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ENHANCING DAILY PHYSICAL ACTIVITY IN SEDENTARY EMPLOYEES: THE EFFECT OF THE COACH BEHAVIORAL MODIFICATION STRATEGY

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PREFACE

The worksite physical activity intervention in the current thesis is part of the cross-country multi-disciplinary projects conducted by Dr. M. H. G. De Greef in the Netherlands, who has extensive expertise working in this field for more than 10 years. With his permission, I had a chance to engage in part of this ongoing research project as my master thesis, which was a requirement for the 'Erasmus Mundus Master in Adapted Physical Activity' degree. My investigation was related to enhancing daily physical activity in sedentary employees and against this background, I tested the effect of the COACH behavioural modification strategy towards the implication of daily physical activity, morphological fitness, and physical fitness.

The evidence on the benefits of physical activity has been well documented. Regular participation in physical activity reduces the risk of premature death, disability and non-communicable diseases, in additional to this, a reduction of the large public health burden associated with a sedentary lifestyle has become a priority in many countries and is endorsed by World Health Organization (Rutten A. et al., 2003). The pioneer worksite physical activity intervention was founded in the 19th century in Western countries, and many industries simply wished to maximize the output of their enterprises by demonstrating concerns for the health and welfare of their employees, according to R. J. Shephard (1986), who did broad research on the topic of fitness and health in industry in the recent decades. Statistics suggested that a well-organized fitness and life-style program could save the Canadian economy as much as $ 15 billion per year, while extending the life span of the average worker by as much as 2 years (Shephard R. J. 1986). However, in eastern countries such as Japan, 'morning exercise' or 'Radio Taiso' has been a customary worksite culture for the employees in all levels before World War I. This management strategy on worksite physical activity was practiced in tradition among the Japanese though there was not a clear written document about it. In recent years, exercises before starting each work session for the maintenance of health and the prevention of lumbago had been marked in Guidelines on the Prevention of Lumbago in the Workplace (1994), Ministry of Labor in Japan.

The result of the present study within this population can be useful for the development and implementation of worksite physical activity or health behavioral motivation guidelines, as well as long-term intervention study among the sedentary working adults. Except for the community health purpose, such study may provoke researchers to investigate a new approach in occupational aspects in order to solve the illness, fatigue, injury and various health problems at the work place in the future.

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Abstract

Rationale. The purpose of this study was to evaluate the enhancement in daily physical activity in sedentary employees by using the COACH behavioural modification strategy. **Design.** A non-balanced, randomised controlled trial with ´pretest-posttest` protocol, was used to assess the effects of the COACH method in daily physical activity (steps/day), physical fitness, and morphological characteristics. Sedentary workers, who agreed to participate in the study, were randomised into an experimental (n = 77) and control group (n = 73). **Results.** Significant differences were found in daily physical activity (steps/day, p <.001), walking endurance, (p= .004), diastolic blood pressure (p= .009), BMI (p= .003), and body fat percentage (p= .001) between the experimental group and control group. **Conclusion**. It can be concluded that the COACH method is adequate to enhance daily physical activity in sedentary workers.

Introduction

According to the World Health Organization (WHO) a sedentary lifestyle is one of the top ten causes of morbidity and mortality worldwide (WHO, 2006). Epidemiological researches illustrate that a majority of the adult population is sedentary. Sjöström et al.(2006) show that two thirds of the adult populations of European countries are insufficiently active to maintain their health. A lower prevalence of a sedentary lifestyle was found in Northern European countries (Scandinavian region) compared to other European countries: percentages of sedentary lifestyles across European countries ranges from 43% in Sweden to 88% in Portugal. (Varo et al., 2003). In USA 78% of the population was at risk for health problems due to lack of exercise and physical activity (USDHHS, 1996). Sedentariness of the adult population is remarkably consistent in the health surveys in most developed and developing countries, (WHO, 2006). WHO claimed in 2006 that effective public health measures were urgently required to promote physical activity and improve public health worldwide. Consequently and due to the public health burden of sedentariness governments of all western industrialised countries took initiatives to enhance a physical active lifestyle in the sedentary population.

The worksite is worldwide targeted as an important setting for public health interventions, especially for the enhancement of physical activity among sedentary employees (USDHHS 2002, WHO 2006) The worksite presents extensive opportunities to reach large numbers of people for health promotion and disease prevention, because most of the adult population is employed. Not only do worksites provide an easy longitudinal access to a large number of people, they also offer the possibility to conduct multi-level interventions, directed at individual, organizational and environmental determinants of health and health behaviours.

Besides health benefits physical inactivity has also impact on work performance, like work productivity and performance, turnover, loss of expertise, workplace accidents and injuries in employees (Bouchard and Shephard, 1994; Howard & Machalachki 1979; Steers and Rhodes, 1978; Chisholm, 1977; Pravosudov, 1978; Bertera, 1990; Pronk et al., 2004). According to the Toronto Model, a link is assumed between physical activity, physical fitness and work performance (Bouchard and Shephard, 1994). Physical activities are basically all sports, household and leisure-time activities as well as professional work. Physical fitness is defined as motor properties that are necessary to perform and maintain actions in the workplace (Pate, 1988). Among these motor properties are manual dexterity, strength, agility, balance, reaction time and endurance. According to Van Heuvelen et al. (2000) physical fitness determines 31-47% in women and 14-34% in men of the variance in physical performance and fitness characteristics. Strength and walking endurance influence these abilities the most.

Matson-Koffman and colleagues (2005) had recently reviewed the literature to determine whether worksite interventions can increase people's physical activity or improve their dietary habits. In total, details were given on 18 worksite-based interventions directed at either physical activity or nutrition. They concluded that worksite-based interventions are effective in changing physical activity and nutrition behaviors of the working population. However Kwak and colleagues (2006) showed, based on a secondary analysis of the results of data used by Matson-Koffman et al, that the participation rate of employees in worksite based intervention studies is low. They suggest the important reasons for refusal to participate in worksite based interventions are lack of time and resources in times of economic stagnation. Prodaniuk et al. (2004) suggest that the low participation rate is due to lack of targeting the psychological factors to enhance physical activity behavior. Especially expected benefits and costs of performing a behavior (i.e., outcome expectations), and one's belief that he or she is capable of performing a behavior to get a desired result (i.e., self-efficacy), are constructs utilized from established cognitive-based theories, such as Social Cognitive Theory, to promote physical activity at the individual level. Based on reviews of the literature, however, workplace interventions using such theoretical constructs as a basis for intervention have only been modestly successful at increasing physical activity involvement. Current theoretical approaches focused on psychological constructs (e.g., Transtheoretical Model, Theory of Planned Behavior, Social Cognitive Theory) to predict physical activity have been quite limited, at best explaining about 30% of variance in physical activity, suggesting a more comprehensive understanding of physical activity determinants is needed.

As more focus is placed on employing an ecological approach in physical activity research, ecological models have emerged for understanding this behavior. Recently, an ecological model for physical activity behavior has been conceptualized (Spence & Lee 2003; Plotnikoff et al, 2005). Ecological models provide a comprehensive ecological framework from which several testable hypotheses concerning physical activity promotion have been proposed. There has been some research supporting direct relationships between the environment and goal-directed behaviors. From Bargh and Gollwitzer's work, it seems reasonable to suggest that people with a long term goal to be physically active could be prompted to do physical activity in situations where they have continually chosen to be active over time, without cognitive mediation. This line of research however, has not been directly tested in the physical activity domain. The overall aim of the study is to analyze the effect of goal-directed worksite-based behavioral change strategies in sedentary employees. Consequently, this study focuses on exercise counseling as a goal-directed worksite-based strategy to enhancing daily physical activity and physical fitness in sedentary employees. Second aim exploration of the predictors which determine a positive response to the programme?.

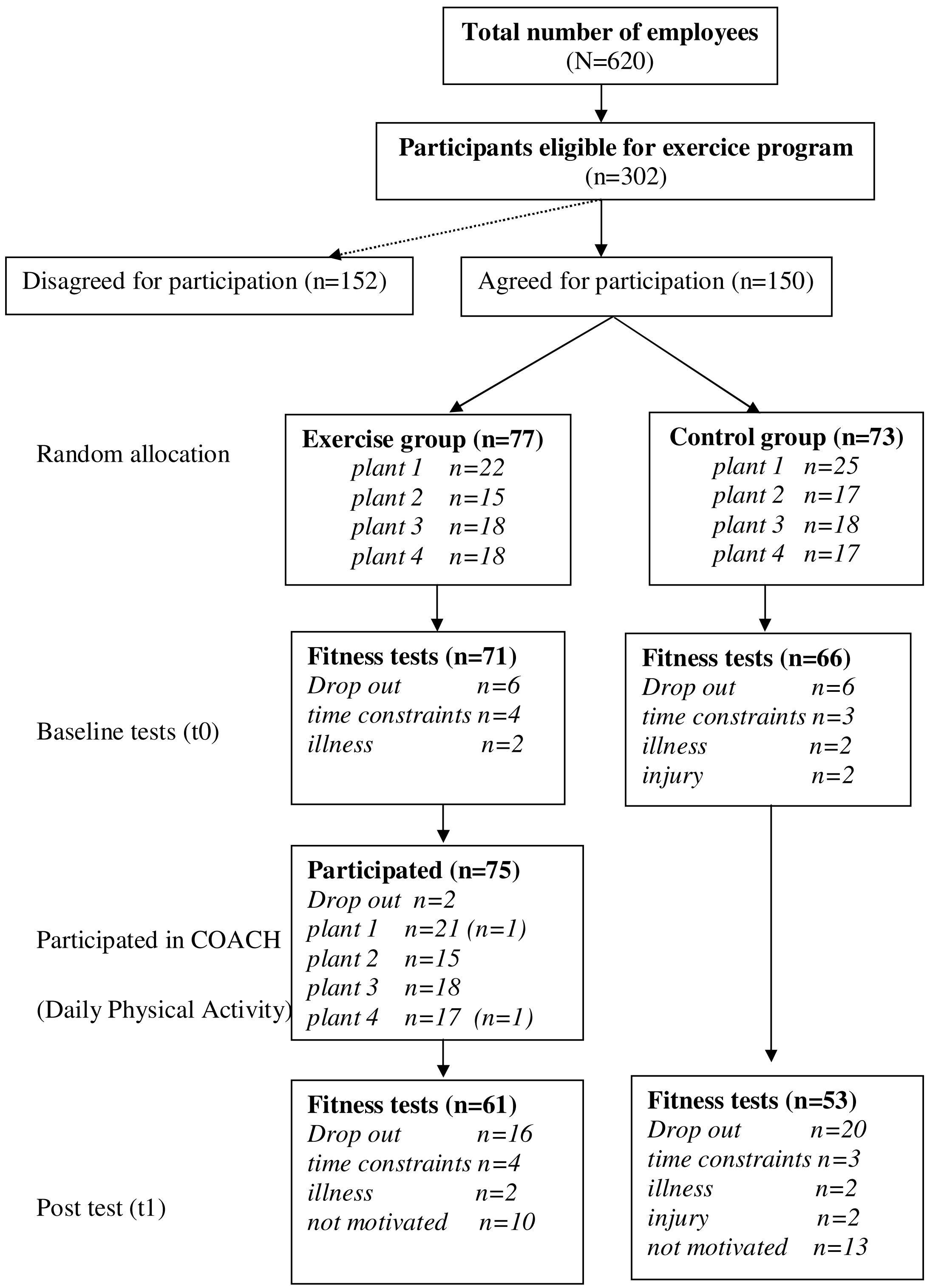
Methods

This section and the results section follow the order criteria of the CONSORT statement for reporting randomized trials (Altman et al., 2001). I would not add this statement. According to CONSORT a lot more detail is needed about the randomization procedure and what the primary and secondary outcomes are.

Subjects and Design

A non-balanced, randomized controlled trial was carried out to evaluate the effects of the COACH behavioral change program in sedentary employees. All employees (n=620), aged 21 to 65, from a plant in Rotterdam were informed about the study by e-mail and individually visited. During this visit, employees were screened for physical inactivity using the Stage of change questionnaire (Marcus & Simkin, 1993). About 49% of the employees (n=302) with a score 2 (thinking about becoming physical active) or 3 (infrequently physical active) were, according to the Dutch Public Health recommendations, considered to be sedentary and eligible for the study. About 50% of the sedentary employees (n=150) agreed to participate and were enrolled in the study and randomized in the experimental (n=77) and control group (n=73). It was estimated that 150 participants were needed to detect a clinically meaningful difference in effect size of 0.45 with 80% power at alpha 0.05 (Cohen, 1988). A written informed consent was obtained from each participant. The 150 workers who were enrolled in the study had similar white collars' computer-based work characteristics in the same office environment (working as information technology specialists, project design team, draft-men, technicians and engineers).

Figure 1: Flow Chart



Measurements

Chronic diseases

As part of the safety procedure all subjects who participated in the fitness test and the intervention had their blood pressure measured and filled out a modified version of the Physical Activity Readiness Questionnaire (PAR-Q) (British Columbia Ministry of Health, 1989). The chronic disease questionnaire included a list of 33 chronic conditions or diseases and the respondent was asked whether he or she had these conditions currently or had them in the 12 months preceding the interview. The list was an adapted version of the continuous household survey of the Statistics Netherlands (Mootz & van den Berg, 1989)

Stages of change

The behavioral change status will be assessed with the stage of change questionnaire. The items of the questionnaire intend to identify the adult's stage of readiness to start physical activity (Ainsworth & Youmans, 2002). Five physical activity intention levels like precontemplation, contemplation, preparation; action and maintenance (DiClemente & Prochaska, 1985) were used. The questionnaire was validated by Marcus (Marcus & Simkin, 1993).

Daily Physical Activity

Daily physical activity was monitored with a pedometer (Digi-walker SW-200). Pedometer is a gadget commonly to be worn on the belt to record the number of steps taken. It is designed to measure vertical accelerations, so they are most sensitive to physical activities especially walking and running (Welk *et al.*, 2000; Tudor-Locke *et al.*, 2002, Tudor-Locke *et al.*,2004). Pedometers are simple to use, inexpensive and produce a user-friendly output - steps taken (Tudor-Locke *et al.*, 2004). It particularly works well for people who claim lack of time to walk consistently as a form of exercise. By tracking the number of steps daily means doing regular daily physical activities, with an ultimate goal in achieving 10000 steps minimum per day, the workers may find carious ways to obtain more steps. The criterion validity of the pedometer with different accelerometers is r .86, with self-reported physical activity r.33 (Tudor-Locke et al., 2002, Tudor-Locke et al., 2004). The recommended number of steps is 10000 steps per day, disregard the intensity, for average healthy adult to be excluded from the sedentary category. According to the physical activity guidelines, this 10000-step represents the accumulated 30 minutes of moderate intensity exercise per day which may lead to the prevention of cardiovascular disease (Tudor-Locke et al, 2006).

Physical fitness

Physical fitness was assessed by using tests of the Groningen Fitness Test for the Elderly (GFE) together with the Functional Reach Test. For all the fitness tests, except reaction time, the higher they scored the better the performance indicated.

Leg strength: Lower-body strength was measured withy the chair stand test (CST), which counts the total number of full stands completed in 30 seconds. Employees were instructed to sit on the middle of a flat chair, which was placed against the wall to prevent slipping, with back straight, feet flat on the floor and arms crossed at the wrists and held against the chest. Upon a start signal the patients were instructed to rise to full stand and then return to a seated position. Employees were told to complete as many full stands as possible in 30 seconds.

Grip Strength: The subject held a handgrip dynamometer in the preferred hand with his arm by his side and had to squeeze with maximum force. The score obtained (kgF) was the best of three trials.

Dynamic balance - '8 Foot up and go': It was measured by the number of seconds required to get up from a seated position, walk 8 feet (2.44 m), turn, and return to seated position.

Manual Dexterity: The subject had to replace 40 blocks from a full board to an empty board in a prescribed way as quickly as possible with the preferred hand. The time taken to complete the task was recorded (seconds).

Reaction Time: The subject had to react to a visual signal by pushing a button as quickly as possible. The time between signal and reaction was recorded (milliseconds). The score was the median of 15 trials.

Low back Flexibility: The participants had to sit on the floor with the legs fully outstretched at right angles on a box. The heels were approximately eight inches apart. The subject then had to bend forward and push an object, which was the yardstick, on the box as far as possible with their fingertips (Sit-and-Reach Test). The distance or the shift of the object was recorded (cm). The best of three trials was taken as the obtained score.

Shoulder Flexibility: This is a modified version of 'back scratch test' by using a cord with a fixed handle on one end and a sliding handle on the other end. It started when the participants held both handles of a cord and passed it from the front of the body, over their head to place it behind the body. The arms were kept straight and as close together as possible. The distance or shift of the sliding handle was used to determine the score (cm). The score was the best trial of three.

Walking Endurance: The participants walked on a rectangular course (8.3 x 16.7 m) which was divided into three 16.7 interval. Walking speed was controlled by means of auditory signals. Between two signals, a distance of 16.7 m had to be covered. The time intervals between signals were chosen in such a way that walking speed was increased by 1 km/h every 3 minutes, starting from 4 km/h and ending at the speed of 7 km/h. The subject had to keep up the effort as long as possible. The score was the number of completed intervals of 16.7m.

Morphological fitness

Diastolic and systolic blood pressure (mmHg) was examined electronically (Omron M4). (Yarows & Brooks, 2000). Percentage body fat was measured by means of leg-to-leg bioelectrical impedance analysis (Tanita TBF-300). This method proved to be reliable to measure body fat percentage, and results correlated highly with body fat percentages as measured with underwater weighing and dual energy x-ray absorptiometry (Nuñez et al., 1997). Body Mass Index (BMI) was calculated by dividing the body mass in kilograms by height in square meters (Must et al.,1991).

Measurements protocol

Employees were assessed at baseline (t0) and after 10 weeks (t1). Data were collected by trained staff, blinded for group assignment. Before taking the fitness test blood pressure was examined. If participants had a systolic blood pressure over 160 mmHg or a diastolic blood pressure over 100 mm Hg or answered one or more questions of the PAR-Q with 'yes' then they had to visit the physician who was available at the test site. Demographic characteristics were measured by a questionnaire in which chronic diseases were registered by means of part of the list of chronic diseases used in the Dutch national health survey (Mootz and Van den berg, 1989) Daily physical activity (steps/day) was daily assessed during the intervention. The daily steps for experimental group was measured throughout the 15 weeks, while the control group was tested in week one, week two, and week 15.

Intervention

The experimental group followed a lifestyle physical activity counseling program with feedback of a pedometer in 15 weeks. The main goal was to meet the standard of 10000 steps per day (Tudor-Locke et al., 2004). The participants were motivated by four exercise counselors to incorporate lifestyle physical activity. Pedometer was adopted as a motivational and feedback tool to monitor their daily physical activity. Activities such as cycling, swimming and weight-training, the duration (minute) taken was recorded and converted into number of steps according the criteria of Tudor-Locke (2004). The current exercise counseling program was used as a multidimensional technique to identity the behavioral change. The most important technique underlying the exercise counseling in this intervention program was motivational interviewing (Terry, 2000). Five exercise counseling sessions were carried out during the 15 weeks of the study. The 45 minutes (estimated duration) small group counseling consisted of 5 persons per session. Initially, the first session dealt with motivation to increase physical activity and pedometers with user instructions were given to the participants. The second and third counseling sessions that targeted in goal-setting were executed in week 5 and 8. The fourth was in week 12 and dealt with shifting boundaries. The movement pattern was evaluated and participants were asked to set a goal for seeking their maximal physical activity limit. The fifth counseling session was conducted in week 15 focusing consolidation of physical activity behavior. Participants set a goal for their personal physical activity, aiming at the range between their mean steps per day and maximal number of steps. After each session of counseling, participants received a report of that particular session sent by post. The control group was only required to wear the pedometer for week-1, week-2, and week-15, their score were recorded. The control group received no exercise counseling and information about lifestyle activities or the criteria of 10000 steps per day. The main outcomes of measurement were daily physical activity and physical fitness, other supporting measurement was health related fitness

Analysis Procedures

Data analysis was performed with SPSS 10.0 for Windows. Descriptive statistics were used to describe the main characteristics of the study sample. For these characteristics the baseline comparability of the different groups was analyzed student test Analysis of Variance (ANOVA), Chi-square, and Independent T-test. Multivariate Analysis of Variance with repeated measures (MANOVA repeated measure) was used to evaluate the effects of group assignments on change over time (group x time effect). Multiple regression analysis and Discriminant function analyses was used to determine which variable dicriminate between each other. Effect sizes (ES) were calculated using Cohen (1988). ES <.20 indicated a low effect, between 0.50 and 0.80 a moderate effect, >0.80 high effect.

Results

Hundred and fifty employees, 65% men and 35% women, with a median (range) age of 44.5 (21-61) yrs were included. Employee features are shown in table 1. For these employees the median (range) BMI was 27.0 (18.7 – 41.5) kg/m^2, whereby 42.8 % were overweight (BMI >25<30) and 20.3% obese (BMI >30). The median (range) body fat was 28.2% (10.6-49.5): The mean (range) systolic blood pressure was 142.3 mmHg (100-202) and the diastolic blood pressure 85.0 mmHg (60-120). The results revealed that, the subjects showed overweight or obesity in body fat percentage and BMI, and pre-hypertension symptoms according to the blood pressure standards of the Center for Disease Control and Prevention, US Department of Human Health Service. According to self-reported physical activity status (stage of change) about 57% of the employees were sedentary, while the assessment by the performance based pedometer showed that 100% of the employees in the present study were sedentary (>10000 steps?). About 41% of the employees in the sample reported problems in the PARQ questionnaire, which meant that they may not have been fit enough to undergo certain exercise tests, whereas 53% of the participants reported one or more chronic diseases.

Due to an age effect, participants in the experimental group (mean age 46yr) were significantly older ($p<.05$) than participants in the control group (mean age 42 yr). Statistically significant differences in blood pressure, both systolic and diastolic, BMI and number of chronic diseases were in tune with the difference in mean age between the experimental and the control group.

Table 1 Biographic, morphological, physical activity and health characteristics in employees participating in the COACH trial

characteristics			conditions		descriptive statistics		
		n	experimental	control	score	df	p
Biographic							
Gender (%)	Male	95	61.6	67.6	$Chi^2 = 0.56$	1	0.45
	Female	52	38.4	32.4			
Age categorized (%)	20-40	47	39.7	23.4	$Chi^2 = 9.23$	2	0.01*
	41-50	60	42.5	37.7			
	51-65	43	17.8	39.0			
Age (mean)	years	150	46.1 (± 8.4)	42.8(± 7.9)	t=-2.5	148	0.01*
morphological							
Blood pressure mmHg	Pre-systolic	138	146 (± 15)	139 (± 18)	t=-2.48	136	0.01*
	Pre-diastolic	138	87(± 10)	81(± 11)	t=-316	136	0.02*
BMI-categorized (%)	<25	51	36.4	37.5	$Chi^2 = 2.57$	2	0.02*
	25.01-30	59	37.9	47.2			
	>30.1	48	25.8	15.3			
BMI (mean)	index	138	27.6(±4.8)	26.3(±3.6)	t=1.78	136	0.08
%Fat-categorized*	acceptable	66	42.2	52.8	$Chi^2 = 1.48$	1	0.22
	obese	72	57.6	47.2			
%Fat (mean)	index	138	27.2(±9.17)	29.5(±9.37)	t=1.51	136	0.13
Physical activity							
Sedentary (%)	Yes (stage 1-3)	85	58.4	54.8	$Chi^2 = 0.20$	1	0.65
	No (stage4,5)	65	51.6	45.2			
Steps/day baseline	Mean	149	8297(±3676)	7919(±2652)	t=.72	138	0.47
Health status							
PARQ (%)	no problems	81	66.2	57.5	$Chi^2 = 3.05$	1	0.08
	>1 problems	56	33.8	48.5			
Chronic diseases (%)	No diseases	64	56.3	36.9	$Chi^2 = 5.13$	1	0.02*
	>1 diseases	72	43.7	63.1			

* % body fat criteria: acceptable in men 18-25% , acceptable in women 25-31%; obese in men >25% , obese in women >32%
* $p < 0.05$ PARQ= Physical Activity Readiness Questionnaire = >1 problems is contraindication for physical activity

Results of physical activity status (steps/day) and physical fitness are shown in Table 2. The employees enrolled in this study did understand the pedometer instructions and were able to wear the Digiwalker. About 114 employees (76%) produced consistent day-to-day results during the 15 week COACH program. The increase in median steps/day appeared to be significantly higher in the experimental group as compared to participants in the control group (+ 4575 experimental group vs. + 1757 control group, $p \leq 0.001$). About 85% of the participants reached the criteria of 10.000 steps/day.

Table 2: Effects in daily physical activity and physical fitness in the experimental and control group in the COACH trial

	Experimental Group						Control Group										
	Pre			Post			Pre			Post			F	df	Sig	Power	Effect Size (ES)
	Mean	**SD**	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**					
Daily Physical Activity																	
Steps/day	8433	3624	75	13008	3708	75	7955	2876	57	9712	3254	57	24.223	1	0.001**	1.00	1.01
Physical Fitness																	
BMI	26.29	3.51	59	25.85	3.46	59	26.98	4.54	40	26.98	4.50	40	9.325	1	0.003*	0.856	-0.25
Body fat %	27.34	9.27	61	25.61	8.58	61	28.66	9.57	40	28.89	9.18	40	15.620	1	0.001**	0.975	-0.36
Systolic BP	146	15	59	139	17	59	135	14	34	133	14	34	2.247	1	0.137	0.317	0.43
Diastolic BP	88	10	60	85	9	60	79	11	34	81	9	34	7.213	1	0.009*	0.757	0.44
Leg strength	15.76	3.65	60	16.94	4.36	60	15.43	3.90	37	15.84	3.74	37	1.953	1	0.166	0.282	0.29
Grip strength	47.5	12.3	61	49.8	12.6	61	43.2	10.4	38	44.6	10.0	34	2.144	1	0.146	0.305	0.52
Dynamic balance	3.66	0.47	59	3.58	0.45	59	3.73	0.56	44	3.70	0.58	44	0.410	1	0.523	0.097	-0.21
Manual dexterity	40.5	3.3	61	39.2	5.6	61	39.1	3.6	39	38.0	4.0	39	0.045	1	0.833	0.055	0.30
reaction time	227.93	37.56	60	221.35	24.39	60	237.79	24.08	48	236.96	27.44	48	1.204	1	0.275	0.19	-0.57
flexibility low back	28.75	8.64	58	29.83	8.92	58	29.28	9.84	38	30.76	9.05	38	0.157	1	0.693	0.068	-0.10
flexibility shoulder	-0.32	9.51	60	1.29	9.41	60	3.09	6.98	40	3.90	6.81	40	1.797	1	0.183	0.264	-0.38
walking endurance	193	36.1	49	212.8	32	49	198.2	30.1	37	203.7	35	37	8.8	1	0.004*	0.834	0.26

* $p < .05$ ** $p < .001$

Table 2 also shows the results of testing the group by time interactions. Statistically significant differences in decrease in diastolic blood pressure (p= .009), decrease in BMI (p= .003), decline in body fat percentage (p= .001), and increase in walking endurance (p= .004) were found in the experimental group compared to the control group. No statistically significant differences (p>.05) in systolic blood pressure, leg strength, grip strength, dynamic balance, manual dexterity, reaction time, flexibility shoulder and flexibility low back were found in the experimental group compared to the control group. There were no significant difference in biographic and morphology (baseline) characteristic between the participants and dropouts in all tests among both experimental and control groups.

A multiple regression analysis using the variables, number of chronic diseases, age, number of PARQ problems, the baseline information in pretests of endurance for walking BMI, percentage of body fat, and leg strength has an explained variance of R^2 (adjusted) .04. A discriminant analysis (method *Enter)* was performed in order to assess the determinants that affect the increase in mean number of steps/day in employees in the experimental group. Therefore, employees were divided into two equal groups on the basis of their increase in steps/day by 'high increase' (> +4505 steps/day) versus 'low increase' (< +4505 steps/day). The variables included in the multiple regression analysis were re-assessed. Discriminant analysis (n=59) showed that according to the standardized canonical discriminant functions, the determinants showed the subsequent order: pre-endurance for walking (0.60), number of chronic diseases (- 0.51), age (0.46), number of PARQ problems (0.38), pre-BMI (-0.29). Overall, the canonical correlation (proportion explained variance) was 0.20 (Wilks' Lambda = 2.20, df = 5, p < 0.82). Fifty seven % of the originally grouped cases were correctly classified.

Discussion

I would be in favour to change the discussion to past tense throughout!

The COACH behavioural intervention protocol results in a statistical significant increase (P <.001, β 1.00, ES 1.01) in the experimental group (+ 4575 steps/day) compared to the control group (+ 1757 steps/day). About 85% participants reach the criteria of 10.000 steps/day. The result show a statistically significant change in diastolic blood pressure (P=.009, β= .76, ES= .44), BMI (p= .003, β= .86, ES= - .25), body fat percentage (p= .0.001, β= .98, ES= - .36) and walking endurance (P=.004, β= .83, ES= .26) in the experimental group compared to the control group.

The results in this study are in tune with other studies in the field of enhancement of daily physical activity in employees. An increase in physical activity was found in a number of other studies in employees (Emmons et al., 1999; Peterson et.al.; 1999; Speck et al., 2001; Hager et al., 2002; Napolitano et al., 2003; Proper et al., 2003). The duration of these studies vary between 6 weeks and 2 to 5 years and different types of intervention were used. Only one study used a pedometer to assess daily physical activity. (Speck et al., 2001) Compared to the study of Speck et al. (2001), in which 25 employees were counselled during 12 weeks, the increase in mean steps/day in our study is about 31% higher.

The dropout in this study, according to the participation rate in the 15 week intervention, was low (75 out of 77 employees completed the intervention), although 53 out of 77 employees in the experimental group fully registered their steps/day during the 15 week intervention. Compared to other health enhancing physical activity studies in employees the dropout rate, which was estimated >50%, was significantly lower in this study (Dishman, 1988). Significant changes in aerobic capacity were also found in studies of Proper et al.,2004; Grandjean et al.,1996; Oja et al., 1998; Winett et al., 2003, although the assessment of aerobic capacity differs in these studies (VO_2max, sub maximal capacity) and the duration of the interventions varies between 12 weeks and 9 months. A number of studies show changes in body fat after a long-term exercise regime (10-12 yrs, a 20-24% reduction of body fat), in combination with a diet counseling (Shephard, 2000). However, in this 15 weeks study, a reduction of 6.3% body fat is found. No health enhancing physical activity studies in employees found statistically significant effects in systolic blood pressure, flexibility, strength, dynamic balance, and reaction time. In contrast with our results, one study into enhancement of physical activity found statistical significant effect in flexibility in the low back and shoulder (Campbell et al., 2002, Shephard, 2000). Exercise reduces blood pressure but the response varies between individual (Frank et al., 2004). Vahid et al. (2004) found no observed differences in body flexibility, strength, dynamic balance and reaction time among the normal and overweight subjects. BMI in the control group had a drastic decline ($0.44 kg/m^2$) in experimental group, whereby the control group remained unchanged. Variety in the tests used in different intervention studies and among different populations may contribute to the dissimilar epidemiological pattern.

You do not comment on the discriminant anlysis results….

A number of methodological aspects are relevant for the interpretation of the results of this study. Due to the non-balanced study design a selection bias had arisen, due to the difference ($p<.05$) in mean age in the experimental and control group. How can future study accommodate for this (stratified design, statistical control for confounders) Although participants in the experimental group were significantly ($p<.05$) older (+ 4 yr), the number of participants in the highest age category (51-65 yr) in the control group differed significantly from he experimental group (table 1).

Even though assessment of daily physical activity by pedometers is shown to be reliable and valid (Tyron et al., 1991) there are a number of limitations using this device. First, non-ambulatory daily physical activity like cycling, swimming are not registered by the pedometer. These limitations result in an under-registration of daily physical activity. Secondly, no intensity or type of daily physical activity was assessed in this study. Consequently the increase in mean steps/day provides only a limited picture of the change in daily physical activity. Thirdly, the study concentrates on effects in the short term. A follow up study is needed to study long term effects of this type of intervention.

Conclusions

It can be concluded that the COACH behavioural modification strategy is an adequate method to enhance daily physical activity and physical fitness in walking endurance, and morphological characteristics in diastolic blood pressure, BMI, body fat percentage in sedentary employees. Even short-term physical activity enhancement intervention may improve the daily physical activity and a number of physical fitness and morphological characteristic. A structured program such as COACH may be useful for future reference in intervention and research.

Some key issues may be pinpointed from the current study. Future attention should be directed towards understanding workers' sedentary behavior, including both physical, biological and psychological variables, the environmental and social limitations to enhance daily physical activity, targeting subgroups of working adults in different age groups and understanding the synergy between physical activity and other health behaviors.

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