical activity and sedentary behavior, and completed fitness testing at weeks 1, 8, and 16. Data were analyzed by group across the three time points using an ANOVA while Pearson's Correlations assessed change scores pre to post. Both groups met recommended physical activity guidelines, significantly increased cardiorespiratory fitness (p = 0.01) and abdominal curl-up repetitions (p < 0.001) over the 16-weeks. The Intervention group achieved a significant reduction (p = 0.003) in sedentary behavior and a significant increase in push-up repetitions ($p \leq 0.02$ for all time points). Changes in sedentary behavior were negatively associated with changes in cardiorespiratory fitness (r = - 0.3, p = 0.04). In conclusion, the worksite exercise program and regular fitness testing improved health behavior for all participants, but greater improvements were achieved in the exercise program group

Keywords: *worksite exercise intervention, health-related variables, physical activity*

Cite This Article: C. Fennell, J.E. Barkley, J.D. Kingsley, H.D. Gerhart, and E.L. Glickman, "Effects of a 16-week Worksite Exercise Program on Physical Activity, Sedentary Behavior, and Fitness Variables." *Journal of Physical Activity Research*, vol. 2, no. 2 (2017): 85-94. doi: 10.12691/jpar-2-2-4.

1. Introduction

Presently, the majority of adults in the United States do not participate in adequate amounts of physical activity, as only approximately 10%-50% of the population participate in minimum recommendations. [1,2,3,4] Additionally, excessive sedentary (i.e., sitting) behavior is of major concern for American adults, since the average American may sit for more than 7-9 hours per day. [5,6] These data are troubling as both physical inactivity and sedentary behavior are independent risk factors for developing a multitude of adverse health consequences, including cardio-metabolic disease [7] and diabetes, [8] as well as decreased life expectancy. [9] Conversely, physical activity is associated with many health benefits, including increasing life expectancy and prevention of cardiovascular disease, type 2 diabetes, and osteoporosis, [3,10] while improving functional and cognitive health. [11] These behaviors also place a large burden on healthcare systems nationwide. [12,13]

A strategy to increase physical activity, reduce sedentary behavior and thereby improve health, may be the use of worksite health promotion programs. [14] A majority of the American population spends a great amount of time at work, which leads to the work environment having a large influence on employee health. [15] Focusing on health behavior at the work environment may produce positive outcomes in employee health such as improved physical fitness and improved mental outcomes. [16] These programs may also reduce employee medical costs by about $3.27 for every dollar spent on wellness programs. [17] A wide variety of worksite interventions range from traditional exercise classes, [14] walking or step programs, [18] use of pedometers, [19] and cosmetic and structural enhancements to encourage physical activity including behavior and counseling techniques. [14]

Depending on the program in place, some of these worksite health promotion programs have been shown to improve healthy behavior, [20,21,22,23,24] while other studies do not show a change in improvement [25,26,27] or had high attrition rates. [26,27,28] Recently, researchers demonstrated that a 12-week faculty and staff exercise program (exercising three times per week) resulted in significant improvements in measures of muscular endurance, flexibility, and balance. [23] Even minimal physical activity interventions using a 12-week walking program at a worksite has shown to reduce body mass index (BMI), blood glucose, and total cholesterol. [18] On the contrary, French et al. (2010) reported after 18 months of the worksite offering exercise competitions, personal training, and exercise instruction, there were no significant differences of BMI, weight, or physical activity between controls and those in the program. Likewise, Tveito and Eriksen (2009) conducted an investigation which randomized 40 employees to either an intervention or control group, where the intervention group were subjected to physical exercise with an aerobic exercise instructor, 15 hours of health information/stress management training, and a practical examination of the workplace over a nine-month period of time. The control group only participated in pre- and post-testing with no intervention for the nine-months. The researchers reported there was no difference in subjective health between the control and intervention groups. Overall, it seems that worksite programs may only lead to modest improvements in many health behaviors [14,17] and leaves questions regarding the effectiveness of worksite health promotion programs. [29] This, in turn, warrants further research to determine the reasons as to which types of worksite exercise programs are effective at improving health variables. [14,30]

Given these aforementioned low physical activity levels in this population and mixed results of the wide variation of worksite exercise programs, future research is needed to understand what programs and strategies are effective in improving physical activity, reducing sedentary behavior, and increasing fitness variables (physical activity behavior, cardiorespiratory endurance, muscular endurance). Therefore, the purpose of this investigation was to examine the effectiveness of a worksite exercise program on physical activity, sedentary behavior, and fitness-related variables compared with a group of controls who are not participating in the program. Our hypotheses were that participation in a worksite exercise program would result in greater physical activity, lower sedentary behavior, and improvements in fitness-related variables when compared to age-matched controls.

2. Methods

2.1. Participants

A total of 67 (n = 53 females) faculty and staff employees at a major, public University volunteered to participate in a 16-week exercise program intervention (Intervention group) or to be monitored for a similar period but not participate in the exercise intervention (Control group). Of the 67 who agreed to participate, five individuals dropped-out from the study due to time constraints or did not complete the measures of data collection. Therefore, 62 (n = 49 females) individuals volunteered for the Intervention group (n = 47, n = 39 females) or the Control group (n = 15, n = 11 females). Figure 1 provides a consort of participant enrollment, recruitment, and drop-out. Originally, the intervention group was divided into three subgroups based on previous participation time in the ongoing exercise program: 0 months (were participating in the program for the first time, n = 17 total, n = 15 females), 4 months (had participated in the program for the last four months, n = 6 total, n = 5 females), and ≥8 months (had participated in the program for the last eight or more months, n = 24 total, n = 18 females). However, statistical analyses of these data demonstrated the differences relative to the Controls (i.e. interactions) were unaffected. Therefore, we chose to report only the two group design data.

This program was open to all faculty and staff employees on campus. Participants were recruited by advertisement through e-mail and website pages. The Intervention group, who volunteered for the exercise program, included individuals who either were (n = 31) and were not (n = 16) presently meeting the American College of Sports Medicine threshold for being considered physically active of achieving >500 MET-minutes per week, as indicated from baseline self-reported physical activity. [1] Therefore, a Control group of individuals who either were (n = 10) and were not (n = 5) presently meeting the American College of Sports Medicine threshold for being considered physically active were selected to allow a proper comparison of groups. This was done per American College of Sports Medicine recommendations that suggest physically active individuals should be assigned to control groups to avoid a misinterpretation of findings. [31] These misinterpretations could occur due to the controls continuing their sedentary behavior compared with an intervention group with scheduled exercise classes; hence it would be expected that the Intervention group would improve health-related variables and Controls would not. However, with a mix of sedentary and active controls, the true effectiveness of the worksite exercise program can be better examined as previous behaviors of both groups were similar. Prior to enrolling in the intervention, all participants were familiarized with the 16-week protocol, including instruction on the benefits and risks of the exercise program, and provided written consent. Medical history forms and physician's consent were completed prior to participation to ensure there were no contraindications to safely participating in exercise. Participants were excluded if they reported a history of medical disorders (orthopedic injuries, cardiovascular disorder, etc.) and/or did not receive clearance from their physician beforehand for such issues as orthopedic injuries, cardiovascular disorder, and so forth. The university Institutional Review Board approved all procedures.

2.2. Procedures

Objective measurements of physical activity behavior were obtained for three one-week periods of time (week 1, week 8, week 16) over the course of the 16-week exercise intervention. Fitness-related variables (e.g., push-ups, sit-ups, cardiorespiratory fitness, etc.) were also measured at these three time points. Self-reported physical activity and sedentary behavior were also assessed using validated survey instruments. Finally, attendance of the intervention group was measured at each session. Therefore, this was a two group (Intervention, Control by three time points (baseline, midpoint, final) mixed-factorial, cross-sectional design with the cross-sectional groups serving as the between-subjects independent variable and time point serving as the within-subjects variable.

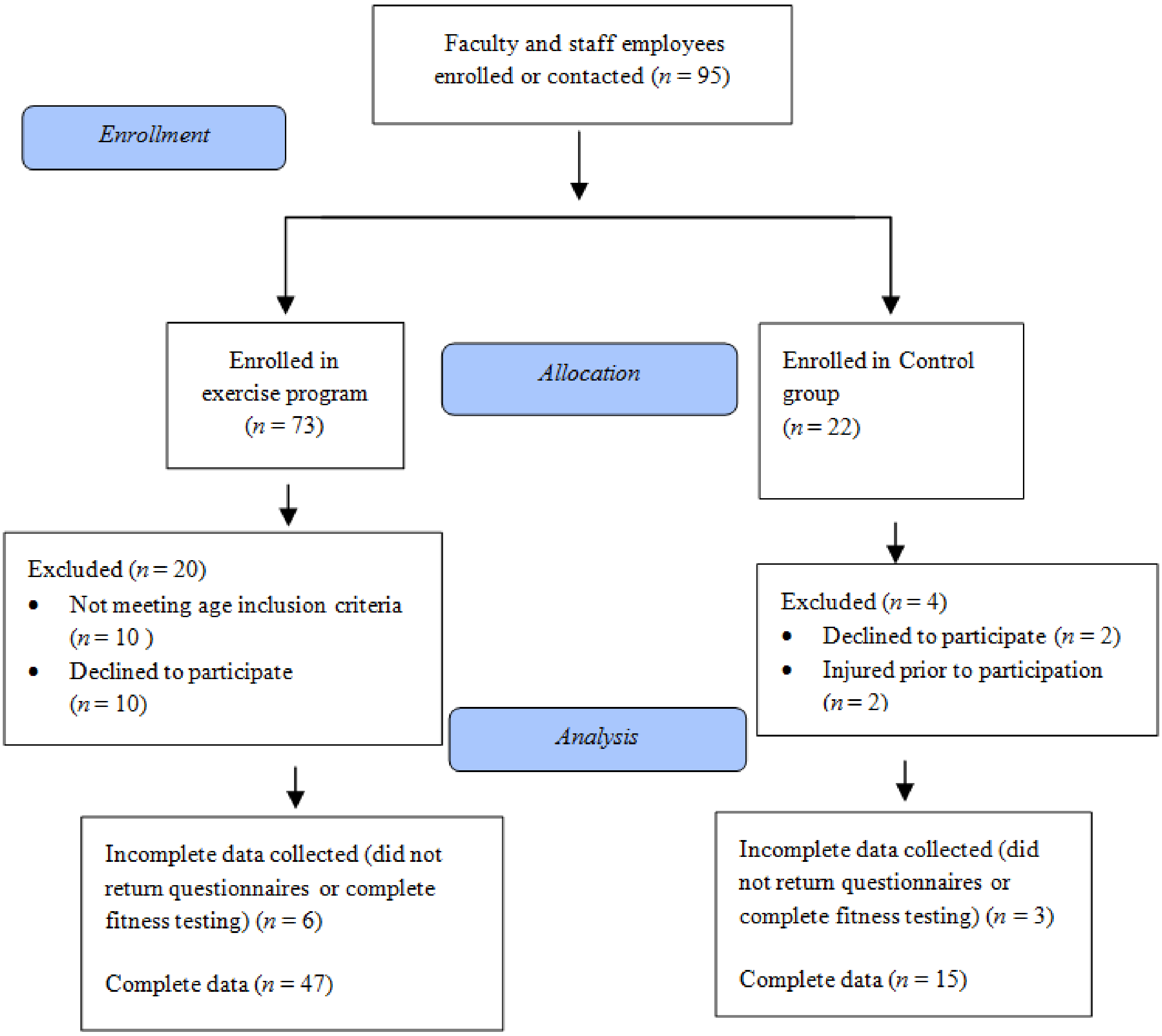


Figure 1. Flow diagram of participants in enrollment, allocation, and analysis phases

2.3. Intervention

The Intervention and Control group completed the questionnaires and fitness-related variable assessments at the three time points. Included in the Intervention group were those participating in the worksite exercise program consisting of 60-minute classes, three times per week, for 16 weeks. These classes included a five minute warm-up and five minute cool-down. Each session, participants chose one of six class options to attend: jogging, boot camp, cardio dance, weight training, weight and cardio circuit training, or shallow water aqua. All classes were led by one or two members of the research staff who were trained in the specific area of exercise. Attendance to the intervention was measured daily. The boot camp class used exercise equipment (dumbbells and medicine balls) with intervals of high-intensity exercise. The cardio dance class involved following the instructor in moving to the beat of the music at a pace that ranged from moderate to vigorous exercise intensity. The circuit training class consisted of classic circuit training using resistance training machines, free weights, and cardio machines. The shallow water aqua class included lower impact, dynamic water aerobics. The walking/jogging class consisted of walking and/or jogging at an intensity the participant felt comfortable on dry land or the treadmill. Weight training incorporated stationary exercises using dumbbells and body weight.

2.4. Measurements

2.4.1. Objective Physical Activity Measurement.

To measure physical activity, each participant (Intervention and Controls) were given a Movband (Movable, Cleveland, OH) accelerometer with instructions to wear it on the dominant wrist as much as possible daily, although physical activity data were only collected at the three time points. The Movband is a three-plane accelerometer that measures movement to quantify an accurate estimate of each participant's physical activity, which was previously validated against the Actigraph (Actigraph Corporation, Pensacola, FL) accelerometer and indirect calorimetry. [32] The Movband provides visual feedback to the user and also allows the user to view other participant's physical activity to promote health competition. Physical activity was recorded as moves where then a built-in algorithm was used to convert the movement data from moves to steps and miles (http/www.movable.com), which is more widely understood. On measurement weeks' participants were asked to wear the Movband as much as possible, specifically a minimum of 10 hours throughout the day. The participants were also given an activity monitor report to complete at the end of each day which asks the participant at what times during the day the Movband was worn. This was done to quantify the amount of minutes the participant wore the Movband. That information was then used to calculate "moves" per minute ("moves" per minute = total "moves" ÷ time worn).

2.4.2. Questionnaires

Data collection at the three time points began on the first day of week one of the intervention. Participants were given a questionnaire with instructions to complete and return the questionnaire in one week. They were told to complete the subjective physical activity questionnaire for the current week. These directions were given so the objective physical activity data collection and subjective physical activity questionnaire would be analogous, since the objective physical activity data would be collected from the first week of usage. The questionnaires consisted of the following. (1) Demographic information (e.g., gender, age, occupational status, etc.). (2) Physical activity and sedentary behavior assessment using the International Physical Activity Questionnaire (IPAQ). [33] The demographic questionnaire was only completed at baseline. The IPAQ was completed at the three time points over 16 weeks.

2.4.3. Objective Fitness-related Variables Measurement

Fitness parameters were assessed prior to beginning the intervention (baseline), at week 8 (midpoint), and at week 16 (post). Each individual test was measured by a member of the research staff who was trained in the current fitness testing protocols. The specific order of testing was in the order it is mentioned in this paragraph. This testing included resting measurements of height and weight. Active measurements included the 12-minute Cooper test, push-ups to failure, partial curl-up, which measures the maximal number of curl-ups performed in one minute, and flexibility. These tests are based on American College of Sports Medicine guidelines for exercise testing. [34]

Participants were measured for height to the nearest centimeter via a stadiometer. Weight was measured to the nearest pound then converted to kilograms using a balance beam scale (Health O Meter, Chicago, IL). BMI was calculated by dividing the participants' weight in kilograms over the height squared in centimeters.

The 12-minute Cooper test is an assessment of cardiorespiratory endurance. [35,36] This included participants walking and/or running around a measured gymnasium floor for 12 minutes. Participants were instructed to cover as much distance as possible in the 12 minutes. The dependent variable of this test is the distance, which was measured by the research staff.

Push-ups are a measurement of upper-body muscular endurance and were performed herein according to American College of Sports Medicine guidelines. [1,34] Males were instructed to complete the test from their toes while females were to perform the push-ups from their knees. All participants were instructed to maintain a straight line from the shoulders through the hips to either the knees or toes. The research staff supervised the test and commented on incorrect form. Participants completed as many push-ups as possible without pausing. A completed push-up counted if the arms were bent to 90 degrees in the down position and extended fully in the starting position. Participants were instructed to keep a steady pace for the duration of the test. Any pause or break in form was not acceptable. If the corrections were not made immediately, the research staff member terminated the test.

Partial curl-ups were performed based on American College of Sports Medicine guidelines for physical fitness assessments, as this is a valid measurement for abdominal muscular endurance. [1,34] Participants laid supine on an exercise mat with their knees bent to 90 degrees and the soles of their feet flat on the ground. Their arms laid by their side with the hands relaxed and the middle fingers touching a piece of tape that is placed 10 cm from the end and parallel to the edge of the exercise mat. Participants were instructed to use the abdominal muscles to curl-up so their middle fingers reached the edge of the exercise mat, then to return to the resting position. This motion was completed as many times as possible in 60 seconds without pausing. The research staff counted the repetitions for each participant.

Flexibility was measured using the sit-and-reach test recommended by the American College of Sports Medicine. [1,34] A sit-and-reach box was used (Finder Flex-Tester, Novel Products Inc. Rockton, IL) for assessment. Participants were instructed to remove their shoes while sitting on the ground in an upright position with knees extended and their feet and heels flat against the box. Next, participants placed one hand over the other and extended their arms straight forward. Then, participants bent forward and held their final position for approximately two seconds. The most distant point reached with the finger tips is the score. The better of three trials, as seen by the research staff was recorded.

2.5. Statistical Analysis

These data were analyzed with Statistical Packages for the Social Sciences version 21.0. Significance was set *a priori* at $p \leq 0.05$. Two group (Intervention, Control) by three time-point (baseline, mid, final) analysis of variance (ANOVAs) were conducted to examine differences in the same dependent variables. This would examine the differences between the Intervention and Control groups and changes over time. Post-hoc t-tests were performed if there was significance.

Change scores from baseline to final assessment were calculated (Δ score = final assessment – baseline assessment) for the objective physical activity (steps per minute), subjective physical activity (IPAQ METs), sedentary behavior (IPAQ), and fitness variables (12-minute Cooper test, push-ups, curl-ups, sit-and-reach). Pearson's correlations were then conducted to assess the relationship among change scores in the Intervention and Control.

3. Results

The final sample size was N = 62 (47 Intervention, n = 38 females; 15 Controls, n = 11 females). If a participant did not complete an assessment they were dropped from that assessment. The data are presented as mean ± Standard Deviation (SD). Baseline physical characteristics of the two groups are presented in Table 1. Attendance to the exercise program for the Intervention group was 66%.

There were no significant main effects of time (F = 0.4, p = 0.6), group (F = 1.3, p = 0.3), or interactions (F = 0.1, p = 0.9) for steps per minute, (Table 2). For IPAQ MET-min per week there was a significant main effect of time (F = 4.8, p = 0.01) due to a significant increase (t = 3.2, p = 0.002) in METS from pre (1582.7 ± 2114.7 METS) to mid (2743.1 ± 2796.3 METS) and significant increase (t = 3.8, $p < 0.001$) in METS from pre to post (2336.6 ± 1672.8 METS), (Table 2).

For IPAQ Sedentary behavior time there was a significant group by time interaction (F = 3.1, p = 0.05), (Figure 2) such that the Intervention group significantly decreased ($t \geq 3.13$, $p \leq 0.003$ for both) sedentary minutes per week pre (3194.6 ± 1224.4 min) to mid (2657.5 ± 1156.0 min) and pre to post (2606.7 ± 1134.3 min).

For the 12-minute Cooper test there was a significant main effect of time (F = 4.5, p = 0.01) due to a significant increase in meters (t = 3.4, p = 0.001) from pre (1458.2 ± 382.3 m) to mid (1533.7 ± 432.6 m) and significant increase (t = 2.8, p = 0.01) pre to post (1570.4 ± 502.8 m), (Table 2).

For the push-up test there was a significant interaction (F = 5.7, p = 0.005) (Figure 3) and main effect of time (F = 17.1, $p < 0.001$). Push-up repetitions revealed a significant, stepwise increase ($t \geq 7.5$, $p < 0.01$ for all) in the Intervention group from pre (16.2 ± 8.3 reps) to mid (21.6 ± 9.1 reps) and mid to post (24.1 ± 9.7 reps). The main effect of time was due to the significant, stepwise increase ($t \geq 7.0$, $p < 0.02$ for all) in push-up repetitions at all time points.

Table 1. Baseline physical characteristics (N = 62) (data are mean ± SD)

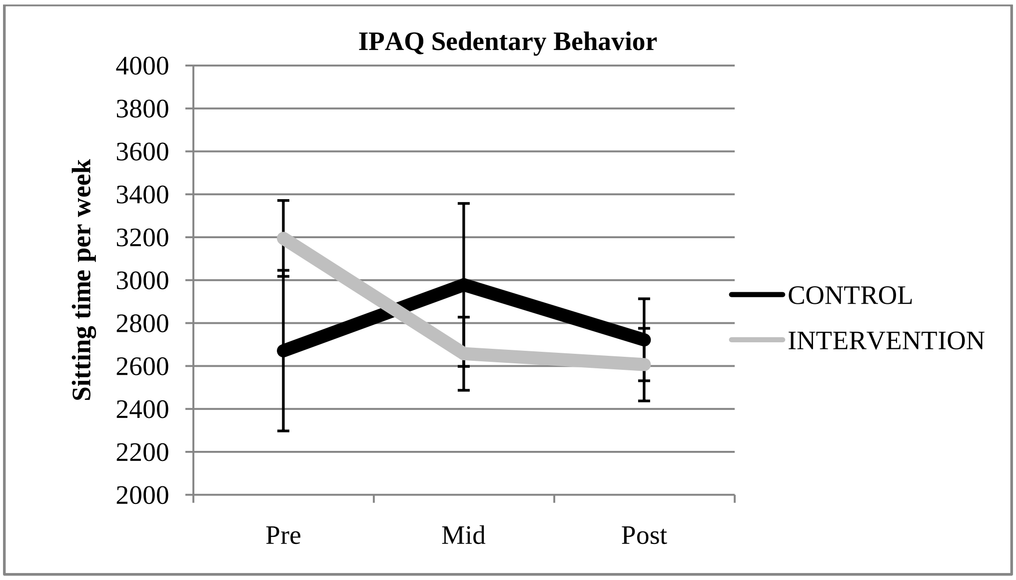
Characteristic	Intervention (n = 47)	Controls (n = 15)
Age (yrs)	51 ± 8	49 ± 8
Sex	9 m, 38 f	4 m, 11 f
Height (cm)	165.7 ± 7.9	167.5 ± 10.8
Weight (kg)	83.6 ± 18.2	80.0 ± 18.5
BMI (kg/m2)	30.7 ± 6.7	28.5 ± 6.4

BMI: body mass index.

Table 2. Pre, mid, and post physical Activity, sedentary behavior, and fitness-related variables in Intervention and Control groups (data are mean ± SD)

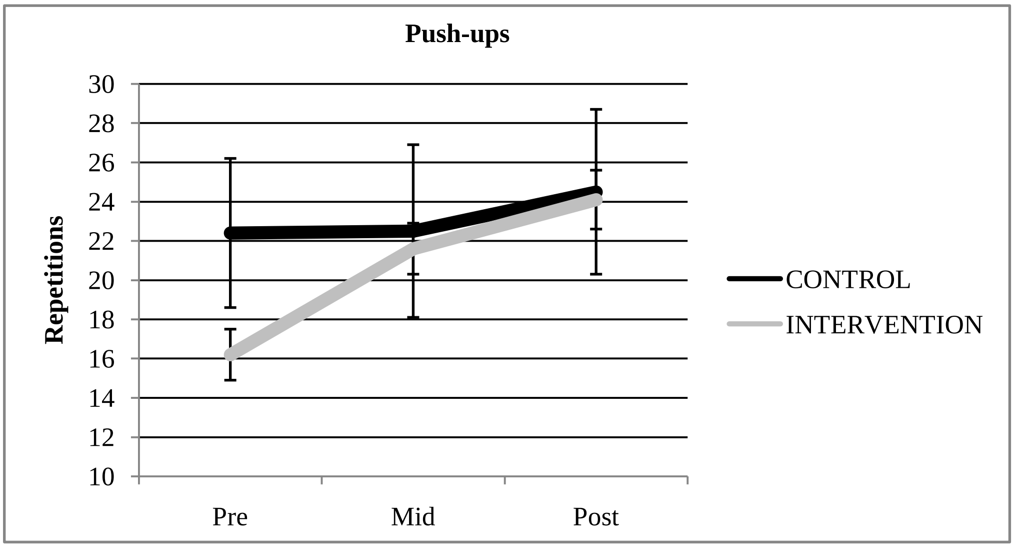
Variable	Intervention (n = 47) Time			Sum Mean	Control (n = 15) Time			Sum Mean	Intervention & Control (n = 62) Time		
	Pre	Mid	Post		Pre	Mid	Post		Pre	Mid	Post
Steps per min (min)	11.8 ± 4.7	11.8 ± 4.3	12.5 ± 5.1	12.0 ± 4.0	10.9 ± 2.3	10.5 ± 3.7	10.9 ± 3.3	10.8 ± 2.3	11.6 ± 4.2	11.4 ± 4.1	12.1 ± 4.7
IPAQ MET-min per week (METS)	1676.5 ± 2267.0	2996.7 ± 2578.6	2474.6 ± 1561.7	3905.3 ± 2875.3	1293.7 ± 1520.2	1948.6 ± 3368.2	1948.3 ± 1954.6	3434.1 ± 5071.3	1582.7 ± 2114.7	2743.1 ± 2796.3*	2336.6 ± 1672.8*
IPAQ sedentary time per week (min)	3194.6 ± 1224.4	2657.5 ± 1156.0*	2606.7 ± 1134.3*	2803.9 ± 1011.0	2671.9 ± 1496.4	2978.0 ± 1470.3	2722.5 ± 764.0	2776.0 ± 993.4	3067.3 ± 1298.4	2736.3 ± 1235.4	2637.1 ± 1045.0
12-min Cooper test (m)	1458.5 ± 394.5	1547.1 ± 463.8	1541.1 ± 491.9	1504.3 ± 446.5	1508.9 ± 376.3	1493.6 ± 331.2	1614.4 ± 550.6	1503.0 ± 361.5	1458.2 ± 382.3	1533.7 ± 432.6*	1570.4 ± 502.8*
Push-ups (repetitions)	16.2 ± 8.3	21.6 ± 9.1*	24.1 ± 9.7*#	20.9 ± 8.5	22.4 ± 15.5	22.5 ± 15.9	24.5 ± 16.1	21.9 ± 15.8	17.6 ± 11.1	21.8 ± 10.8*	23.7 ± 11.8*#
Curl-ups (repetitions)	35.2 ± 18.3	41.7 ± 19.6	47.3 ± 20.0	41.4 ± 18.3	28.3 ± 19.6	29.7 ± 22.2	36.0 ± 20.8	31.4 ± 20.8	33.9 ± 18.7	38.8 ± 20.8*	44.8 ± 20.6*#
Sit-and-reach (cm)	31.2 ± 8.2	31.5 ± 8.2	31.6 ± 8.2	31.7 ± 8.0	33.7 ± 10.5	35.0 ± 9.6	35.3 ± 9.2	34.8 ± 9.5	31.9 ± 8.9	32.3 ± 8.6	32.5 ± 8.5
BMI (kg/m^2)	30.7± 6.7	30.6 ± 6.8	30.4 ± 7.0	30.6 ± 6.9	28.5 ± 6.4	28.3 ± 5.9	28.3 ± 6.0	28.4 ± 6.1	30.1 ± 6.7	29.9 ± 6.6	29.8 ± 6.7
Weight (kg)	83.9 ± 26.0	83.6 ± 18.2	83.3 ± 18.1	83.6 ± 18.1	80.0 ± 18.5	79.3 ± 17.2	79.4 ± 17.3	79.7 ± 17.7	82.7 ± 18.2	82.3 ± 17.8	81.8 ± 18.0

BMI: body mass index; IPAQ: International Physical Activity Questionnaire
*Significantly different from pre $p \leq 0.05$
#Significantly different from mid $p \leq 0.05$
†Significantly different from Control $p \leq 0.05$.



*Significant difference for Intervention group from pre $p \leq 0.05$

Figure 2. Sedentary time during week 1, week 8, and week 16 ($N = 62$, mean ± SEM)



*Significant difference for Intervention group from pre $p \leq 0.05$.
#Significant difference for Intervention group from mid $p \leq 0.05$.

Figure 3. Push-up repetitions at week 1, week, 8, and week 16 ($N = 62$, mean ± SEM)

For the one-minute curl-up test there was a significant main effect of time ($F = 15.3$, $p < 0.001$) due to a significant stepwise ($t \geq 4.2$, $p \leq 0.001$ for all) increase of repetitions in one minute (pre: 33.9 ± 18.7 reps, mid: 38.8 ± 20.8 reps, post: 44.8 ± 20.6 reps) (Table 2).

3.1. Pearson's Correlations Δ Score Combined Groups

Pearson's Correlations of the pre to post changes with the groups combined revealed Δ\steps per minute to be positively (r = 0.3, $p = 0.05$) associated with ΔBMI, meaning a greater positive change in steps per minute were predictive of a greater positive change in BMI. The ΔIPAQ METS-min per week was not associated with any variable (Table 3).

The ΔIPAQ Sedentary questionnaire was negatively associated with the ΔCooper test (r = - 0.3, $p = 0.04$), meaning the negative change in sedentary behavior were predictive of positive changes in cardiorespiratory fitness (Table 3).

3.2. Pearson's Correlations Δ Score Separated Groups

This section will be reported in order by the variable then group (e.g. Δsteps per minute: Intervention then Control), (Table 4). For the Intervention group, Δsteps per minute was positively (r = 0.4, $p = 0.02$) associated with ΔBMI, meaning predictive of a positive change of weight-to-height ratio. In the Control group, Δsteps per minute demonstrated a positive (r = 0.5, $p = 0.04$) relationship with the ΔCooper test. In other words, a positive change in steps were predictive of a positive change in cardiorespiratory fitness. ΔSteps per minute was positively (r = 0.7, $p = 0.02$) associated with Δpush-ups, meaning a positive change of physical activity was predictive of a positive change of push-ups.

Table 3. Correlations of Δ from pre to post of Δsteps per min, ΔMET-min per week, and Δsitting time in combined groups

	ΔSteps per min	ΔMET-min per week	ΔSitting Time (min)
ΔCooper test (m)	$r = 0.1, p = 0.7$	$r = -0.2, p = 0.1$	$r = -0.3, p = 0.04$*
ΔPush-ups repetitions	$r = 0.0, p = 0.4$	$r = 0.1, p = 0.5$	$r = -0.07, p = 0.6$
ΔCurl-ups repetitions	$r = 0.0, p = 0.9$	$r = -0.1, p = 0.4$	$r = -0.1, p = 0.5$
ΔSit-and-reach (cm)	$r = 0.0, p = 0.8$	$r = 0.0, p = 0.9$	$r = -0.1, p = 0.9$
ΔBMI (kg/m^2)	$r = 0.3, p = 0.05$*	$r = -0.1, p = 0.3$	$r = 0.1, p = 0.7$
ΔWeight (kg)	$r = 0.2, p = 0.3$	$r = -0.9, p = 0.5$	$r = 0.1, p = 0.6$

BMI: body mass index
*Significant relationship $p \leq 0.05$.

Table 4. Correlations of Δ from pre to post of Δsteps per min, ΔMET-min per week, and Δsitting time in Intervention and Control groups

	ΔSteps per min (min)		ΔMET-min per week (METS)		ΔSitting Time (min)	
	Intervention	Control	Intervention	Control	Intervention	Control
ΔCooper test (m)	$r = 0.0, p = 1.0$	$r = 0.5, p = 0.04$*	$r = -0.2, p = 0.2$	$r = -0.2, p = 0.5$	$r = -0.2, p = 0.3$	$r = -0.4, p = 0.1$
ΔPush-ups (repetitions)	$r = 0.1, p = 0.5$	$r = 0.7, p = 0.02$*	$r = 0.0, p = 0.8$	$r = 0.3, p = 0.4$	$r = -0.8, p = 0.6$	$r = 0.2, p = 0.4$
ΔCurl-ups (repetitions)	$r = 0.03, p = 0.8$	$r = -0.0, p = 0.9$	$r = -0.6, p = 0.7$	$r = -0.4, p = 0.2$	$r = -0.2, p = 0.3$	$r = 0.2, p = 0.4$
ΔSit-and-reach (cm)	$r = 0.1, p = 0.5$	$r = -0.5, p = 0.8$	$r = -0.2, p = 0.2$	$r = 0.3, p = 0.2$	$r = -0.2, p = 0.3$	$r = 0.3, p = 0.3$
ΔBMI (kg/m^2)	$r = 0.4, p = 0.02$*	$r = -0.2, p = 0.9$	$r = -0.1, p = 1.0$	$r = -0.3, p = 0.3$	$r = 0.1, p = 0.4$	$r = -0.6, p = 0.8$
ΔWeight (kg)	$r = 0.2, p = 0.1$	$r = -0.4, p = 0.9$	$r = 0.1, p = 0.5$	$r = -0.3, p = 0.3$	$r = 0.2, p = 0.2$	$r = -0.9, p = 0.8$

BMI: body mass index
*Significant relationship $p \leq 0.05$.

4. Discussion

The purpose of this study was to examine the changes over time of physical activity, sedentary behavior, and fitness variables during a voluntary 16-week faculty and staff exercise program and to compare with a group of employees not participating in the program. Additionally, we assessed the relationship between changes in objective physical activity, subjective physical activity, sedentary behavior, and changes in fitness-related variables.

Presently neither the Intervention nor Control groups altered total objectively measured physical activity behavior over the course of the study and there was no difference between the groups. The step count for the Intervention and Control groups averaged 12.1 and 10.8 steps per minute. These step counts are sufficient at meeting physical activity guidelines. [37,38] Before quantifying these steps into steps per minute the average steps per day were 10,190 and 9,437 for the Intervention and Control group, respectively. It is suggested to reach a minimum of 8,000 daily steps; [38,39] hence, participating in either group resulted in reaching the recommended physical activity behavior. The objectively measured physical activity was not altered; however, there were significant increases in weekly exercise intensity (METS) in both groups. The Intervention group increased push-ups repetitions and reduced sedentary behavior throughout the 16-weeks. Furthermore, there were improvements in the following fitness variables for both groups (Intervention, Control) over the course of the study: cardiorespiratory fitness (12-minute Cooper test) and musculoskeletal endurance as assessed via abdominal curl-ups

There were similar improvements in these aforementioned variables in both the Intervention and Control groups over the 16-weeks, therefore it is reasonable to ask if there is a benefit to a workplace exercise program beyond what may be achieved with regular fitness testing. First, because participants self-selected into the Intervention or Control groups we do not know if those in the Intervention would have similarly benefited from assessment only or if they had some personality trait that better suited them for the intervention. For example, while both groups exhibited similar improvements for several fitness-related variables, there were some important group by time interactions. The Intervention group significantly increased upper body muscular endurance (measured via the push-up test) whereas the Control group did not. This is important as maintaining musculoskeletal fitness as a person ages is a significant predictor of quality of life and independence in later years. [40,41,42] Third, and perhaps most importantly, the Intervention group significantly reduced sedentary behavior over the course of the intervention whereas the Control group did not. This is important as sedentary behavior is an independent risk factor for cardio-metabolic disorders and there is evidence that high sedentary behavior has negative health effects even in individuals who are meeting physical activity guidelines. [6,9,43] The term "active couch potato" is used to describe someone who is highly sedentary yet meeting the physical activity guidelines. [44] Female "active couch potatoes" have been shown to have greater waist circumference, systolic blood pressure, glucose, triglycerides, and high density lipoprotein cholesterol [45] and, likewise, taking breaks from sitting to be physically active results in reducing metabolic risk, [43,46] regardless of biological sex. Because both the Intervention and Control groups were equally physically active and only the Intervention group reduced sedentary behavior, it is possible that there was a greater risk for being an "active couch potato" in the Control group.

While we hypothesized behavioral, fitness and psychological improvements in the Intervention group, as we have outlined in previous sections, we noted several of these improvements in the Control group as well. Prior findings have demonstrated the efficacy of workplace exercise programs for increasing physical activity and fitness and these current findings do not refute those previous. [14,20,21,22,23] However, because the Control group had similar improvements in the previously outlined variables (increased MET-min per week, increased curl-ups repetitions, increased self-efficacy making time, and increased competence), this suggests the Control group comprised of previously sedentary and physically active individuals maintained their physical activity behavior and achieved improvements of health-related variables without the help of the program, or that our battery of fitness testing and/or wearing a visual feedback activity monitor may have also positively affected exercise behavior resulting in changes in certain health and psychological variables. The Control group achieving improvements has been shown in other research studies. [47,48,49] The Control group participated in high levels of physical activity at baseline and demonstrated fitness levels which matched or exceeded the Intervention group at the beginning of the 16-weeks. Thus, this Control group was an active control group, as the American College of Sports Medicine warrants the use of physically active controls, [31] and maintained their activity over the 16-weeks. Additionally, there is evidence regarding the ability of regular exercise assessments increasing physical activity behavior, [20] due to competition with others, reaching personal goals, and/or comparing performance with a predetermined standard. [34,50] Fitness testing is frequently conducted in worksite exercise interventions to assess the changing of fitness variables over time. Fitness testing may be a tool used to improve motivation for fitness participation due to the improvement of competence. Studies on worksite interventions which have utilized fitness testing in the control groups have shown both an increase in fitness [47,48,49] and a decrease or no change in fitness. [51,52] Furthermore, there is also evidence that wearing an activity monitor which provides visual feedback of daily physical activity may have a positive effect on physical activity behavior as the role of feedback may provide extrinsic reinforcement motivation to engage in a behavior [19,53,54] while also promoting healthy peer competition, and may increase awareness of physical activity. [55] One study used pedometers in an 8-week worksite exercise program to find that throughout the 8-weeks, physical activity increased. [56] On the other hand, a study which used pedometers to assess physical activity over 12-weeks reached a plateau at week 4, and no further improvements were made. [57] Similarly, a 12-month study using a visual feedback activity monitor group found a decrease in moderate to vigorous physical activity when just using the activity monitor. This suggests a gap in the literature of the effectiveness of visual feedback activity monitors on physical activity [58] and evidence regarding the effectiveness of these monitors in the workplace and recommends further research. [59] Therefore, while workplace exercise programs may not be feasible for some companies, offering employees physical activity monitors that provide feedback and making regular assessments of employee's physical fitness and exercise habits and attitudes may yield several similar benefits of these difficult-to-implement interventions.

In addition to assessing changes in physical activity, sedentary behavior, and fitness in these two groups over the course of the Intervention or Control condition we also assessed the relationships between the changes in physical activity, sedentary behavior, and fitness. Greater positive changes in steps per day were associated with greater positive changes in cardiorespiratory fitness and greater musculoskeletal endurance (via the push-up test). Negative changes in sedentary behavior (reduced sedentary behavior) were associated with greater positive changes in cardiorespiratory fitness. These findings provide a potential mechanistic explanation (i.e., increased physical activity and decreased sedentary behavior) behind the improvements seen in participants in the present study. They also provide additional evidence of the positive outcomes that are associated with increasing physical activity and decreasing sedentary behavior.

4.1. Limitations and Future Directions

While the present study provides useful insights into the efficacy of workplace exercise interventions and health monitoring programs, it is not without limitations. First, the sample size was small. This is especially true for the analyses separating the intervention groups into smaller subgroups. Second, only 21% of the participants were male, which limits the ability to generalize the results of this study. The high number of female participants is consistent with other worksite health promotion programs. [60] Additionally, these participants were employees of a large, public university, which limits the ability to generalize to other work environments and individuals of different social economic statuses. The exercise program was only offered at certain times and days of the week, which may deter the participation of individuals with schedules which are not convenient with these times. Future research could compare different types of exercise programs, including the current design, with planned fitness testing of different populations including: previously sedentary, ethnic groups, different types of jobs, different regions, and a greater proportion of males, which may have differing results than this report.

4.2. Conclusion

This study examined the effects of a worksite exercise program versus a control group who participated in fitness testing on physical activity, sedentary behavior, and fitness variables. Overall, physical activity behavior met physical activity recommendations in both groups. Fitness-related variables such as cardiorespiratory fitness, and curl-ups improved in both groups, with the Intervention group increasing push-ups to a greater quantity than the Control group. Sedentary behavior decreased in the Intervention group but not the Control group. The change scores of decreasing sedentary behavior were associated with the change of increasing cardiorespiratory fitness. Overall, these results suggest that both a worksite exercise program and possibly an assessment-only control in addition to wearing a visual feedback activity monitor are effective in the improvement of health-related variables. There may be a larger benefit to health improvements in worksite exercise programs such as the current program employed herein.

Acknowledgements

There are no acknowledgements.

Statement of Competing Interests

The authors have no competing interests.

References

[1] Garber CE, Blissmer B, Deschenes MR, Franklin BA, Lamonte MJ, Lee I-M, American College of Sports Medicine position stand. "Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise", *Medicine and Science in Sports and Exercise*, 43 (7). 1334-59. 2011.

[2] Centers-for-Disease-Control-Prevention, "Adult participation in aerobic and muscle-strengthening physical activities--United States, 2011", *Morbidity and Mortality Weekly Report*, 62 (17). 326-30. 2013.

[3] Physical-Activity-Guidelines-Committee, "Physical activity guidelines advisory committee report, 2008", Washington, DC: US Department of Health and Human Services. A1-H14. 2008.

[4] Tucker JM, Welk GJ, Beyler NK, "Physical activity in US adults: compliance with the physical activity guidelines for Americans", *American Journal of Preventive Medicine*, 40 (4). 454-61. 2011.

[5] Matthews CE, Chen KY, Freedson PS, Buchowski MS, Beech BM, Pate RR, "Amount of time spent in sedentary behaviors in the United States, 2003–2004", *American Journal of Epidemiology*, 167 (7). 875-81. 2008.

[6] Owen N, Healy GN, Matthews CE, Dunstan DW, "Too much sitting: the population-health science of sedentary behavior", *Exercise and Sport Sciences Reviews*, 38 (3). 105. 2008.

[7] Wijndaele K, Healy GN, Dunstan DW, Barnett AG, Salmon J, Shaw JE, "Increased cardio-metabolic risk is associated with increased TV viewing time", *Medicine & Science in Sports & Exercise*, 42 (8). 1511-8. 2010.

[8] Warren TY, Barry V, Hooker SP, Sui X, Church TS, Blair SN, "Sedentary behaviors increase risk of cardiovascular disease mortality in men", *Medicine and Science in Sports and Exercise*, 42 (5). 879-85. 2010.

[9] Lee I-M, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT, "Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy", *The Lancet*, 380 (9838). 219-29. 2012.

[10] Vogel T, Brechat PH, Leprêtre PM, Kaltenbach G, Berthel M, Lonsdorfer J, "Health benefits of physical activity in older patients: a review", *International Journal of Clinical Practice*, 63 (2). 303-20. 2009.

[11] Martinsen EW, "Physical activity in the prevention and treatment of anxiety and depression", *Nordic Journal of Psychiatry*, 62 (47). 25-9. 2008.

[12] Pratt M, Norris J, Lobelo F, Roux L, Wang G, "The cost of physical inactivity: moving into the 21st century", *British Journal of Sports Medicine*, 48 (3) 171-3. 2014.

[13] Oldridge NB, "Economic burden of physical inactivity: healthcare costs associated with cardiovascular disease", *European Journal of Cardiovascular Prevention & Rehabilitation*, 15 (2), 130-9. 2008.

[14] Goetzel RZ, Henke RM, Tabrizi M, Pelletier KR, Loeppke R, Ballard DW, "Do workplace health promotion (wellness) programs work"? *Journal of Occupational and Environmental Medicine*, 56 (9). 927-34. 2014.

[15] Linnan L, Bowling M, Childress J, Lindsay G, Blakey C, Pronk S, "Results of the 2004 national worksite health promotion survey" *American Journal of Public Healt*h, 98 (8). 1503-9. 2008.

[16] Sorensen G, Barbeau E, "Steps to a healthier US workforce: integrating occupational health and safety and worksite health promotion: state of the science", Washington, DC, National Institute for Occupational Safety and Health, 1-65. 2004.

[17] Baicker K, Cutler D, Song Z, "Workplace wellness programs can generate savings", *Health Affairs*, 29 (2). 304-11. 2008.

[18] Haines DJ, Davis L, Rancour P, Robinson M, Neel-Wilson T, Wagner S, "A pilot intervention to promote walking and wellness and to improve the health of college faculty and staff", *Journal of American College Health*, 55 (4). 219-25. 2007.

[19] Bravata DM, Smith-Spangler C, Sundaram V, Gienger AL, Lin N, Lewis R, "Using pedometers to increase physical activity and improve health: a systematic review", *Journal of American Medical Association*, 298 (19). 2296-304. 2007.

[20] von Thiele Schwarz U, Lindfors P, Lundberg U, "Health-related effects of worksite interventions involving physical exercise and reduced workhours", *Scandinavian Journal of Work, Environment & Health*, 34 (3). 179-88. 2008.

[21] Freak-Poli RL, Wolfe R, Walls H, Backholer K, Peeters A, "Participant characteristics associated with greater reductions in waist circumference during a four-month, pedometer-based, workplace health program", *BMC Public Health*, 11 (1). 824-42. 2011.

[22] Gazmararian JA, Elon L, Newsome K, Schild L, Jacobson KL, "A randomized prospective trial of a worksite intervention program to increase physical activity", *American Journal of Health Promotion*, 28 (1), 32-40. 2013.

[23] Rebold MJ, Kobak MS, Peroutky K, Glickman EL, "The effects of a 12-week faculty and staff exercise program on health-related variables in a university setting. *International Journal of Exercise Science*, 8 (1). 49-56. 2015.

[24] Anshel MH, Brinthaupt TM, Kang M, "The disconnected values model improves mental well-being and fitness in an employee wellness program", *Behavioral Medicine*, 36 (4), 113-22. 2010.

[25] French SA, Harnack LJ, Hannan PJ, Mitchell NR, Gerlach AF, Toomey TL, "Worksite environment intervention to prevent obesity among metropolitan transit workers", *Preventive Medicine*, 50 (4). 180-5. 2010.

[26] Leininger LJ, Harris D, Tracz S, Marshall JE, "Differences in physical activity participation between university employees with and without a worksite health promotion program", *California Journal of Health Promotion*, 11 (1). 67-75. 2013.

[27] Tveito TH, Eriksen HR, " Integrated health programme: a workplace randomized controlled trial", *Journal of Advanced Nursing*. 65 (1). 110-9. 2009.

[28] Albury AR, Forsythe JD, Thorpe GM, "The effects of an exercise program on cardiovascular risk factors at a faith based university", *Cedarville University Digita*, 14. 1-11. 2014.

[29] Osilla KC, Van Busum K, Schnyer C, Larkin JW, Eibner C, Mattke S, "Systematic review of the impact of worksite wellness programs", The American *Journal of Managed Care*, 18 (2). 68-81. 2012.

[30] Hill-Mey PE, Kumpfer KL, Merrill RM, Reel J, Hyatt-Neville B, Richardson GE, "Worksite health promotion programs in college settings", *Journal of Education and Health Promotion*, 4. 12-9. 2015.

[31] Booth FW, Lees SJ, "Physically active subjects should be the control group", *Medicine and Science in Sports and Exercise*, 38 (3). 405. 2006.

[32] Barkley JE, Rebold M, Carnes A, Glickman EL, Kobak M, "The validity of a commercially-available, low-cost, wrist-mounted accelerometer during treadmill exercise" *Medicine and Science in Sports and Exercise*, 46 (5). 490. 2014.

[33] Booth ML, Ainsworth BE, Pratt M, Ekelund U, Yngve A, Sallis JF, "International physical activity questionnaire: 12-country reliability and validity", *Medicine and Science in Sports and Exercise*, 35 (8). 1381-95. 2003.

[34] Pescatello LS, and American College of Sports Medicine, "*ACSM's Guidelines for Exercise Testing and Prescription 9th Ed.* 2014", Wolters Kluwer/Lippincott Williams & Wilkins Health, 2014.

[35] Zwiren LD, Freedson PS, Ward A, Wilke S, Rippe JM, "Estimation of VO2max: a comparative analysis of five exercise tests", *Research Quarterly for Exercise and Sport*, 62 (1). 73-8. 1991.

[36] Grant S, Corbett K, Amjad A, Wilson J, Aitchison T, "A comparison of methods of predicting maximum oxygen uptake", *British Journal of Sports Medicine*, 29 (3), 147-52. 1995.

[37] Spence J, Adamo K, Colley R, Tudor-Locke C, "A step-defined physical inactivity index for adults: How many steps/day are too few?", *Journal of Science and Medicine in Spor*t, 15, S301. 2012.

[38] Tudor-Locke C, "How many steps/day are too few?", *Journal of Science and Medicine in Sport*, 18:e108. 2014.

[39] Tudor-Locke C, Bassett Jr DR, "How many steps/day are enough?", *Sports Medicine*. 34 (1), 1-8. 2004.

[40] Jurca R, Lamonte MJ, Barlow CE, Kampert JB, Church TS, Blair SN, "Association of muscular strength with incidence of metabolic syndrome in men", *Medicine and Science in Sports and Exercise*, 37 (11). 1849-55. 2005.

[41] Brill PA, Macera CA, Davis DR, Blair SN, Gordon N, "Muscular strength and physical function", *Medicine and Science in Sports and Exercise*, 32 (2), 412-6. 2000.

[42] Hunter GR, McCarthy JP, Bamman MM, "Effects of resistance training on older adults", *Sports Medicine*, 34 (5),329-48. 2004.

[43] Van der Ploeg HP, Chey T, Korda RJ, Banks E, Bauman A, "Sitting time and all-cause mortality risk in 222,497 Australian adults", *Archives of Internal Medicine*, 172 (6). 494-500. 2012.

[44] Healy GN, Wijndaele K, Dunstan DW, Shaw JE, Salmon J, Zimmet PZ, "Objectively measured sedentary time, physical activity, and metabolic risk the Australian Diabetes, Obesity and Lifestyle Study (AusDiab)", *Diabetes Care*, 31 (2). 369-71. 2008.

[45] Healy GN, Dunstan DW, Salmon J, Shaw JE, Zimmet PZ, Owen N, "Television time and continuous metabolic risk in physically active adults", *Medicine and Science in Sports and Exercise*, 40 (4). 639. 2008.

[46] Healy GN, Dunstan DW, Salmon J, Cerin E, Shaw JE, Zimmet PZ, "Breaks in sedentary time beneficial associations with metabolic risk", *Diabetes Care*, 31 (4). 661-6. 2008.

[47] Waters L, Reeves M, Fjeldsoe B, Eakin E, "Control group improvements in physical activity intervention trials and possible explanatory factors: a systematic review", *Journal of Physical Activity and Health*, 9 (6). 884-95. 2012.

[48] Høj K, Skriver MV, Hansen A-LS, Christensen B, Maindal HT, Sandbæk A, "Effect of including fitness testing in preventive health checks on cardiorespiratory fitness and motivation: study protocol of a randomized controlled trial", *BMC Public Health*, 14 (1). 1057. 2014.

[49] Waters L, St George A, Chey T, Bauman A, "Weight change in control group participants in behavioural weight loss interventions: a systematic review and meta-regression study", *BMC Medical Research Methodology*, 12 (1). 120. 2012.

[50] Morrow Jr JR, Mood D, Disch J, Kang M, "Measurement and Evaluation in Human Performance", 5E: Human Kinetics, 2015.

[51] Zavanela PM, Crewther BT, Lodo L, Florindo AA, Miyabara EH, Aoki MS, "Health and fitness benefits of a resistance training intervention performed in the workplace", *The Journal of Strength & Conditioning Research*, 26 (3). 811-7. 2012.

[52] Kettunen O, Vuorimaa T, Vasankari T, "12-mo intervention of physical exercise improved work ability, especially in subjects with low baseline work ability", *International Journal of Environmental Research and Public Health*, 11 (4), 3859-69. 2014.

[53] Patterson R, "Changing patient behavior: Improving outcomes in health and disease management", Jossey-Bass Inc Pub, 2001.

[54] Rooney B, Smalley K, Larson J, Havens S, "Is knowing enough? Increasing physical activity by wearing a pedometer", WMJ-MADISON, 102 (4). 31-6. 2003.

[55] Proper K, Van der Beek A, Hildebrandt V, Twisk J, Van Mechelen W, "Short term effect of feedback on fitness and health measurements on self reported appraisal of the stage of change", *British Journal of Sports Medicine*, 37 (6). 529-34. 2003.

[56] Butler CE, Clark BR, Burlis TL, Castillo JC, Racette SB, "Physical activity for campus employees: a university worksite wellness program", *Journal of Physical Activity and Health*, 12 (4). 470-6. 2015.

[57] Chan CB, Ryan DA, Tudor-Locke C, "Health benefits of a pedometer-based physical activity intervention in sedentary workers", *Preventive medicine.* 39 (6). 1215-22. 2004.

[58] Finkelstein EA, Haaland BA, Bilger M, Sahasranaman A, Sloan RA, Nang EEK, "Effectiveness of activity trackers with and without incentives to increase physical activity (TRIPPA): a randomised controlled trial", *The Lancet Diabetes & Endocrinology*, 4 (12). 983-95. 2016.

[59] Freak-Poli RL, Cumpston M, Peeters A, Clemes SA, "Workplace pedometer interventions for increasing physical activity", *The Cochrane Library*, 2013.

[60] Robroek SJ, Van Lenthe FJ, Van Empelen P, Burdorf A, "Determinants of participation in worksite health promotion programmes: a systematic review", *International Journal of Behavioral Nutrition and Physical Activity,* 6 (1). 26. 2009.