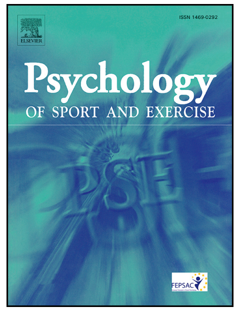

Worksite intervention effects on motivation, physical activity and health: A cluster randomized controlled trial

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Worksite intervention effects on motivation, physical activity and health: A cluster randomized controlled trial.

Pedersen, C.*[1], Halvari, H.[2], & Williams, G.C.[3], 2017

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Abstract

Objectives: The current study tested the hypothesis that a group-based physical activity (PA) intervention in the worksite would lead to increases in autonomous motivation and perceived competence for PA, self-administered regular PA, and cardiorespiratory fitness, as well as improvements in health (i.e., reduced blood pressure (BP), waist circumference, and improved non-HDL cholesterol levels). Moreover, the study tested the Self-Determination Theory (SDT) process model of health in which the motivational variables would mediate the effect needs support on PA and health. ***Design***: Cluster randomized controlled trial. ***Method:*** N = 202 participants from a population of employees working with transport and distribution were cluster randomized (n = 6) to an intervention and a control condition. The group-based worksite intervention was designed based on the tenets of SDT combined with techniques from Motivational Interviewing. Participants were assessed at baseline and at post-test five months later. ***Results:*** Complete-case analyses of variance indicated an overall intervention effect, and significant, moderate to small effects sizes (Cohen's d) in favor of the intervention group on needs support, autonomous motivation and perceived competence for PA, diastolic BP, and cardiorespiratory fitness. The effect sizes were small for all other measures (d's < .30). Intention-to-treat analyses demonstrated the same pattern with smaller effect sizes. Path analysis obtained a good fit between the data and the SDT process model of health. ***Conclusions:*** Offering needs supportive interventions to enhance autonomous motivation and competence for PA among employees resulted in important improvements in cardiorespiratory fitness as well as positive changes in health.

Keywords: Worksite health promotion, Physical activity, Self-Determination Theory, Autonomous motivation, Cardiorespiratory fitness, non-HDL cholesterol.

Trial registration: "My Exercise. A Team-based Workplace Intervention for Increased Exercise", clinicaltrials.gov, NCT02429635, April 14, 2015.

Physical activity (PA) at the recommended levels is known to prolong life, reduce risk for cardiovascular diseases (heart attack, stroke, and atherosclerosis), risk of diabetes, and risk of certain types of cancer (American College of Sports Medicine, 2014). The most recent national survey on PA habits among Norwegian adults found that only 32% satisfied the recommendations of 150 minutes of moderate PA, or 75 minutes of high intensity PA per week (Hansen et al., 2015). Despite of public education campaigns and intensive media attention to health benefits of regular PA, the changes in activity levels among Norwegians are surprisingly small. There is a need for more knowledge on how health promotion initiatives in non-treatment settings should be designed in order to support adults in increasing and maintaining their level of regular PA.

For several decades, the worksite has been regarded as an important context for health promotion initiatives aimed at increasing PA levels of the adult non-clinical population (Conn, Hafdal, Cooper, Brown, & Lusk, 2009). Due to the presence of natural social networks, employer-initiated programs can potentially enhance the degree of commitment to and support for lifestyle changes from colleagues and management (Abraham & Graham-Rowe, 2009; Rongen, Robroek, van Lenthe, & Burdorf, 2013). Despite the apparent advantages of the worksite context, health promotion programs can potentially be perceived a controlling and an intrusion to private life. Fear for negative reactions or pressure from colleagues and supervisors is a common reason for not participating in such programs (Linnan, Weiner, Graham, & Emmons, 2007). Hence, carefully designing the programs in order to avoid a sense of coercion is of pivotal importance, both for long-term behavioral change and for the well-being of employees.

Self-Determination Theory (SDT) (Deci & Ryan, 1985, 2000) is especially relevant to the worksite context given the focus on autonomous regulation for behavior change. SDT has been applied as a theoretical framework in numerous work-related studies, however never in the context of a worksite health and PA promotion intervention. According to SDT, individuals are most effective and persistent in pursuing a healthy lifestyle when they report autonomous motivation and perceived competence. That is.they engage in the behavior because they find it intrinsically satisfying or because they truly identify with and value the outcome. Further, SDT posits that individuals will develop autonomous motivation for a particular behavior when significant others adopt a needs-supportive approach toward the person (Ryan & Deci, 2002). When basic psychological needs for autonomy, competence, and relatedness are supported, this will facilitate a process of internalization resulting in more autonomous forms of self-regulation (Deci & Ryan, 1985, 2000; Ryan, Williams, Patrick, & Deci, 2009). Autonomous motivation has consistently shown to predict increased PA frequency, improved physical fitness, and increases in behavior related to regular PA (Edmunds, Ntoumanis, & Duda, 2007; Teixeira, Carraca, Markland, Silva, & Ryan, 2012). However, there is a need for more intervention studies in general, and specifically studies that last for more than three months allowing the internalization process to unfold. SDT-based PA intervention studies on adults have primarily been carried out in the context of community health services (Silva et al, 2008), and primary care (Fortier, Sweet, O'Sullivan, & Williams, 2007; Ng et al., 2012; Williams, Gagné, Ryan, & Deci, 2002). This is the first intervention study in the context of a worksite health promotion program.

The current intervention was developed based on an understanding of human motivational processes as described in SDT combined with techniques from Motivational Interviewing (MI) suitable for self-reflection and dialogue among peers in a group setting. Several studies have recommended a more systematic integration between SDT and MI given the strong emphasis on autonomy they have in common (Markland & Vansteenkiste, 2007; Vansteenkiste, Williams, & Resnicow, 2012). Meta-analysis of worksite PA interventions in general found that they were significantly more effective with employee interventionists compared to external ones (Conn et al., 2009). In the majority of the SDT based intervention studies, the provider of needs support, the "significant other" is represented by a figure of authority such as a physician (Williams, McGregor, Zeldman, Freedman, & Deci, 2004), a teacher (Reeve, 2002), a dentist (Münster Halvari, Halvari, Bjørnebekk, & Deci, 2012), and a parent (Fenner, Straker, Davis, & Hagger, 2013). The core of their profession is the expert helper, which makes them a natural and efficient source of needs support, especially in terms of competence, assuming that they are able to provide the required time. There are considerably fewer studies where peers, someone who is of equal standing, are targeted as agents of needs support. Peers are known to play an important role in terms of needs support during team sports or PA sessions (Ntoumanis, Vazou, & Duda, 2007; Wilson & Rodgers, 2004). However, there are few SDT based PA intervention studies designed specifically to influence the needs supportive behavior of peers, and none in the context of worksite health promotion. Health promotion programs offered by the employer tend to be restricted in terms of financial resources. Incorporating colleagues as an active ingredient can possibly provide participants with the needs support necessary for the maintenance of PA changes after completing the program.

The overall aim of this study was to increase participants' level of regular PA as well as their cardiorespiratory fitness. Despite the importance of regular PA, recent studies have indicated that the health benefits are negligible in terms of reduced risk of cardiovascular disease and premature mortality if cardiorespiratory fitness remains poor (Lee, Kuk, Katzmarzyk et al., 2005; Aspenes et al., 2011). Hence, health promotion initiatives will have a stronger impact on health if they target the participants' motivation (e.g. awareness, willingness and ability) to increase their PA intensity. The pivotal role of PA in terms of lowering the risk of cardiovascular diseases has been supported in both intervention trials and epidemiological studies (Gill & Malkova, 2006). This is especially the case for individuals with a risk profile defined as metabolic syndrome; abdominal obesity (large waist), raised triglycerides, an unfavorable combination of high-density lipoprotein cholesterol (HDL-C) and non-HDL-C levels, raised systolic and diastolic BP, and high levels of fasting plasma glucose (blood sugar) (Alberti, Zimmet, & Shaw, 2006). The current study aims to assess the effects of the PA intervention on some of these biomedical outcome variables, namely systolic and diastolic BP, non-HDL-C, and waist circumference. Recent studies state that low-density lipoprotein cholesterol (LDL-C) is a better risk marker for cardiovascular diseases compared to HDL-C, and guidelines recommend that apoB or non-HDL-C should be the main target of assessment and treatment (Wadhera, Steen, Khan, Giugliano, & Foody, 2016; Lloyd-Jones et.al., 2016).

Research questions and hypothesis

The primary aim of this study was to test the hypothesis that a needs-supportive team-based PA intervention (relative to a standard control condition) would lead to increases in regular PA and cardiorespiratory fitness, as well as improvements in health (i.e., reduced BP, waist circumference, and improved nonHDL-C levels). The secondary aim was to assess whether the data supported an SDT-based process model for health. The model was developed and tested by Williams and colleagues (2002), and received support in a meta-analysis based on studies in health related settings (Ng et al., 2012). The model assumes that perceived needs support for PA will have a positive effect on autonomous motivation and perceived competence for PA, and that this will mediate the effects on PA and health.

Method

The current intervention study adhered to the CONSORT 2010 checklist for cluster randomized trials (Moher et al., 2010) and the TIDieR checklist for interventions (Hoffmann et al., 2014). Statistical analyses were executed in SPSS version 21 (SPSS, 2012) and Mplus version 7.4 (Muthén & Muthén, 2015).

Design and procedures

A cluster randomized control trial design was preferred due to the group-based nature of the intervention sessions and the role of colleagues as a source of needs support for PA. In addition, individual-level randomization would increase the risk of contamination and crossover between groups considerably, and hence geographic worksite was chosen as the clustering variable. The practical and financial scale of the study did not allow for more than six worksite locations. All procedures were defined in the research protocol, and approved by the Data Protection Official for Research in Norway. In addition, the project was presented to the Regional Committees for Medical and Health Research Ethics, Norway, who concluded that the project could proceed without further approval according to the Norwegian health research legislation. Individual and written declarations of informed consent was administered by the researchers.

Participants and recruitment

All participants were employed by the Norwegian Post (18000 employees), delivering mail and logistic services, and they were terminal workers, drivers and mail carriers. They were recruited by means of information meetings at the workplace premises headed by the researchers. Inclusion criteria for clusters were defined as worksites that consisted of teams working shifts, and employees having a positon of more than 20%. Having a health condition was not a criterion for exclusion as long as the employees were fit for work.

Sample size calculations

The study was powered in order to detect clinically relevant changes in the primary outcome variable cardiorespiratory fitness since this is an objective measurement with stronger indication of actual change compared to the self-reported measure of PA. Sample size calculations were based on an estimated Cohen's effect size (ES) of 0.39, derived from a meta-analysis of worksite PA intervention studies resulting in an estimated mean of true ESs of 0.51 (95% CI = 0.39 to 0.63) (Conn et al., 2009). A conservative estimation of ES = 0.39 was expected since participants were to initiate and organize their exercise sessions individually. An estimate of the intra-cluster correlation coefficient (ICC) was set to 0.040 based on a review of cluster randomized controlled trials in primary care since equivalent meta-analyses of ICC was not found for worksite interventions (Eldridge, Ashby, Feder, Rudnicka, & Ukoumunne, 2004). SD was set to 0.5 based on a clinically relevant change of 3.5 mL/kg/min (Myers et al., 2004) combined with results from a large Norwegian study on healthy adults (mean = 40 mL/kg/min, SD = 7) (Aspenes et al., 2011). In order to achieve a detectable effect size of 0.39 with 90% probability at 5 % significance level, a sample size of n = 27 per cluster was required resulting in a total sample size of n = 162. The sample size was increased with 20% to n = 194 in order to account for attrition. Sample size calculations were carried out including cluster correction by means of an internet-based computation service (sample-size.net).

Randomization

Participants were randomized in parallel to the intervention and control groups in six clusters based on worksite locations (three in each). The randomization sequence was created using computer generated list offered at a randomization service website for clinical trials.

Intervention design

Both conditions received a 90 minutes onsite health screening consisting of baseline assessments in addition to a 15 minutes individual talk with explanations and health recommendations based on a written individual health profile. Both conditions received a second health screening after five months where post-test assessments were compared to baseline.

Following the randomization, the intervention condition was offered six sessions of group-based intervention elements; two workshops and four PA support group meetings, a total of 7,5 hours. All sessions were offered at the worksite premises. The intervention design included three sources of needs support; health and exercise advisors (HEA), peers (colleagues), and a reflection booklet. The two HEAs, both physiotherapists and employed by the company occupational health service, received eight hours of training in how to facilitate the group workshops and provide participants with autonomy support, structure, and interpersonal involvement. Peer dialogue was incorporated in both workshops and PA support group meetings. The support groups consisted of 4-5 participants with similar PA levels and interests. They were structured as self-help groups with minimal intervention from the researcher present. Initially, they were instructed to exhibit needs supportive behavior in their response to the person in focus. Instructions were operationalized according to the short version of the Health Care Climate Questionnaire (Williams, Grow, Freedman, Ryan, & Deci, 1996). The booklet consisted of reflection tasks based on a combination of SDT and techniques from MI. During the workshops, reflection tasks were completed individually and then discussed in small groups of 2-3 participants in order to increase awareness, competence and relatedness. In order to provide support especially for the participants' need for autonomy and competence, it was decided that the group sessions were not to offer any joint, organized PA. Rather, the group sessions were designed to help each participant decide on the kind of PA they would engage in based on their preferences, life situation, level of PA competence, and what activities they enjoyed the most. For a complete description of the intervention content and design, see supplementary material, Appendix A.

Primary outcome measures

Cardiorespiratory fitness or endurance is often regarded as the main component of physical fitness, and it is defined by the ability to engage the respiratory, cardiovascular, and musculoskeletal systems in moderate to vigorous activity for a prolonged period of time (American College of Sports Medicine, 2014). A submaximal ergometer bicycle test, the Astrand-Rhyming tes,t was considered most suited to the context in order to estimate the maximal oxygen uptake (VO_{peak}) (Astrand, 1960). The average frequency, duration and intensity of regular PA per week was assessed applying the three items questionnaire International Physical Activity Index (IPAI), previously validated in a compatible population in Norway, the HUNT study (Kurtze, Rangul, & Hustvedt, 2008) (Cronbach's alpha = .80).

Secondary outcome measures

Waist circumference was measured with a measuring tape. Blood samples were collected by means of capillary puncture and analyzed for non-HDL-C. Systolic and diastolic BP were measured manually applying an auscultatory technique with a mercury column or mechanical aneroid sphygmomanometer.

Motivation measures

Autonomous motivation for PA was measured by a composite construct of the two subscales Intrinsic and Identified motivation from the Behavioral Regulation in Exercise Questionnaire, modified version (BREQ-2; Markland & Tobin, 2004) (Cronbach's alpha= .89), on a 5-point Likert-scale. An item example being "I value the benefits of exercise". Perceived competence for PA was measured by the Perceived Competence in Exercise Scale (PCES; Williams and Deci, 1996) (Cronbach's alpha= .90), on a 7-point Likert-scale. A sample item is: "I feel confident in my ability to exercise on a regular basis”. Perceived needs support for PA was assessed with the short version (seven items) of the 15-items Health Care

Climate Questionnaire (HCCQ; Williams et al, 1996) (Cronbach's alpha= .92) adjusted to peers. The items were completed on a on a 7-point Likert-scale. A sample item is: "My colleagues listen to how I would like to do things regarding my regular exercise".

Results

Baseline analyses

Six worksite locations were invited to participate, consisting of 297 eligible employees. A total of n=202 (68 %) employees agreed to participate in the study. After baseline assessments, n=113 (56%) were randomly allocated to the intervention, and n=89 (44%) to the control condition (Figure 1). The mean cluster size was n = 34 (range from 23 to 47, with 65% between 30 and 36). The sample had a mean age of 42.5 years (SD 11.65). Independent sample t-tests revealed that there were significantly more men in the control group (13%, CI = .00 to .24) at baseline. In addition, the control group obtained significantly higher levels of cardiorespiratory fitness (4.68 mL/kg/min, CI = 1.72 to 7.64), and somewhat lower levels of both systolic (1.89 mmHg, CI = -8.37 to -.29) and diastolic BP (1.43 mmHg, CI = -6 to-.54). In terms of motivation measures, both perceived competence for PA (0.64, CI: = 0.21 to 1.06) and autonomous motivation for PA (0.14, CI = 0.07 to 0.59) were significantly higher in the control group. For all other measures, differences were non-significant (see supplementary material, Appendix B).

Attrition checks and missing

A total of 22 % (n = 45) were lost to post-test assessments. The Little's test of missing completely at random (MCAR) did not support the hypothesis that data were MCAR (X^2 = 300, df = 233, p= .002). Analysis of the groups separately demonstrated a MCAR pattern in the intervention group (X^2 = 166, df = 152, p= .20), however this was not the case in the control group (X^2 = 266, df = 205, p= .003). Attrition rates were significantly higher in the control group compared to the intervention group (p = .042). Analyses by means of binary logistic regression demonstrated that gender, educational level, autonomous motivation for PA, and perceived competence for PA significantly predicted dropout rates, albeit none of teh outcome measures. Further analysis of the dropouts revealed that 12% (n = 24) chose to withdraw from the study, whereas 10% (n = 21) were not able to attend post-test assessments due to vacation (n = 13), sickness absenteeism (n = 6), absence due to training (n = 1), or ending employment (n = 1). Analysis comparing those who completed with those who were presumably willing but not able to attend, indicated that only education level (Wald = 4.51, p = .034, odds ratio = .402, CI = .174 to .932) significantly predicted dropout rates. However, comparing those who completed with those who actively withdraw, the latter were lower in education levels (Wald = 5.66, p = .017, odds ratio = .372, CI = .165 to .840) and there were more men (Wald = 7.29, p = .007, odds ratio = .291, CI = .119 to .713). Moreover, they were considerably less autonomously motivated for PA (Wald = 9.75, p = .002, odds ratio = .463, CI = .286 to .751) and perceived themselves to be less competent related to PA (Wald = 5.26, p = .022, odds ratio = .711, CI = .531 to .952). Based on these findings, the data was assumed to be missing at random (MAR).

Intervention attendance rates

Average attendance rate was 50%, or three sessions (mean=2.75, SD=1.76). In the intervention group, 56% (n=62) attended the first and 44% (n=49) the second workshop. None of the baseline participant characteristics significantly predicted attendance rates.

Analysis of intervention effects

The robustness of the results were assessed by executing both intention-to-treat analysis (n = 202), and complete case analysis consisting of participants with both baseline and post-test assessments (n = 151). The missing data were accounted for by means of multiple imputation (n = 15). Multilevel modeling methods were considered inappropriate due to the small number of clusters (n = six) and cluster sample sizes (n = 23-36) (Snijders & Bosker, 2012). All the analyses applied worksite location as a covariate in order to control for the effects of the cluster randomization. MANOVA repeated measures demonstrated an overall Intervention x Time effect in both intention-to-treat analysis ($F = 4.113$, $df = 9$, $p = .000$) as well as complete-case analysis ($F = 5.980$, $df = 9$, $p = .000$). ANOVA repeated measures for each of the variables in the analysis are listed in Table 1. Cardiorespiratory fitness obtained the strongest intervention effect of all outcome variables in both analyses, and Cohen's effect size d was moderate in both analyses. However, self-reported regular PA did not yield any significant intervention effect. The secondary outcome variables related to health all indicated a positive development in the intervention group compared to the control group. Diastolic BP demonstrated significant effects in both analyses albeit small Cohen's effect sizes, whereas systolic BP, non-HDL-C and waist circumference were both non-significant. As for the motivational variables assumed to mediate the effects of the intervention on the outcome variables, they were all significant and demonstrated moderate Cohen's effect size values in the complete-case analyses, and somewhat smaller values in the intention-to-treat analyses. The post-test assessments demonstrated a decline on all three motivational variables in the control group, adding to the overall effect sizes of the intervention.

Test of the SDT-based process model of health

The current adaption of the model posits that perceived needs support for PA from peers would have a positive effect on the participants' degree of autonomous motivation and perceived competence for PA, leading to increases in PA levels and cardiorespiratory fitness and health. This changes were expected to improve health related outcome variables. Prior to the path analysis, a zero order correlational analysis of linear regressions (change scores) was performed in SPSS applying the complete-case sample (supplementary material, Appendix C). The analysis indicated a pattern that was in accordance with the research hypotheses, except that perceived competence for PA did not correlate with cardiorespiratory fitness.

Measurement model

Next, a covariance-based path analysis in Mplus was applied in order to account for the potential effects of the cluster randomization variable. Given the small number of clusters to analyze (i.e., 6), "type is complex" was chosen above a multilevel analysis, in accordance with the recommendations of McNeish and Stapleton (2016). According to Cole and Preacher (2013), a combination of latent and manifest constructs decreases the stability of complex models due to large reliability differences. Since the model consisted of five objective and one index (physical activity) outcome measure, manifest constructs were preferred to latent variables. The analyses employed robust maximum likelihood in order to account for the missing data. First, the motivation measures were assessed for model fit in Mplus by means of Confirmatory Factor Analysis (CFA). Autonomy support for PA received acceptable fit by omitting three items (X^2/df = 1.61, RMSEA = .056 (CI = .000 to .164), CFI = .99. TLI = .99, SRMR = .012). Perceived competence for PA received a good fit all items included (X^2/df = 1.36, RMSEA = .043 (CI = .000 to .155), CFI = .99. TLI = .99, SRMR = .013). Autonomous motivation for PA obtained a strong model fit by omitting one item from the identified motivation subscale (X^2/df = 0.77, RMSEA = .00 (CI = .000 to .075), CFI = 1, TLI = 1, SRMR = .048).

Measurement model

The specified model obtained a good fit to the sample data (X^2/df = 1.01, RMSEA =.010 (CI = .000 to .069), CFI = .99, TLI = .99, SRMR=.052). Further, 13 of 17 hypothesized links in the model were supported (Figure 2). The hypothesized link between perceived competence for PA and cardiorespiratory fitness was not statistically significant ($p=.16$). Likewise, PA levels did not demonstrate significant links with diastolic BP ($p=.11$) and waist circumference ($p=.068$). Moreover, cardiorespiratory fitness had significant links with all secondary outcome measures except non-HDL-C ($p=.98$). Additional significant indirect effects were found from changes in autonomous motivation via PA on cardiorespiratory fitness ($Z=2.445$, CI = .005 to .061), systolic BP ($Z=-2.90$, CI = -.123 to -.023), and non-HDL cholesterol ($Z=-2.92$, CI = -.166 to -.030) (see supplementary material, Appendix D). Indirect effects were also found from changes in autonomous motivation via cardiorespiratory fitness on systolic BP ($Z=-3.36$, CI = -.050 to -.014), and diastolic BP ($Z=-2.06$, CI = -.096 to .000). In addition, the intervention had indirect effects on perceived competence for PA ($Z= 3.93$, CI = .017 to .053), albeit not on autonomous motivation for PA.

Discussion

This is the first intervention study situated in the context of a worksite health-promotion program based on the principles of SDT in combination with MI. It offers important information on how the worksite and the community of colleagues can be incorporated in an intervention designed to move participants towards autonomous self-regulation for behavioral change, and the potential effects such an intervention has on regular PA and health. Furthermore, the study contributes to the understanding and applicability of SDT as a theoretical framework for the design of health promotion programs in non-treatment settings.

The primary aim of the study was to test the hypothesis that a needs-supportive group-based PA intervention (relative to a standard control condition) would lead to increases in regular PA and cardiorespiratory fitness, as well as improvements in health (i.e., reduced BP, waist circumference, and improved cholesterol levels). The findings are in line with reviews of previous PA intervention studies in the worksite context reporting moderate albeit mixed effect sizes on cardiorespiratory fitness (Conn et al., 2009; Abraham & Graham-Rowe, 2009; Rongen et al., 2013). A key finding in the present study was the effectiveness of the intervention in motivating participants to increase their intensity, measured by cardiorespiratory fitness, with a mean increase in the intervention group of 4.18 mL/kg/min. According to Myers et al. (2004), a change above 3.5 mL/kg/min would be considered clinically relevant in terms of reduced risk of cardiovascular diseases and premature mortality. This is an important finding given the fact that PA was self-organized. The intervention was designed to merely help participants decide on the kind of activities they felt were most suited to their life-situation, preferences, and competence levels. Findings indicate that the participants responded positively to the focus on autonomy and self-regulation, and that they felt competent enough to increase the intensity of their activities of choice. Intervention studies tend to prefer organized group PA sessions due to control of experimental manipulation. However, we hypothesized that this could possibly have had negative effects on attendance rates due to shift work. Moreover, groups PA sessions offering one kind of activity could be perceived as need thwarting, especially related to the need for autonomy.

The lack of a significant intervention effect on self-reported PA levels is somewhat surprising given the changes in cardiorespiratory fitness. Several studies have found a relatively small correlation between self-reported levels of PA and objective measures fitness (Dyrstad, Hansen, Holme, & Anderssen, 2014). At baseline, 49.4% of the participants in the intervention group and 59.0% in the control group described their PA levels as high, and this increased to 62.9% at post-test in both groups. Comparing these findings to cardiorespiratory fitness measures, there is an apparent discrepancy. Only 8% of the participants in the intervention group and 16.3% in the control group obtained levels that would be defined as high or very high at baseline. Doing manual labor could possibly mask their perception of the extent to which their level of PA during working hours actually satisfied the recommended level of regular PA, especially when it comes to intensity.

All secondary outcome measures on health demonstrated a positive development in the intervention group compared to the control group (see Table 1). However, waist circumference, non-HDL-C and systolic BP did not change significantly. In terms of clinical relevance, the improvements in the intervention group on BP (SBP: -3.64 mmol/L, DBP: -1.83 mmol/L) were compatible to the mean values found in a review study of randomized controlled trials related to PA (SBP: -3.84 mmol/L, CI -.4.97 to 2.72, DSP: -2.58 mmol/L, CI -3.35 to -1.81) (Whelton, Chin, Xin, & He, 2002). Hence, the intervention proved effective in terms of clinically relevant changes in BP that reduced the risk myocardial infarction, stroke, heart failure, and premature mortality. Changes in waist circumference and non-HDL-C were too small to represent any clinical relevant change in terms of reduced risk for diseases related to lifestyle. A possible explanation for these findings could be the nature of the intervention which was designed to facilitate an individual process of increased self-regulation and internalization of autonomous motives for self-organized PA. Observations during the group-based sessions indicated that many participants needed time for this process to evolve before they were ready to increase their PA levels. The results indicate that a period of five months between baseline and post-test was sufficient for participants to increase their cardiorespiratory fitness, however there seems to have been insufficient time for considerable biomedical changes to develop.

The secondary aim of the study was to assess whether the data supported the SDT process model for health (Williams et al., 2002). The path analyses of both direct and indirect effects demonstrated an overall support, and most of the paths are in line with the findings of the meta-analysis by Ng and colleagues (2012). The effect of needs support from peers was borderline significant ($r = .17$, $p = .056$) albeit considerably weaker than the findings in the above-mentioned review ($r = .40$). Direct and indirect paths indicated that the two additional sources of needs support included in the intervention, the booklet and the HEAs, added to the effect on perceived competence and autonomous motivation for PA. The current study offers a better understanding of needs support in terms of who could effectively constitute the "significant other" in a non-treatment worksite setting. Results demonstrated that it is possible to effectively instruct work-colleagues to behave in a manner that is perceived as needs supportive. Compared to health-care professionals, colleagues lack the formal training and authority regarding health care. On the other hand, faced with an expert helper participants can be sensitive to their authority, act obediently and feel a need to please. Hence, the dialogue may have the potential to enhance participants' controlled motivation for PA. Peers, in the form of colleagues, may be more prone to offer needs support in a reciprocal manner, sharing their experience in PA and lifestyle changes.

Limitations and concerns

Despite the promising findings, the current study has limitations that must be taken into consideration. Most importantly, the small number of clusters enhances the risk of bias in terms of high levels of ICC and reduced statistical power resulting in inflated effect size estimates (Snijders and Bosker, 2012). This risk is enhanced by the relatively large number of dropouts, albeit the fact that only the 12% who actively withdraw were significantly different from those who completed. The overall sample size could be described as acceptable compared to what is common for experimental studies in the field of sport and exercise psychology (mean $n = 40$, interquartile range from 24 to 72) (Schweizer & Furley, 2015). However, the effects of the intervention should be interpreted cautiously and replications of the intervention study with a sufficient number of clusters is recommended.

The current intervention could be considered as a limited dose in terms of 7.5 hours of group-sessions and duration of five months. Attendance rates for the workshops and PA support group sessions were modest, albeit similar to other group-based PA intervention studies (Hardcastle, Taylor, Bailey, Harley, & Hagger, 2013). Participants in the current study worked shifts, and group sessions were offered immediately before and after working hours at the worksite premises. This may have affected their willingness and ability to attend the sessions. Conn et al. (2009) found that worksite PA interventions offered during payed working hours were more effective on some outcome measures like cardiorespiratory fitness. The results on cardiorespiratory fitness in particular support the assumption that a modest dose intervention can be effective in bringing about meaningful changes on important mediating and outcome variables. The intervention consisted of short sessions of 1-2 hours every second week in order to give participants the necessary time to develop the ability and motivation to initiate and maintain lifestyle changes. Ideally, the intervention design could have included monthly or quarterly follow-up booster meetings after five months in order to offer some structure that facilitated needs supportive interaction between participants. We argue that this is especially important for the current study population given the nature of the occupation, and the fact that they were working shifts which reduced both the formal and informal interaction during working hours.

Strengths

Worksite health promotion interventions are characterized by rather low participation rates. A review study found participation levels from 10-64%, with a median of 33% (Robroek, van Lenthe, van Empelen, & Burdorf, 2009). In addition, the programs are criticized for attracting only the healthy and fit employees (Linnan, Sorensen, Colditz, Klar, & Emmons, 2001). According to Rongen et al. (2013), worksite health promotion intervention studies were four times more effective when the participation rates were low. The current study obtained a reasonably high participation among eligible employees (68%). Although the study did not include any information about the health status of the 32% who chose not to participate, participant health status was compared to a reference population of healthy Norwegian adults (n=27 766) (Aspenes et al., 2011). Although 5.61 years younger than the reference population, mean values on waist circumference and BP were compatible. Non-HDL-C level were higher in the current study sample compared to the HUNT population (male: 4.21 mmol/L, female: 4.1 mmol/L). Cardiorespiratory fitness was considerable higher in the male reference population (40.0 mL/kg/min, SD=9.5), compared to the current study sample (33.85 mL/kg/min, SD=10.45), whereas mean levels among females were compatible. In conclusion, we argue that the current intervention managed to attract employees of average health, including those with low fitness levels. This strengthens the relative effectiveness and the generalizability of the findings of the study, especially to similar occupational groups.

Conclusions

The present study contributes to the understanding and applicability of SDT as a theoretical framework for the design of health promotion programs in non-treatment settings. In addition, the study offers important information on the theoretical understanding of needs support, and the effectiveness of peers in the role the “significant other”. The study demonstrated that it is possible to instruct colleagues to behave in a manner that is actually perceived as needs supportive. In the context of a non-treatment health promotion program, the inclusion of peers as an active component is especially important since employers are less willing to dedicate time and resources to individual follow-up with health personnel.

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Table 1

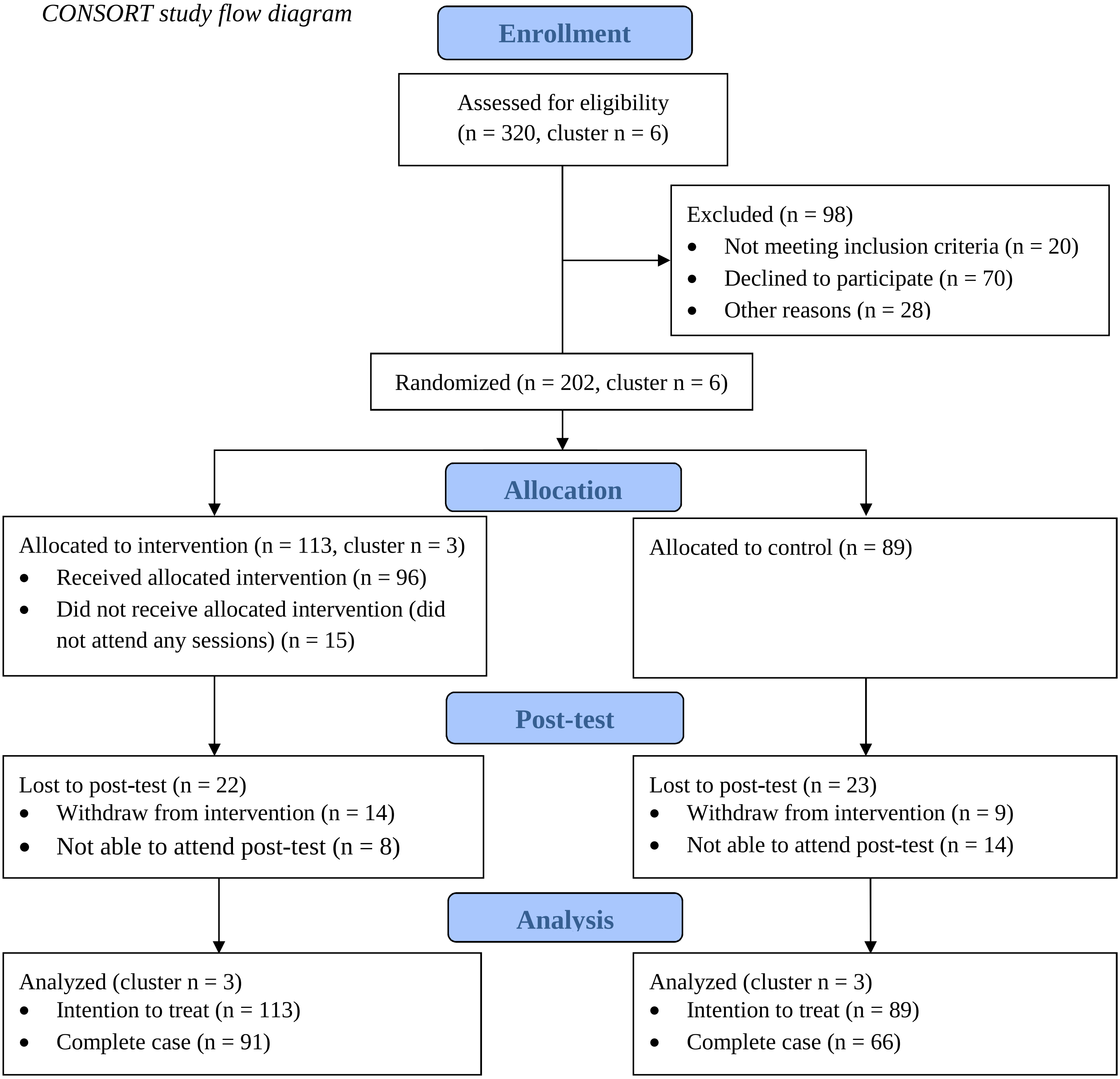
ANOVA Repeated Measures with means (M) and standard deviations (SD): Primary and secondary outcome measures, and mediating variables.

	Complete case analysis (n = 151)				Intention-to-treat analysis (n = 202)			
Effect	Baseline (M/SD)	5 months (M/SD)	Time x Group (F/p)	Effect size (Cohen's d)	Baseline (M/SD)	5 months (M/SD)	Time x Group (F/p)	Effect size (Cohen's d)
Cardiorespiratory fitness								
Intervention (n=85)	32.33 (7.97)	36.13 (9.31)	19.75/.000	0.49	31.82 (8.37)	36.51 (8.28)	7.82/.007	0.39
Control (n=58)	38.28 (12.59)	37.09 (10.18)			36.25 (11.66)	36.99 (10.06)		
PA levels								
Intervention (n=89)	3.73 (2.22)	4.41 (2.08)	0.09/.763	0.15	3.67 (2.19)	4.43 (1.99)	0.25/.686	0.07
Control (n=61)	4.29 (2.27)	4.63 (2.15)			3.95 (2.33)	4.55 (1.96)		
Waist circumference (cm)								
Intervention (n=87)	96.37 (11.90)	95.91 (12.24)	2.08/.151	-0.01	96.55 (13.16)	95.88 (10.98)	0.28/.642	0.02
Control (n=58)	94.84 (12.83)	94.47 (12.63)			94.57(13.64)	93.69 (11.15)		
Non-HDL-C (mmol/L)								

Intervention (n=87)	5.11 (2.37)	5.13 (2.40)	3.65/.058	-0.04	5.07 (2.36)	5.12 (2.41)	1.68/.300	-0.01
Control (n=53)	5.59 (2.32)	5.72 (2.42)			5.64 (2.36)	5.71 (2.48)		
Systolic BP (mmHg)								
Intervention (n=89)	135.34 (16.85)	131.70 (14.80)	2.37/.127	-0.13	135.47 (16.15)	131.55 (13.15)	0.17/.710	-0.18
Control (n=62)	131.29 (12.95)	129.61 (23.08)			131.26 (12.38)	129.97 (15.16)		
Diastolic BP (mmHg)								
Intervention (n=89)	83.66 (9.82)	81.83 (10.10)	12.29/.001	-0.30	84.26 (9.37)	81.75 (9.12)	7.18/.015	-0.26
Control (n=62)	80.26 (10.23)	81.48 (8.44)			81.06 (9.62)	81.06 (7.93)		
Perceived competence for PA								
Intervention (n=88)	4.46 (1.44)	4.59 (1.52)	8.51/.004	0.43	4.43 (1.50)	4.60 (1.39)	4.38/.043	0.24
Control (n=62)	5.37 (1.36)	4.89 (1.34)			5.05 (1.43)	4.86 (1.18)		
Needs support for PA (peers)								
Intervention (n=88)	3.95 (1.29)	4.42 (1.26)	10.51/.002	0.59	4.00 (1.31)	4.39 (1.15)	4.70/.034	0.29
Control (n=62)	4.38 (1.18)	4.11 (1.34)			4.08 (1.34)	4.09 (1.22)		
Autonomous motivation for PA								
Intervention (n=88)	3.40 (0.85)	3.54 (0.80)	13.34/.000	0.45	3.32 (0.87)	3.55 (0.73)	5.85/.020	0.29
Control (n=62)	3.82 (0.79)	3.59 (0.76)			3.61 (0.84)	3.59 (0.67)		

Figure 1

CONSORT study flow diagram



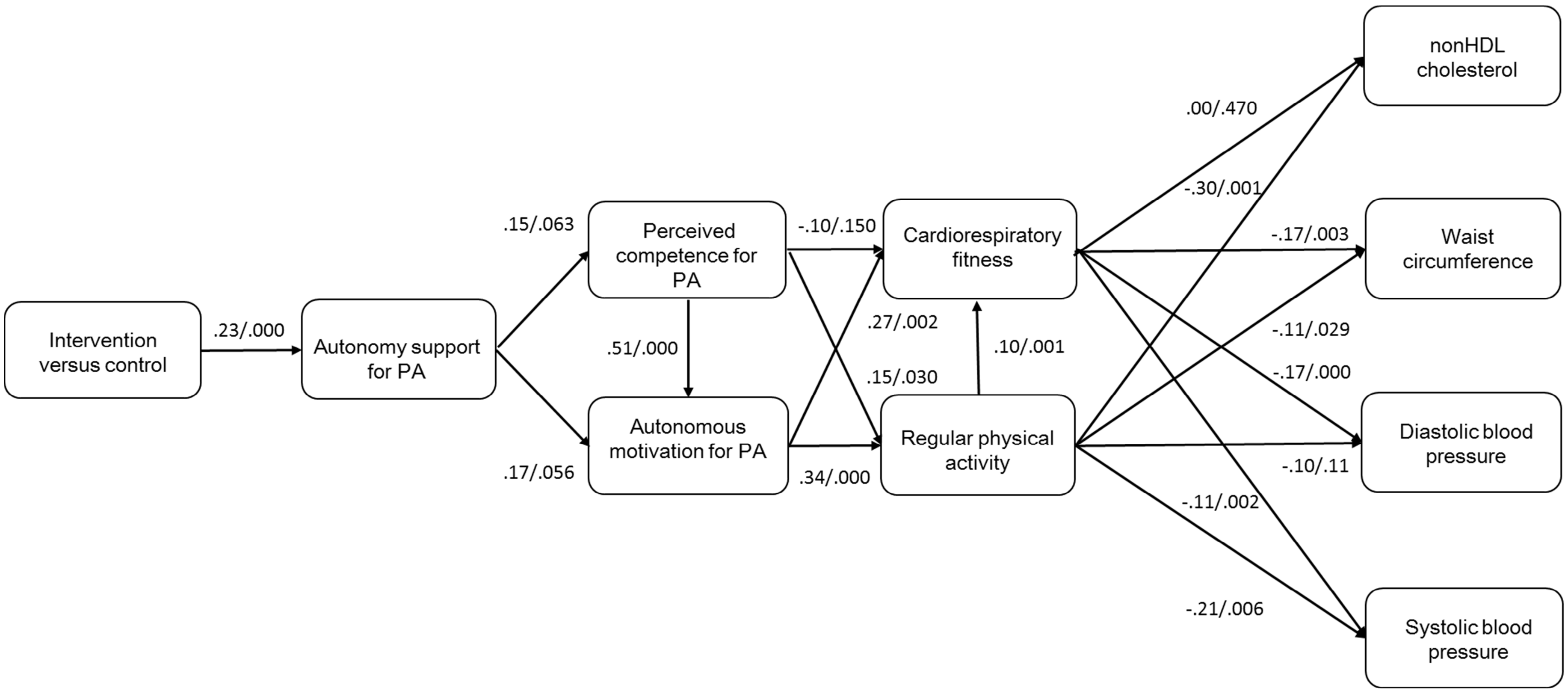


Figure 2

The SDT-based health model of behavior and its change. Mplus analysis consisting of manifest variables and maximum likelihood estimation with robust standard errors to account for missing values. $X^2/df = 1.01$, *RMSEA* = .010 (95% *CI* = .000 to .069), *CFI* = .99, *TLI* = .99, *SRMR* = .052. *Single-tail p-values.*