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Worksite health promotion, coworker support, and motivation for lifestyle change

Effects of a self-determination theory based
cluster-randomized controlled trial on physical activity,
cardiorespiratory fitness, and health

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Two post-it notes have been hanging on my office wall these last years:

"Continuous effort, not strength or intelligence, is the key to unlocking your potential."

Winston Churchill

"Always find time for the things that make you feel happy to be alive."

Instagram

SUMMARY

Introduction: National surveys around the world repeatedly report that adults are not physically active enough to obtain various health benefits. The worksite represents an important context for physical activity (PA) promotion initiatives because it provides access to a large intersection of the adult population. Employers initiate health promotion programs in order to increase employees' health and reduce the costs of sickness absence. Existing networks among coworkers represent a source of social support that can be incorporated into the programs as an active ingredient. PA intervention studies based on the tenets of self-determination theory (SDT) have been proven effective in the context of health care and treatment. The present SDT based PA intervention study was adjusted to the context of a worksite health promotion program targeting employees working with transport, sorting, and distribution.

Aim: This doctoral thesis aims to contribute to the understanding of how interventions, situated in the worksite context, can be designed to increase autonomous motivation for behavioral change and produce health benefits regarded as both clinically relevant, and important to the worksite. The primary outcome variables were PA and cardiorespiratory fitness (CRF). The secondary outcome variables were biomedical markers (paper I), in addition to somatic symptoms and sickness absence (paper II). A SDT model of health behavior change was tested in order to assess mediating effects of SDT constructs (paper I-II). The thesis also aims to explore the development of PA behavior over a period of one year, and how behavioral patterns were related to competence and motivational regulation (paper III). Moreover, the thesis aspired to contribute to the theoretical understanding of peers as a provider of support for basic psychological needs (i.e., for autonomy, competence, and relatedness).

Methods: A cluster randomized controlled trial with a delayed-intervention control group. A total of 202 employees ($M = 42.4$, $SD = 11.65$, 76.2% men) agreed to participate, and six worksite locations (clusters) from the same company were randomly allocated to two conditions. The intervention group was offered six group-based sessions during 16 weeks. To establish a climate supportive of basic psychological needs, three active ingredients were combined during the sessions: talks and plenary discussions facilitated by a health and exercise advisor, a booklet consisting of individual reflection tasks related

to behavioral change, and peer dialogue in small groups of coworkers. The baseline and post-test data collections included electronic questionnaires, in addition to objective assessments of CRF and biomedical markers. The follow-up data collection (12 months) consisted of questionnaires.

Main results: The intervention was moderately effective related to the primary outcome variable, CRF, albeit no between-groups effect was found for PA since both groups reported significant increases at post-test. The effectiveness of the intervention on secondary outcome measures was more mixed. Change in diastolic BP and HDL-C demonstrated a significant between-groups effect, and were considered clinically relevant. Changes in non-HDL-C and waist circumference were non-significant and clinically irrelevant. The intervention was also effective related to self-reported levels of somatic symptoms, albeit with small effect sizes. However, the intervention was not able to produce a statistically significant between-groups effect on sickness absence. The moderate effect sizes indicated that the intervention was able to incorporate coworkers as an active ingredient.

The SDT model of health behavior change was tested for model fit with two different sets of secondary outcome variables; 1) biomedical health markers, and 2) somatic symptoms and sickness absence. For the most part, the hypothesized associations between study variables demonstrated the expected direction and significant strength, particularly among motivational variables and primary outcome variables.

The analyses of possible subgroups related to changes in PA over a period of one year indicated that there were three distinct trajectories. The three trajectories differences related to motivational regulation and perceived competence for PA, in line with the tenets of SDT. The intervention was able to attract a subsample of relatively sedentary employees who increased their levels of PA considerably during one year.

Conclusions: The present study demonstrated the effectiveness of an intervention, both complex in nature and modest in dose, incorporating several sources of support for PA. The effects of the intervention on PA, CRF, some biomedical markers, and somatic symptoms are promising. SDT represents a valuable and practical framework for the design of PA interventions in the worksite. SDT also offers an understanding of the motivational antecedent of PA behavior, which has gained strong empirical support.

SAMMENDRAG

Bakgrunn: Nasjonale kartlegginger verden over rapporterer at voksne ikke er tilstrekkelig fysisk aktive, og derfor ikke oppnår de ulike helsegevinstene dette kan gi. Arbeidsplassen representerer en viktig arena for fysisk aktivitetsfremmende tiltak fordi den gir tilgang til store deler av en voksne befolkningen. Arbeidsgivere iverksetter helsefremmende programmer for å bedre medarbeideres helse og redusere kostnader til sykefravær. Eksisterende kolleganettverk representerer en kilde til sosial støtte som aktivt kan utnyttes og innarbeides i programmene. Intervensjoner som benytter selvbestemmelsesteorien som rammeverk har vist seg å være effektive i helse- og behandlingskontekster. Denne intervensjonen ble utviklet basert på selvbestemmelsesteorien, tilpasset arbeidsplasskonteksten og rettet seg mot sjåførere, bud og terminalarbeidere.

Hensikt: Denne doktorgradsstudien har til hensikt å bidra til økt forståelse for hvordan intervensjoner på arbeidsplassen kan utformes for å øke autonom motivasjon for atferdsendring og gi helsegevinster som er både klinisk relevante og viktige for arbeidsgiver. De primære utfallsvariablene var fysisk aktivitet og kondisjon. De sekundære utfallsvariablene var biologiske helsemarkører (artikkel I) samt somatiske plager og sykefravær (artikkel II). En modell for endring av helseatferd som bygger på selvbestemmelsesteorien ble testet for å vurdere om teoretiske begreper medierte effektene (artikkel I-II). Studien hadde også til hensikt å utforske hvordan deltakernes fysiske aktivitet utviklet seg over en periode på ett år, og hvordan eventuelle mønstre var relatert til opplevd kompetanse og autonom motivasjon for fysisk aktivitet. Studien hadde også ambisjoner om bidra til den teoretiske forståelsen for hvordan likemenn, i denne sammenhengen arbeidskollegaer, kan støtte grunnleggende psykologiske behov (autonomi, kompetanse og tilhørighet).

Metoder: En klynge-randomisert kontrollert studie der kontrollgruppa fikk utsatt intervensjon. I alt 202 medarbeidere samtykket i å delta (gjennomsnittlig alder var 42.5 år og 76.2% var menn), og seks geografiske arbeidsplasser innen det samme selskapet ble randomisert til intervensjons- og kontrollgruppa. Intervensjonsgruppa fikk seks gruppebaserte samlinger over en periode på 16 uker. Tre aktive ingredienser ble utviklet for å skape et klima på samlingene som skulle støtte grunnleggende psykologiske behov:

1) innlegg og diskusjoner i plenum som en helse- og treningsveileder fasiliterte, 2) et arbeidshefte bestående av refleksjonsoppgaver knyttet til atferdsendring og 3) dialog mellom likemenn i små grupper av arbeidskollegaer. Datainnsamling ved oppstart og etter intervensjonen bestod av elektroniske spørreskjema samt målinger av kondisjon og biologiske helsemarkører. Oppfølging av effekter ett år etter oppstart bestod av spørreskjema.

Resultater: Intervensjonen hadde moderate effekter på den primære utfallsvariabelen kondisjon. Ingen effekt av intervensjonen relativ til kontrollgruppa ble funnet da begge grupper rapporterte signifikante økninger i fysiske aktivitet fra oppstart til etter intervensjonen. Effekten av intervensjonen på sekundære utfallsmål var mer blandet. Endringene i diastolisk blodtrykk og HDL-kolesterol viste signifikante forbedringer relativt til kontrollgruppa. Endringene i blodtrykk og HDL-kolesterol var også klinisk relevante. Det ble ikke funnet endringer i non-HDL-kolesterol og livvidde. Intervensjonen var også effektiv målt i selvrapporterte somatiske plager selv om effektstørrelsene var små. Ingen signifikante effekter på sykefravær ble funnet når det ble sammenlignet med kontrollgruppa. De moderate effektstørrelsene indikerte at det å inkludere sosial støtte fra arbeidskollegaer i intervensjonen var vellykket. SDT modellen for endring av helseatferd ble testet med to ulike sett av sekundære utfallsvariabler; 1) biologiske helsemarkører og 2) somatiske plager og sykefravær. De fleste assosiasjoner i modellen viste den retningen og styrken som SDT predikerte, særlig mellom motivasjonsvariablene og de primære utfallsvariablene. Analyser av utvalget relatert til endringer i fysisk aktivitet i løpet av ett år indikerte at det var tre tydelig ulike ban sub-grupper. De tre var også ulike i forhold til grad av selvbestemt selvregulering og opplevd kompetanse relatert til fysisk aktivitet, i tråd med selvbestemmelsesteorien. Funnene viser at intervensjonen klarte å rekruttere relativt inaktive medarbeidere, og at disse viste betydelig økning i fysisk aktivitet i løpet av ett år.

Konklusjoner: Denne studien viser at en intervensjon, bestående av flere ulike tiltak for å skape støtte, kan være effektiv til tross for en relativt beskjeden dose. Effektene den hadde på fysisk aktivitet, kondisjon, flere av de biologiske helsemarkørene og somatiske plager er lovende. Studien viser at selvbestemmelsesteorien representerer et verdifullt og praktisk anvendbart rammeverk for arbeidsplassintervensjoner. Teoriens forståelse for hva som skaper motivasjon for fysisk aktivitet har oppnådd sterk empirisk støtte.

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What a challenge, what a struggle, and what a joy this has been!

Cathrine Pedersen

Oslo, 03.09.2018

LIST OF PAPERS

This thesis is based on the following papers:

Paper I*

Pedersen, C., Halvari, H., & Williams, G.C. (2018). Worksite intervention effects on motivation, physical activity, and health. A cluster randomized controlled trial. *Psychology of Sport and Exercise*, 35, 171-180. Doi:10.1016/j.psychsport.2017.11.004.

Paper II

Pedersen, C., Halvari, H., & Olafsen, A.H. (In press). Worksite physical activity intervention and somatic symptoms burden: The role of coworker support for basic psychological needs and autonomous motivation. *Journal of Occupational Health Psychology*, Doi:10.1037/ocp0000131. [Epub ahead of print].

Paper III

Pedersen, C., Halvari, H., & Bentzen, M. (submitted and under review in *Psychology of Sport and Exercise*). Longitudinal trajectories of physical activity among employees participating in a worksite health promotion intervention: A latent class growth approach.

- * Detailed information about the study protocol and design procedure originally planned to be published as a protocol paper, was included as supplementary material in paper I, as required by the editor of the paper.

ABBREVIATIONS

BP	Blood pressure
CFA	Confirmatory factor analysis
CRF	Cardiorespiratory fitness
HEA	Health and exercise advisor
HDL-C	High-density lipoprotein cholesterol
HIT	High-intensity interval training
LCGA	Latent class growth analysis
MI	Motivational interviewing
Non-HDL-C	Non-high-density lipoprotein cholesterol
PA	Physical activity
SDT	Self-determination theory
SEM	Structural equation modeling

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THEORETICAL FRAMEWORK

First, I will give a brief introduction to the health benefits of physical activity (PA), followed by a description of health-related PA and the PA recommendations of the Norwegian Health Authorities. I proceed to present population level data related to compliance of these recommendations. Health promotion programs designed to help people increase their levels of regular PA are highly recommended by the World Health Organization (WHO). The benefits, challenges and effectiveness of the worksite as a context for such programs will be outlined. Next, I will elaborate on the theoretical foundation of the present study, which is based on the tenets of self-determination theory (SDT) in general, and more specifically on the SDT-based model of health behavior change, and techniques from motivational interviewing (MI). I will highlight the role of motivational regulation for behavioral change related to PA, and how SDT-based intervention studies have been designed to influence the participants' perceived competence and autonomous motivation for PA. The importance of a social environment capable of providing support for basic psychological needs has gained extensive empirical support. I reflect on the relevance of incorporating coworkers as a source of social support in health promotion programs. Finally, the purpose of the thesis followed by the objectives and hypotheses per paper are presented.

Health benefits of regular physical activity

Researchers concur that regular PA has an immediate and long-lasting effect on the health and well-being of the adult population. Moreover, these effects are presumed to produce financial benefits for employers, health care, and the society as a whole. According to WHO calculations in 2013, inactivity was estimated to cost 54 billion US dollars related to health care and 14 billion US dollars in lost productivity globally (World Health Organization [WHO], 2018). In Norway, the cost of sickness absence is estimated to be about 3.7 billion US dollars (Sintef, 2016). Sickness absence is a complex phenomenon with numerous causes, and the amount attributed directly to inactivity is uncertain. Musculoskeletal complaints are the most common cause of sickness absence (36.5%), followed by mild-to-moderate mental complaints (19.6%; NAV, 2018). In comparison, cardiovascular diseases only account for 3%.

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In the following, I will comment very briefly on the benefits of PA related to physical and mental health. I will elaborate on the benefits of PA related to one prevalent kind of ill-health: somatic symptoms burden.

The benefits of PA related to physical health (e.g., reduced risk of cardiovascular diseases, Type 2 diabetes, hypertension, obesity, osteoporosis, osteoarthritis, some types of cancer, and all-cause mortality) are well documented (Lee, Shiroma, Lobelo, Puska, Blair, & Katzmarzyk, 2012; Warburton, Nicol, & Bredin, 2006). PA intervention studies have commonly assessed biomedical risk factors such as abdominal obesity, raised triglycerides, an unfavourable combination of high-density lipoprotein cholesterol (HDL-C) and non-HDL-C levels, raised systolic and diastolic blood pressure, and high levels of fasting plasma glucose (Alberti, Zimmet, & Shaw, 2006). In terms of mental health, PA has been shown to reduce symptoms of mild to moderate cases of mental complaints such as depression (Rimer et al., 2012; Teychenne, Ball, & Salmon, 2008) and anxiety (Conn, 2010; Herring, O'Connor, & Dishman, 2010; Stonerock, Hoffman, Smith, & Blumenthal, 2015). Overall, PA intervention studies have reported moderate clinical effects, and effect sizes tended to be small in intervention studies with a rigorous design or a longer follow-up period (Cooney et al., 2013; Herring et al., 2010).

Somatic complaints can be regarded as a third category of ill-health as they lie in an ambiguous area between the physical and mental aspects of health (Lipowski, 1988; Mayou, Kirmayer, Simon, Kroenke, & Sharpe, 2005). Approximately half of all patient consultations in primary and secondary care are presented with somatic symptoms such as headaches, fatigue, chest pain, bowel problems, insomnia, shortness of breath, and various musculoskeletal complaints, specifically in the back, arms, legs, and joints (Ihlebak, Brage, & Eriksen, 2007; Kroenke, 2003; Sharma & Manjula, 2013). In about one third to half of the cases, no underlying medical condition is found. Somatic symptoms can be regarded as complex biopsychosocial responses to various stressors related to factors such as personal finance, health conditions such as organic diseases or accidents, work-situation, social relationships, and lifestyle (Henningsen et al., 2007; Tveito, Halvorsen, Lauvålien, & Eriksen, 2002). Most of us will experience mild cases of these complaints from time to time. A Norwegian study of healthy adults found that 80% reported some musculoskeletal pain, and 65% reported feeling tired or dizzy (Ihlebak, Eriksen, & Ursin, 2002). However, having severe or numerous somatic symptoms can seriously hamper the

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ability to function on a daily basis, both at work and in personal life, and reduce quality of life.

So far, there are a limited number of studies assessing the effects of PA treatment on somatic symptoms burden as such. Studies tend to focus on a single symptom or one type of symptoms such as pain in different parts of the body (Henningsen et al., 2007). A randomized controlled trial (RCT) on patients with persistent somatic symptoms found a significant decrease in primary care consultations and prescriptions 6 months after a PA intervention, and the patients reported lower levels of somatic symptoms (Peters, Stanley, Rose, Kaney, & Salmon, 2002). A review of worksite PA programs found strong support for the effectiveness on musculoskeletal disorders (e.g., neck and back pain), and limited evidence for the effectiveness on fatigue (Proper et al., 2003). Other review studies have found strong empirical support for the benefits of aerobic exercise on the management of fibromyalgia (Sim & Adams, 2002), fatigue (Edmonds, McGuire, & Price, 2004), and moderate support for low back pain (Hayden, van Tulden, Malmivaara, & Koes, 2005). More research is needed on the effectiveness of PA interventions assessing the whole range of somatic symptoms burden rather than each symptom separately. Also, we need more knowledge on the nature of effective intervention strategies, the underlying mechanism of change, and the PA dose required to produce clinically significant reductions in somatic symptoms burden. Next, I will explain the concept of health-related PA and present the PA recommendations of the Norwegian Health Authorities.

Health-related physical activity

PA encompasses a wide variety of activities, from active commuting and manual labor to sports, exercise, and recreational activities like walking or playing. By definition, PA entails that the "contraction of skeletal muscles result in a substantial increase in caloric requirements over resting energy expenditure" (American College of Sports Medicine, [ACSM], 2014, p.2; Caspersen, Powell, & Christenson, 1985). The intensity and resistance we expose our bodies to during PA influences our physical fitness, which consists of the following elements: cardiorespiratory endurance, muscular strength and endurance, body composition, and flexibility (U.S. Department of Health and Human Services, 1996).

A certain dose of PA is required to obtain health benefits (Haskell, Lee, Pate, Powell, & Blair, 2007). The dose is commonly defined as a combination of duration (the length of

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the PA sessions in minutes), intensity (the amount of energy expended during the sessions), and frequency (number of sessions per week; ACSM, 2014). The Norwegian Health Authorities recommend that adults are physically active at a moderate intensity minimum 150 minutes per week, alternatively 75 minutes of high intensity per week (Hansen et al., 2015). In the following, I will refer to PA as *moderate-to-vigorous intensity PA* unless the intensity is specified.

One component of physical fitness, cardiorespiratory endurance (often referred to as cardiorespiratory fitness [CRF]), has demonstrated a pivotal role in the prevention of non-communicable diseases, particularly cardiovascular diseases, and premature mortality (Aspenes et al., 2011; Lee et al., 2012). CRF refers to “the capacity of respiratory and cardiovascular systems to provide muscles with oxygen during sustained and/or intense exercise” (Lin et al., 2015, p. 2). CRF is commonly used as an indicator of habitual PA because it is a sensitive and reliable measure (ACSM, 2014; Lee, Artero, Sui, & Blair, 2010). An increase in CRF of $3.5 \text{ mL kg}^{-1} \cdot \text{min}^{-1}$ is considered a clinically relevant change in terms of reduced risk of cardiovascular disease and premature mortality (Myers et al., 2004).

Population levels of regular physical activity

Global comparative estimates of PA levels have indicated that 81% of adolescents (aged 11-17 years) and 23% of adults do not meet the recommendations of WHO on health-related PA (2010). In Norway, a national survey found that the majority of Norwegian adults (68% of both adult males and females) report PA levels below the recommendations (Hansen et al., 2015). Similar percentages are reported in comparable countries such as England (60% of adult males and 75% of adult females; Craig, Mindell, & Hirani, 2008). These results are in line with the experience of health and exercise practitioners and research findings in the field of PA and health promotion: the process of changing PA habits is demanding, complex, and multifaceted (Sallis et al., 2006). Or as DiBonaventura and Chapman (2008) describe it: "Underpinned by a complex amalgamation of biopsychosocial factors, the barriers to engagement - and the effort it takes to overcome them - are in ubiquity and are often dramatically underestimated during attempts to adopt pro-health behavior.

People may lack the motivation or feel that they are not capable or competent enough to increase their PA. They may feel that their social networks do not support them, that their

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physical environment does not facilitate regular PA, or that their socioeconomic status or life-situation does not allow them to spend much time or money on regular PA. The barriers to regular PA seem to be considerable, and research has demonstrated that individuals need far more support in order to increase their PA levels than sporadic governmental information campaigns. Moreover, the barriers are multileveled, and each level interact with the others. Hence, PA promotion initiatives should incorporate several levels in order to be effective (Sallis et al., 2006). [recently launched "The global action plan on physical activity 2018-2030" which aims to reduce physical inactivity among adolescents and adult with 15% (WHO, 2018). One of the 20 policy actions in the plan focuses on enhancing the provision of PA programs and promotion in a variety of areas including worksites "to support participation in physical activity, by all people of diverse abilities (WHO, 2018, p.37)."

The context of worksite health promotion programs

The worksite has emerged as an important context for health promotion initiatives because it provides access to a large intersection of the adult population, and potentially attracts employees with diverse abilities related to PA and health (Dishman, Oldenburg, O'Neal, & Shephard, 1998). Employer-initiated programs have the potential to offer multilevel interventions targeting individual, social, organizational, and structural enablers and barriers to regular PA (Sallis et al., 2006). Existing social networks among coworkers and with managers in addition to the shared organizational culture represent a source of social support that can be incorporated into the programs as an active ingredient (Sorensen & Barbeau, 2012). Over several decades, worksite PA promotion programs have been popular among employers due to the potential effects on increased employee engagement and productivity, reduced costs related to accidents and sickness absence and improved employer branding (National Institute for Health and Clinical Excellence, 2008). According to a large national survey in the U.S., 66% of medium-to-large size worksires (750 employees or more) offered PA promotion programs (Linnan et al., 2008). However, findings indicate that worksite PA programs have not gained the same popularity among the employees. A systematic review of PA promotion intervention studies at the worksite (1988-2007) reported a median participation rate of 33% (95% CI 25 – 42), and a range between 10% - 64% (Robroek, van Lenthe, van Empeen, & Burdorf, 2009). The findings are in line with earlier studies on

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participation rates in worksite health promotion programs, which found an average of 25-50% (Glasgow, McKaul, & Fisher, 1993).

Why are two-thirds of eligible employees reluctant to enroll and participate on PA promotion programs offered by their employer? The large majority of review studies and meta-analyses have focused on the effectiveness of worksite interventions. The degree and determinants of participation are far less studied and understood (Robroek et al., 2009). Studies on demographic characteristics related to participation and non-participation in worksite health screenings consistently report that women were more inclined to participate compared to men (Adshead & Thorpe, 2008; Waters, Galichet, Owen, & Eakin, 2011; Robroek et al., 2009). Findings related to age are less conclusive, with some studies reporting no significant differences (Dobbins, Simpson, Oldenburg, Owen, & Harris, 1998), whereas others found that younger employees were more inclined to participate (Robroek et al., 2009). Socio-economic characteristics such as higher educational levels and higher occupational prestige did also significantly predict participation. Moreover, findings indicated that programs tended to attract employees already committed to a healthy lifestyle related to smoking, weight, blood pressure, and exercise (Dobbins et al., 1998; Lerman & Shemer, 1996; Marshall, 2004).

Some studies have explored the employees' attitudes towards employer-initiated programs and their experience from participating, and findings may contribute to the understanding of why employees are reluctant to employer initiated PA programs. For example, on study on the organizational discourse related to worksite health promotion programs found that when the focus was on lifestyle, the responsibility was placed solely on the individual, and the influence of working conditions was ignored (Allender, Colquhoun, & Kelly, 2006). Moreover, the desirable employee was described as someone "fit, healthy, and presents a low risk to the company" (2006, p.85). Being healthy was related to being professional at work, and employees felt an obligation discipline themselves in order to be perceived as healthy. Employees with ambivalent feelings toward PA and lifestyle changes can possibly be sensitive to this discourse and choose to avoid the external pressure by declining to participate on the program offered by their employer. Rossing and Jones (2015) found that exercisers were comfortable at the local gym despite their inexperience and lack of fitness, but felt embarrassed and apprehensive when exercising together with coworkers because they did not want to be perceived as

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incompetent. The presence of coworkers can represent a source of social support, but can also increase the sense of social comparison and role-conflict in a setting where most of us are eager to be perceived as competent and professional. Modest participation levels among employees represent a challenge to the effectiveness of worksite PA promotion programs, to the organization and to public health. More knowledge is needed to understand how participants react to a worksite PA program, which elements of the design appeal to them, and what increases their motivation for participation and lifestyle change. In the next section, I will give an outline of study findings regarding the effectiveness of worksite PA promotion intervention studies.

The effectiveness of worksite physical activity promotion interventions

There is a growing number of systematic reviews and meta-analyses of worksite PA promotion studies. Overall, they report positive effects albeit small effect sizes ($d = 0.10 - 0.27$) for self-reporting measures of PA (Abraham & Graham-Rowe, 2009; Conn, Hafdahl, Cooper, Brown, & Lusk, 2009; Dishman et al., 1998; Malik, Blake, & Suggs, 2014; Proper et al., 2003). The research evidence related to objective measures of fitness, such as CRF or muscle strength, is inconclusive and divergent (Proper et al., 2003). For instance, meta-analyses have reported positive effect sizes for CRF ranging from $d = 0.29$ (Abraham & Graham-Rowe, 2009) to $d = 0.57$ (Conn et al., 2009). High-quality RCTs tended to report lower effect sizes or non-significant effects compared to quasi-experimental and pre-post studies, and to studies with less rigorous methodology (e.g., randomization procedure poorly implemented or described, lack of intention-to-treat analysis, lack of control for confounders, lack of objectively measured outcome variables, and short follow-up assessments; Rongen, Robroek, van Lenthe, & Burdorf, 2013; To, Chen, Magnussen, & Kien, 2013).

The diversity of worksite PA promotion interventions in terms of content and delivery is considerable: individually delivered versus group-based, lasting for a few weeks to 1-2 years, and some offered less than an hour of contact time (dose) whereas others offered 70 hours. Some included collective exercise classes or walking groups, others offered counselling in order to enhance motivation for making lifestyle changes and training in the ability to apply behavioral change techniques. Meta-analyses have concluded that worksite health promotion interventions that target one health behavior, such as PA as

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opposed to general health and lifestyle changes, seemed to be more effective (Abraham & Graham-Rowe, 2009; Hutchinson & Wilson, 2011).

Findings related to the association between effectiveness and the duration of the interventions are inconclusive. A systematic review found that 82% of the interventions lasting for less than 6 months showed positive changes in PA. As for interventions lasting more than 6 months, only 33% reported positive changes (To, Chen, Magnussen, & To, 2013). To and colleagues questioned whether longer interventions struggled to maintain a sense of enthusiasm and optimism among the participants regarding the potential for changes in PA and increases in health benefits. However, this result was not supported in the meta-regression of Taylor, Conner, and Lawton (2012), which reported that no variance in intervention effectiveness was explained by the length of the PA intervention (ranging from 2 weeks to 12 months). The same was found for intervention dose (hours of contact time). Findings indicate that interventions with weekly contact between the participants and the intervention providers were more effective than interventions with less frequent contact, even when controlling for methodological quality (Rongen et al., 2013). There is a need for more RCTs which measure both the immediate and long-term effect after the intervention has ended. Moreover, studies in the worksite context should explore whether there is a minimum dose of contact time required to bring about clinically significant changes in PA and health. This is of particular importance for programs targeting employees working in production or transport. They often work shifts, on a tight time schedule, and with little flexibility to fit program sessions into their workweek.

The importance of theoretical framework

Researchers in the field of worksite health promotion agree that the design of the intervention content and the nature of the delivery should be based on a theoretical framework for behavioral change (Bartholomew, Parcel, Kok, Gottlieb, & Fernández, 2011; Malik et al., 2014). This entails that the theoretical framework is systematically operationalized, and does not function merely as an inspiration to the intervention development process (Michie & Prestwich, 2010). A meta-analysis of 26 worksite PA intervention studies found that those who explicitly described how theoretical tenets were used and operationalized in the design of specific intervention components were significantly more effective ($d = 0.34$) compared to studies that did not comment on the

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use of theory ($d = .021$) or just broadly described the theoretical framework that inspired the design of the intervention ($d = 0.18$; Taylor et al., 2012). Michie and colleagues (Abraham and Michie, 2008; Michie et al., 2016) distinguish between theoretical constructs and behavioral change techniques (BCT), and have developed a comprehensive taxonomy of 26 reliable BCT for a more standardized classification of intervention content. The taxonomy consists of techniques such as “provide information on the behavior-health link”, “provide general encouragement”, “motivational interviewing”, and “plan social support”. In the context of PA promotion, and specifically in the worksite, the existing body of research does not offer a clear picture of the effectiveness of each BCT. In their review, Dugdill, Brettle, Hulme, McCluskey, and Long (2008) found strong evidence for the effectiveness of interventions that offer worksite counselling on PA behavior, whereas Rongen and colleagues (2013) reported non-significant effects of a counselling component where participants were offered personal advice. Abraham and Graham-Rowe (2009) found strong support for the effectiveness of self-monitoring when self-reporting levels of PA was applied as an outcome variable. However, when objective measures of fitness were applied, interventions without self-monitoring turned out to be the most effective. Finally, Taylor and colleagues (2012) found no significant effect of a single BCT across 27 worksite PA promotion studies. The majority of worksite PA promotion studies are rather comprehensive, incorporating multiple components and several BCT. For instance, in the above-mentioned meta-analysis, the number of BCT ranged between 0-14 ($M = 6.1$, $SD = 3.3$; Taylor et al., 2012).

It can be question whether it is expedient to consider the effectiveness of each BCT separate from the theoretical understanding of the behavioral change process and the theory-based design of the intervention component. Moreover, the different BCT would be interpreted and operationalized differently related to the theoretical framework applied, contextual opportunities and constraints, and characteristics of the specific population of employees. For instance, “plan social support” would look rather different in practice depending on the theoretical understanding of support. A strong theory should be able to model the underlying mechanisms of behavioral change processes, identify relevant moderators and mediators of intervention effects, guide the design of intervention components applicable to the context and population in question, and provide standardized instruments for assessment (Michie & Prestwich, 2010). In sum, a good theory should be both parsimonious across a range of behaviors and outcomes, and

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rigorous from a practical point of view (Patrick & Williams, 2012). The present PhD study applied self-determination theory as a theoretical framework, and in the following section, I will present the theory and try to explain why I found SDT to be a suitable framework for a worksite PA promotion intervention.

Self-determination theory

The technological and structural changes of modern society and working life, such as public and private transportation, elevators, and automatization, have reduced the natural frequency of everyday PA. As a consequence, we have to actively and conscientiously choose and plan for regular PA in order to obtain the dose recommended for health. This involves a complex interaction between physiological, environmental, social, and psychological influences (Biddle & Mutrie, 2001). Central to this process is the concept of motivation – “people being moved to act – for these activities require exertion, energy, focus, and sometimes a great deal of discipline” (Ryan & Deci, 2007, p. 1). Self-determination theory (SDT) offers an organismic dialectic understanding of human motivational processes across all life domains (Deci & Ryan, 1985; 2000). SDT distinguishes between qualitatively different types of motivational regulations based on the underlying motives – the why of the behavior. When an activity is performed because we find it inherently joyful, interesting, challenging, or exciting this is defined as intrinsic motivation. If the activity is performed for instrumental reasons in order to obtain or avoid an outcome separate from the activity itself, this is labeled extrinsic motivation. The motivational regulations are often visualized as a continuum ranging from autonomous forms to increasingly controlled forms, depending on the degree of self-determination, in addition to amotivation (Figure 1). According to SDT, human beings have an innate propensity to actively interact with their environment and seek to integrate the external regulations imposed by important others into a unified sense of self (Deci & Ryan, 2000; 2012).

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<i>Type of motivation</i>	AMOTIVATION	EXTRINSIC MOTIVATION				INTRINSIC MOTIVATION
<i>Type of regulation</i>	No regulation	External regulation	Introjected regulation	Identified regulation	Integrated regulation	Intrinsic regulation

Figure 1. The self-determination continuum (Deci & Ryan, 2000).

The different forms of motivational regulation reflect this innate propensity. *External regulation* is contingent on the expectations or demands of others perceived by the individual as a reward or a punishment. *Introjected regulation* is characterized by a partial assimilation of external expectations where people experience a sense of guilt or shame if they fail to perform the behavior in question. Both extrinsic and introjected regulations are controlled forms of motivation, and are characterized by a low level of internalization. *Identified regulation* can be described as relatively autonomous because the person identifies with the value and purpose of the behavior. If the aim of the activity is not just of personal value but also fully assimilated with overall life goals and way of living, it is labelled *integrated regulation*. Identified, integrated, and intrinsic regulation are often referred to as autonomous forms of motivation characterized by a sense of choice and self-endorsement (Deci & Ryan, 1985; 2000). Amotivation is characterized by a lack of motivation for a behavior, and hence a lack of intention to act (Markland & Tobin, 2004).

According to SDT, these different forms of motivation are not mutually exclusive. For instance, people engage in regular PA for various reasons, both controlled and autonomous (Ryan & Deci, 2007). However, a systematic review of 66 exercise studies found a consistent and moderately strong association between autonomous motivation and exercise (Teixeira, Carraça, Markland, Silva, & Ryan, 2012). The same was found in a large meta-analysis of 185 SDT-based studies, which demonstrated that autonomous motivation for diverse health-related activities had a consistent and positive effect on effort and persistence, resulting in mental and physical health benefits (Ng et al., 2012). Teixeira and colleagues also reported that controlled forms of motivation were either negatively associated with exercise, or no significant relationship was found.

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According to SDT tenets, the process of internalization of values and regulations does not happen automatically. It is influenced by the support, negligence or even thwarting of basic psychological needs (Deci & Ryan, 2000). SDT defines these needs as “innate, organismic necessities rather than acquired motives” (Deci & Ryan, 2000, p. 229), and distinguishes between three basic psychological needs: autonomy (i.e., feeling volitional and self-endorsed), competence (i.e., feeling mastery and effective), and relatedness (i.e., feeling of belonging and being cared for). Autonomy is commonly perceived as a key construct, which distinguishes SDT from other theories (Seifert & Hart, 2014). However, research has supported the SDT notion that the satisfaction of all three needs are equally important for the internalization process to result in autonomous forms of motivation (Deci & Ryan, 2000; Sheldon & Niemiec, 2006).

SDT maintain that it is not the environment per se but rather the need supportive qualities of the environment that matters, particularly the behavior of important others (Vallerand, Pelletier, & Koestner, 2008). Studies in the field of exercise psychology have indicated that two psychological constructs are especially salient in predicting the adoption and adherence of regular PA: enjoying and valuing PA (Deci & Ryan, 1985) and self-efficacy beliefs (Bandura, 2000). The SDT-based concept of *perceived competence* bears a similarity to the concept of self-efficacy presented by social cognitive theory. However, self-efficacy is primarily related to the confidence for performing a task and persisting under different practical and social circumstances. SDT maintains that “the experience of competence in and of itself is a source of satisfaction and contributes to well-being” – regardless of the outcome (Deci & Ryan, 2000, p. 257). Perceived competence is affected by the degree of need satisfaction for autonomy and relatedness as well. Behavioral change and persistence cannot be expected if one of the needs is neglected (Deci & Ryan, 2000).

The self-determination theory model of health behavior change

Several studies have tested a SDT model of health behavior change, which describes the relations between a need supportive health care climate, the mediating role of perceived competence and autonomous motivation, which together predict specific health behaviors and health-related outcomes (Figure 2; Williams et al., 2002; Williams et al., 2006).

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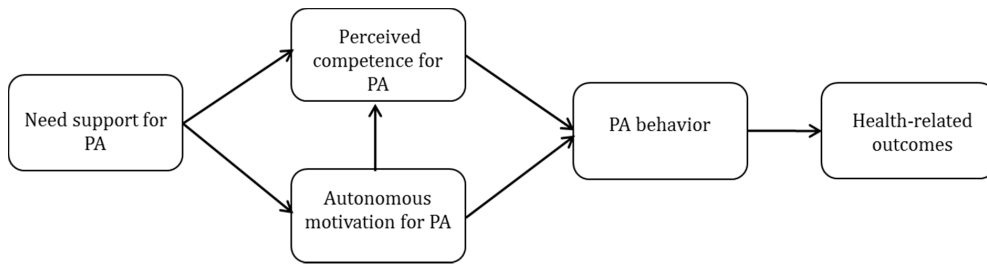


Figure 2. The SDT model of health behavior change – adapted from the model tested by Williams and colleagues (2002, 2006).

In a meta-analysis ($n = 13,356$) the data demonstrated a good model fit across different aspects of physical and mental health, and all directions of paths were in line with the tenets of SDT (Ng et al., 2012). Variants of the model has also been tested in PA intervention studies with similar results among participants on exercise referral scheme (Duda et al., 2014), primary care patients (Fortier, Sweet, O’Sullivan, & Williams, 2007), female patients on a weight loss program (Silva et al., 2011), and senior citizens participating on a PA program (Solberg, Halvari, & Ommundsen, 2013). The model has been tested on a wide range of outcome variables related to physical and mental health (Ng et al., 2012), but never on somatic symptoms burden.

Strategies for enhancing need support in physical activity interventions

In their review, Teixeira and colleagues found that 73% of PA studies applying correlational analysis reported a significant positive association between PA levels and social environments perceived as need supportive (Teixeira et al., 2012). In addition, six of a total of seven intervention studies reported significant group differences in favor of the intervention group. Since this review, the number of SDT-based PA intervention studies has grown in numbers, particularly studies with children (Owen et al., 2016) and adolescents (e.g., Lonsdale et al., 2016). However, PA intervention studies directed at adults are limited in numbers and participants are by and large patients in treatment contexts. There is a need for SDT-based intervention studies in non-treatment contexts targeting a more heterogeneous population in terms of PA levels, health risk profile, and motivation for PA. It can be argued that this will contribute to the applicability and effectiveness of SDT based intervention principles.

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Despite strong empirical support for SDT tenets and the SDT model for health behavior change, researchers still face the challenge of translating theoretical descriptions of a need supportive environment into intervention components and BCT (Patrick & Williams, 2012). Operational characteristics of an “SDT intervention” have not been fully clarified or standardized (Teixeira, Palmeira, & Vansteenkiste, 2012). A meta-analysis aimed to investigate whether intervention studies were able to teach people (predominantly teachers) how to be significantly more autonomy-supportive towards others (Su & Reeve, 2011). Intervention components were rated for the presence of autonomy-supportive elements following the operational definitions listed in the Design and method section (Table 1, no. 1-5). Overall, the interventions were effective related to perceived autonomy support (weighted ES = 0.63, 95% CI: 0.43 to 0.83). Moreover, the most effective interventions also trained teachers in multiple elements of autonomy support.

Three large-scale RCTs (PAC, Empower, and PESO), designed to increase PA among patients in the health care context, have contributed to the development of SDT based intervention principles (Fortier, Duda, Guerin, & Teixeira, 2012). The studies varied considerably in length (3 months to one year) and intensity (2.5 to 30 hours of contact time), but demonstrated significant intervention effects and empirical support for the SDT model of health behavior change. They all applied health and fitness counsellors to facilitate a predominantly face-to-face dialog with and between participants on issues related to goal setting, self-monitoring, how to handle barriers, and solve problems like relapse. The counsellors were trained according to SDT-MI principles. Moreover, all three emphasized the importance of enjoyment related to PA. Participants were presented with different options for PA, and encouraged to find the activities they enjoyed the most and felt were aligned with their values, life goals, and lifestyle. There were differences between the intervention components as well. For instance, The PESO-trial included a 10-week dance curriculum to enhance a positive body image and help participants explore new activities (Silva et al., 2008). The PAC-trial was the only study to include the family physician as a provider of a brief (2-4 min) need supportive counselling session prior to the intensive sessions with the health and fitness counsellors (Fortier et al., 2007).

There is a limited number of SDT-based PA intervention studies carried out in the worksite context so far: a lunchtime walking intervention (group-led and self-organized walks; Thøgersen-Ntoumani, Loughre, Duda, & Fox, 2014) and a group-based spinning

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class intervention (Thøgersen-Ntoumani, Ntoumanis, Shepher, & Wangenmakers, 2016), among sedentary university staff employees. Both applied professional exercise instructors to deliver the intervention, and one of the studies provided instructors with a two hours training in autonomy-supportive style (Thøgersen-Ntoumani et al., 2014). The latter also provided the participants with pedometers, a motivational log-book, and weekly autonomy-support text messages. The training and text messages were informed by SDT principles such as offer choice, minimizing pressure and control, and provide meaningful rationales. The motivational booklet contained information about how to adopt and maintain regular PA such as how to set appropriate goals and handle barriers, in addition to reflection tasks related to reasons for walking, favorite walks, and potential new areas for walking. Participants were also invited to log their weekly walks and assess their achievements (Thøgersen-Ntoumani, Loughren, Duda, Fow, & Kinnafick, 2010). This feasibility study demonstrated promising results measured by steps, particularly during the group-led walks.

Coworkers as the provider of social support

In the large majority of SDT-based PA intervention studies, support for basic psychological needs is provided by health practitioners, exercise instructors, or PE teachers. Systematic reviews and meta-analyses have demonstrated the effectiveness of training these professions in need supportive behavior (Ng et al., 2012; Su & Reeve, 2011; Teixeira et al., 2012). Their competence as expert on PA and health, and experience with counselling and teaching are an evident advantage in SDT-based intervention studies. In Norway, a worksite is legally required to establish cooperation with occupational health service for professional counselling and treatment. Hence, health promotion programs are commonly provided by or in collaboration with occupational health practitioners. However, employers are seldom willing to spend financial resources on long-term, and particularly individual, health promotion counselling. The programs are often restricted in time and offered to groups of employees. Studies incorporating social support from groupings already established or naturally occurring, like coworkers, are rather common in the context of worksite health promotion approach (Linnan, Fisher, & Hood, 2012). A *social network* consists of individuals, groups, or organizations to which the individual is tied – either personally or task-oriented (Bartholomew et al., 2011; Gottlieb, 1985). The relationship between a patient and a physician is hierarchical and task-oriented, whereas

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friends are personal and horizontal. At work, the relationship between an employee and a manager would typically be predominantly task-oriented and hierarchical.

For many people, coworkers represent a horizontal network, which is both task-oriented and personal. People often spend more hours with their coworkers than their families and friends during a workweek. Coworkers function as positive providers of social support, but they can also exert a negative influence, such as social control, undermining, and comparison (Heaney & Israel, 2008). Heaney and Israel list four types of social support that networks can provide related to health behavior change programs: emotional (trust, empathy, and care), informational (facts, advice, and suggestions), instrumental (aid and services), and appraisal (feedback, affirmations, and observations). A review of social support intervention studies across different health related issues found social support from family members, friends or peers to be important, especially when the support was reciprocal (Hogan, Linden, & Najarian, 2002). However, peers are seldom evaluated separately from the intervention as a whole (Linnan et al., 2012). Moreover, training people to improve their social support skills was found to be effective whether the intervention was led by a health professional or a peer (Hogan, Linden, & Najarian, 2002).

According to SDT, *how* social support is provided is as important as the type of social support. For instance, informational support such as facts or advice can be given in a controlling manner or autonomy supportive manner (Deci & Ryan, 2000). An autonomy supportive manner would entail that the recipient was provided with meaningful rationales (Deci, Eghrari, Patrick, Leone, 1994), described as "verbal explanations that help the other person understand why self-regulation of the activity would have personal utility" (Su & Reeve, 2011, p. 161). If the informational support is provided as recommendations using words such as "You must..." or "You have to..." this controlling language can decrease perceived autonomy support (Deci et al., 1994). Social support, which is perceived as supportive of basic psychological needs can potentially increase the effectiveness related to autonomous motivation, behavioral change, and well-being of the receiver.

Several studies have investigated the associations between a work climate perceived as supportive of basic psychological needs and health-related outcomes among employees. However, with a few exceptions, studies tend to focus on perceptions of a manager as the provider of social support (Van den Broeck, Ferris, Chaneg, & Rosen, 2016; Williams,

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Halvari, Niemeic, Sørebo, Olafsen, & Westbye, 2014). A unique contribution from coworkers' support of basic psychological needs has been found to be related to psychological health (Moreau and Mageau, 2012), emotional exhaustion, and turnover intentions (Richer, Blanchard, & Vallerand, 2002). To our knowledge, few SDT-based studies on health promotion intervention have incorporated peers as an active ingredient and assessed whether they were perceived as supportive of basic psychological needs separately. In order to be effective, we hypothesized that an intervention should build on the established bonds between coworkers, offer them simple training in need-supportive behavior, and provide them with a structure that facilitates reciprocal support for basic psychological needs and a mutual process of internalization towards autonomous motivation for PA.

Purpose, objectives, and hypotheses for the doctoral thesis

The present doctoral thesis is based on a one-year cluster-RCT situated in the worksite context. The intervention was developed and tested based primarily on the tenets of SDT, and adjusted to the context of a worksite health promotion program targeting employees working with transport, sorting, and distribution. The overall aim of this thesis is to contribute to the understanding of how interventions can be designed to increase autonomous motivation for behavioral change and produce health benefits regarded as both clinically relevant and important to the worksite. The thesis also aims to explore the development of PA behavior over a period of one year, before, during, and after the intervention, and how the behavior is related to motivational regulation. Moreover, the thesis aspires to contribute to the theoretical understanding of peers as a provider of support for basic psychological needs. The following objectives and hypotheses were formulated per paper:

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Paper I

The aim of the paper was threefold. First, it aimed to explore and discuss the immediate effects of the intervention on the primary outcome variables, regular PA and CRF, and on the secondary outcome variables related to physical health. Second, the paper intended to test whether and how the data supported the SDT model of health behavior change. Third, the paper provided detailed descriptions of the study protocol and how the SDT concept of a support for basic psychological needs was operationalization and provided through each of the three intervention components: workshops facilitated by a health and exercise advisor (HEA), a reflection booklet, and peer dialogue.

The research hypotheses were:

1. A need-supportive group-based intervention would lead to increases in PA and CRF, relative to a control group.
2. A need-supportive group-based intervention would lead to improvements in physical health related to reduced size of waist circumference, reduced levels of systolic and diastolic blood pressure, reduced levels of non-HDL cholesterol, and increased levels of HDL cholesterol, relative to a control group.
3. A need-supportive group-based intervention would lead to increases in perceived need support for PA from coworkers, perceived competence for PA, and autonomous motivation for PA relative to a control group.
4. The data would support the SDT-based model of health behavior change, positing that perceived need support for PA would be positively associated with autonomous motivation and perceived competence for PA, leading to increases in PA levels and CRF. These changes were expected to be positively related to decreases in systolic and diastolic blood pressure (BP), waist circumference, and non-high-density lipoprotein cholesterol (non-HDL-C).

Paper II

Paper II aimed to explore whether a PA promotion intervention, designed to support the employees' basic psychological need satisfaction related specifically to PA, was capable of affecting one of the strongest predictors of ill health: somatic symptoms burden and sickness absence. Moreover, the paper aimed to explore the direct and indirect associations between study variables, and test whether the SDT model of health behavior change was supported for the secondary outcome variable somatic symptoms burden.

The research hypotheses were:

1. The intervention group would demonstrate increased levels of perceived support for PA, autonomous motivation for PA, regular PA and CRF, and in addition reduced levels of somatic symptoms and sickness absence, compared to a non-intervention control group.
2. The data would support the SDT-based model of health behavior change, which postulates that increases in perceived support for PA from coworkers would be associated with increases in autonomous motivation for PA, resulting in increases in PA levels.
3. In line with the model, the study hypothesized that increases in PA would be positively associated with changes in CRF, and negatively associated with changes in somatic symptoms, which in turn would affect sickness absence. Increased CRF was hypothesized to be negatively associated with somatic symptoms.

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Paper III

Paper III aimed to explore, over a period of one year, whether there were latent trajectories in the sample that were related to PA levels. Second, we aimed to assess whether the intervention was able to recruit employees with different levels of PA, particularly those with low levels. Third, we aimed to assess whether these potential patterns of PA differences were associated with the employees' perceived competence and motivation for PA at baseline and follow-up.

The following hypotheses were tested:

1. Employees reporting higher levels of PA are expected to have higher levels of perceived competence for PA, and higher levels of autonomous motivation for PA (intrinsic and identified regulation) compared to those employees reporting lower levels of PA.
2. Employees reporting higher levels of PA are expected to have lower levels of controlled motivation (introjected and extrinsic regulation) and amotivation for PA compared to employees reporting lower levels of PA.
3. Changes in PA from baseline to follow-up are expected to be associated with changes in perceived competence and motivational regulation for PA, in line with hypotheses 1 and 2.

DESIGN AND METHODS

Overall design, study sample, and data collection

This thesis is based on a two-arm cluster RCT with no blinding or stratification, and with a delayed-intervention control group. The study was conducted in the Eastern part of Norway between January 2015 and February 2016. The unit of randomization was six worksite locations, and cluster randomization was chosen due to the group-based design of the intervention and the risk of contamination between conditions. Three worksites were randomized to the intervention group ($n = 113$, 56%) and three to the control group ($n = 89$, 44%) by means of a computerized random number generator. For ethical reasons, participants in the control group were offered a delayed team-based intervention. Figure 3 presents the flow of participants through the study.

The study consisted of employees working in Norway Post. They were so-called blue-collar workers, employed as drivers, mail carriers, or terminal workers (sorting packages).

The recruitment process consisted of one-hour information meetings during working hours at each worksite, held by the PhD candidate (Appendix II). Eligible participants ($n = 320$) were defined as employees working in a position of 20-100%. A total of $n = 202$ (68%) employees chose to participate, and signed a written declaration of informed consent. We had limited access to information about the eligible employees who declined to participate. However, we found that the latter did not differ significant from the study sample related to age and gender.

Three periods of data collection were administered. Baseline assessments were carried out in January-February 2015 prior to randomization. Post-test assessments were implemented five months later in June 2015. Participants in the control group were offered a group-based intervention between September and December 2015, and follow-up assessments of both groups were administered in January-February 2016. Baseline and post-test assessments were in the form of health-screenings. Follow-up assessments consisted solely of questionnaires.

DESIGN AND METHOD

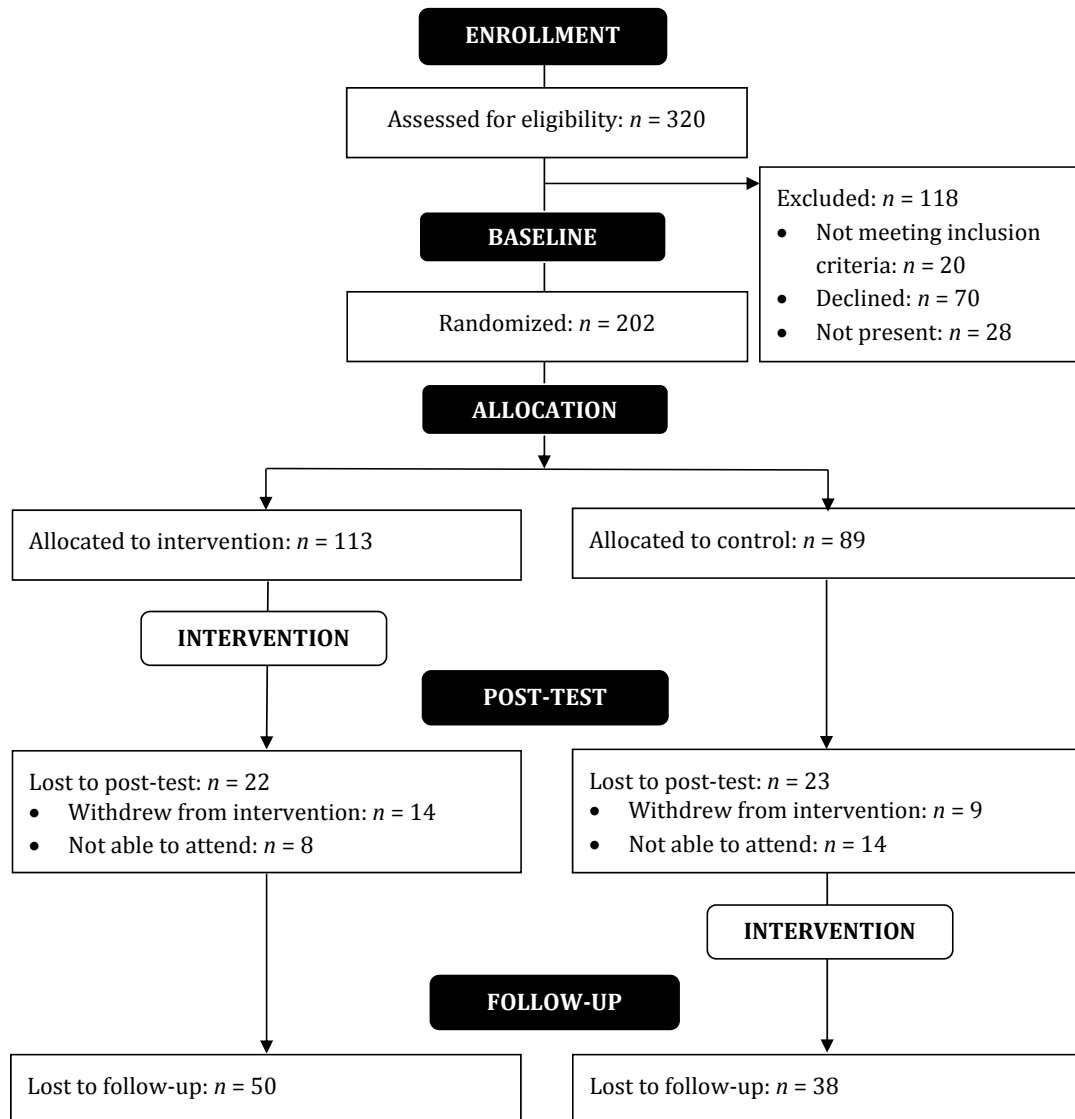


Figure 3. Flow of participants and attrition during the study period.

Ethical approval and trial registration

The study protocol, including all written material related to recruitment and informed consent, was approved by the Data Protection Official for Research in Norway (Appendix 1). In addition, the project was presented to the Regional Committees for Medical and Health Research Ethics in Norway, who concluded that the project could proceed without further approval according to the Norwegian health research legislation (Appendix 1). The study was registered on clinicaltrials.gov April 14, 2015 ("My Exercise: A Team-based Workplace Intervention for Increased Exercise", NCT02429635, April 14, 2015). The paper and thesis as a whole adhere to the CONSORT and TIDieR guidelines for reporting of RCTs (Paper I, Supplementary material E and F).

Health screenings

Both the intervention group and the control group received identical onsite health screening at baseline and post-test. The health screenings lasted for 90 minutes, and were administered by health practitioners from occupational health service (Aktimed). First, participants completed questionnaires, followed by physiological tests of cardiorespiratory fitness and biomedical health markers (e.g., blood pressure, waist circumference, and cholesterol levels). Next, they were offered a 15 minutes individual meeting with the health practitioner who presented them with the results (health status and risk factors), answered questions, recommended lifestyle changes and, in some cases, to consult their physician for further testing and medical treatment. All participants were given a written, individual health profile, and were encouraged to follow the recommendations of the health practitioner.

Delayed-intervention control group

Between post-test and follow-up assessments, the control group was offered similar group-based sessions. Both groups received a second identical health screening after five months where post-test assessments were compared to baseline.

DESIGN AND METHOD

The intervention program

The intervention was developed with the aim of motivating employees to increase and maintain their health-related PA. The intervention components were designed to increase autonomous motivation for PA through the provision of support for basic psychological needs. PA was self-organized and executed during leisure time due to shift work and lack of onsite exercise facilities.

The theoretical framework

The theoretical framework was based on an understanding of human motivation processes as described in self-determination theory (SDT) combined with techniques from motivational interviewing (MI) suitable for self-reflection and dialogue among peers in a group setting. The components were designed to provide a motivational facilitative environment along three dimensions: *autonomy support*, *provision of structure*, and *interpersonal involvement* (Deci & Ryan, 1991; Ryan, Deci, & Grolnick, 1995). The first dimension, autonomy support, is defined as "Providing meaningful rationales", "Acknowledge negative feelings", and "Use non-controlling language" (Deci, Eghrari, Patrick, & Leone, 1994), in addition to "Offer choices" (Reeve, 2002), and "Nurture inner motivational resources" (Williams, Cox, Kouides, & Deci, 1999). The second and third dimensions, provision of structure and interpersonal involvement, are both adapted from the works of Markland and colleagues integrating the tenets of SDT with the practice of MI (Markland, Ryan, Tobin, & Rollnick, 2005; Markland & Vanteenkiste, 2007). Examples of these dimensions being "Offer advice when appropriate but avoid imperatives (e.g., 'you must', 'you should')" and "Demonstrate understanding of the participants' position" (Table 1). The choice and combination of components were inspired by the PAC, Empower, and PESO trials (Fortier et al., 2012). For a detailed presentation of the intervention content and delivery including the training of HEAs, see paper I including supplemental material A.

Table 1. Operational definitions of a need supportive environment.***Autonomy support***

1. *Provide meaningful rationales*
Verbal explanations that help the other person understand why self-regulation of the activity would have personal utility.
2. *Acknowledge negative feelings*
Tension-alleviating acknowledgements that the request one is making of the other is in conflict with his or her personal inclinations and that his or her feelings of conflict are legitimate (yet not necessarily inconsistent with activity engagement).
3. *Use non-controlling language*
Communications that minimize pressure (absence of “shoulds”, “musts”, and “have tos”) and convey a sense of choice and flexibility in the locution of behavior.
4. *Offer choices*
Provide information about options, encouragements of choice making, and encouragements of the initiation of one’s own action.
5. *Nurture inner motivational resources*
Vitalization of the other’s interest, enjoyment, psychological need satisfaction (autonomy, competence, relatedness), or sense of challenge or curiosity during engagement of a requested activity.

Provision of structure

6. Help participants generate and set appropriate, realistic and achievable exercise goals.
7. Present clear and neutral information about what to expect from exercising and what is needed to achieve the participant’s own goal.
8. Offer advice when appropriate but avoid imperatives.
9. Ensure that the participants can receive regular positive feedback.
10. Affirm participants’ efforts as well as their successes.

Interpersonal involvement

11. Demonstrating a genuine interest in participants and their well-being.
12. Explore and acknowledge the participants’ concerns and worries in order to truly understand and respecting the difficulties they are facing.
13. Showing that significant others can be trusted to provide material and emotional support.
14. Demonstrate understanding of the participants’ position.
15. Avoid judgment and blame.

DESIGN AND METHOD

Formative research

First, formative research was carried out in order to map the context and target population, and to make sure that the intervention would be relevant, feasible, and effective (Bartholomew et al., 2011). We conducted a series of interviews: three with employees who had previously participated on a similar health promotion program offered by their employer, Norway Post, and a team-manager from one of the participating worksite. A reference group was established consisting of employees working with human resources (HR) and health, environment, and safety (HSE) in Norway Post, in addition to representatives of the occupational health service provider (Unicare). The reference group was used for discussions, feedback on sketches, quality control, and assisted in the recruitment of worksites. We conducted a pilot in order to test the design and content of the workshops and the booklet, in addition to the set of questionnaires applied at all three time-points. The pilot was evaluated by means of observations, questionnaires, and group-interviews.

Content and delivery

Following randomization, the intervention group was offered six group-based intervention sessions during a period of 16 weeks: two workshops and four PA support group meetings. The total contact time was 7,5 hours (workshops: 90-120 minutes, PA support group meetings: 1 hour each). The sessions were delivered biweekly during the period, and were situated at the worksite premises. The intervention consisted of three components (active ingredients): information and dialog provided by a health and exercise advisor (HEA), peer dialogue in small groups, and a booklet with reflection tasks. Peer dialogue took place during workshops and PA support group meetings. All sessions were offered at the worksite premises.

The workshops were provided and facilitated by a HEA. Initially, the HEA gave short talks on health benefits and recommendations related to PA and health, and on the process of health behavior change and the role of motivational regulation according to the tenets of SDT. The rest of the first workshop was dedicated to individual reflection tasks, small group dialog, and plenary dialogue between the participants and the HEA. The two HEAs were physiotherapists employed by the company occupational health service. They were both experienced and professionally trained in behavioural change counselling and

facilitation of group processes. They were trained to facilitate the workshops and provide participants with autonomy support, structure, and interpersonal involvement.

A booklet was handed out at the beginning of the first workshop, consisting of reflection tasks based on a combination of SDT and techniques from MI. Participants completed each individually during the workshops, and discussed their answers in small groups of 2-3 participants in order to increase awareness, competence and relatedness, followed by plenary discussions facilitated by the HEA (Appendix II).

The PA support group meetings were structured to facilitate mutual sharing of experiential knowledge connected to PA lifestyle changes. The groups consisted of four to five participants with similar PA levels and interests. They were instructed to put one participant in focus at the time, and to offer support for autonomy, competence, and relatedness in their response and comments. During the first one-hour meeting, participants were offered an introduction to the concept of need supportive behaviour, and structured as descriptions of need supportive or need thwarting behaviour. An example is "Explore different options and choices together with the person" versus "Offer strong opinions about what the person should choose or do". The groups were self-directed, and contacted the researcher present for questions or comments.

Assessments

Several different methods were applied to measure the primary and secondary outcome variables. Questionnaires were applied to measure the motivational and demographic variables. An overview of the questionnaires applied in the studies is presented in Table 2. All questionnaires are included in Appendix IV.

Demographic characteristics

Data on age, gender, and education level were collected at all three time-points. Education level was assessed applying the following scale: (1) primary and secondary school (10 years), (2) high school (13 years), (3) college/university degree (1-4 years), and (4) college/university degree (more than 4 years).

DESIGN AND METHOD

Primary outcome variables

Physical activity

A self-reporting measure of PA was applied at all three time-points of data collection. Habitual PA in terms of the average frequency, duration, and intensity per week was assessed applying the three-item questionnaire International Physical Activity Index (IPAQ), previously validated in a compatible population in Norway (i.e., the HUNT study; Kurtze, Rangul, Hustvedt, & Flanders, 2008). Weighted scores were summed to obtain a total index of regular PA.

Cardiorespiratory fitness

CRF was measured at baseline and post-test applying a submaximal ergometer bicycle test. A maximal test of CRF was considered unsuitable in the present context due to the risk of overexertion and negative health reactions (ACSM, 2014). In addition, the test was carried out at the worksite in order to reduce the practical implications of participating for both employee and employer. The Astrand-Rhyming ergometer bicycle test, a single-stage test lasting for six minutes, was administered by qualified health occupational therapists (ACSM, 2014; Astrand, 1960). We used an electronic cycle with a cadence meter and a heart rate monitor with chest strap in order to assess heartrate. CRF levels were estimated based on a steady pace with a heartrate between 120-170 bpm, and workload determined by the participants' gender and physical condition. An adjusted VO₂max value was estimated using the modified Astrand-Ryhming monogram, correcting for age, gender, and weight. Validation studies have demonstrated a consistent difference between submaximal estimations and direct measures (in standard deviations) of approximately +/-15% in a population mixed in age and fitness level (Ekblom, Engstrom, & Ekblom, 2007).

High-intensity interval training

High-intensity interval training (HIT) consists of several 1-4 minutes bouts of vigorous, albeit not maximal, intensity combined with periods of rest or active recovery (Gaesser & Angadi, 2011). Accumulated evidence indicate that the effectiveness of HIT is surprisingly close to continuous PA in terms of cardio-metabolic adaptations (Gibala & McGee, 2008). The intervention content included information about the importance of CRF and instructions on the principles of HIT. Participants were encouraged to apply the principles during PA, but self-reporting measure of HIT was not included in the assessments.

Secondary outcome variables***Biomedical outcome variables***

All biomedical health markers were measured at baseline and post-test. *Systolic and diastolic blood pressures* were measured manually applying an auscultatory technique with a mercury column or mechanical aneroid sphygmomanometer. Blood samples were collected by means of capillary puncture. *Non-HDL cholesterol* levels were calculated by subtracting *HDL cholesterol* from total cholesterol. Blood samples were collected during working hours, and participants were not advised to fast before attending the test due to work safety considerations. *Abdominal obesity* was measured as waist circumference with a measuring tape.

Somatic symptoms burden

A self-reporting measure of somatic symptoms burden was applied at all three time-points of data collection, the Level 2 Somatic Symptoms questionnaire (adult patients), adapted from the Patient Health Questionnaire - Physical Symptoms (PHQ-15; Kroenke et al., 2002). Participants were asked to assess whether they had been bothered by 13 different symptoms (e.g., "Stomach pain," "Back pain," and "Feeling tired or having low energy,") during the last 4 weeks. Two items were omitted from the survey because they were considered to be too sensitive in this worksite context ("Menstrual cramps" and "Problems during sexual intercourse"). Participants responded according to a 3-point Likert-scale, ranging from 0 (*not bothered*) to 2 (*very bothered*). An index score was calculated by summing the items in terms of number and severity to a maximum of 26, according to measurement protocol. The questionnaire was previously translated to Norwegian and applied on Norwegian samples (Williams et al., 2014).

Sickness absence

A self-reporting measure of sickness absence was applied at all three time-points of data collection. Sickness absence was measured with a single item: "During the last 6 months, how many days in total have you been absent from work due to your own sickness?" Participants answered according to a 5-point Likert-scale, ranging from 1 (*0 days*), 2 (*1-4 days*), 3 (*5-8 days*), 4 (*9-18 days*), and 5 (*More than 18 days*; Aronsson & Lindh, 2004). The questionnaire was previously translated to Norwegian and applied on Norwegian samples (Folkedal, Vaag, Halvari, & Svebak, 2000).

DESIGN AND METHOD

Motivational variables

Co-worker support for basic psychological needs

Perceived support for PA from coworkers was measured with the short version of the 15-item Health Care Climate Questionnaire (HCCQ; Williams et al., 1996) at all three time-points. The questionnaire is originally designed to assess the health care climate offered by health care practitioners. The items were slightly changed to fit the worksite context and perceptions of co-workers, and one item was omitted because it was not relevant to the context of coworkers (“My (...) encourages me to ask questions”). Moreover, two items from the HCCQ-15 items were included to obtain a better balance between the items related to all three basic psychological needs as the short version is slightly in favor of autonomy support. Participants responded to the items on a 7-point Likert-scale, ranging from 1 (*not true*) to 7 (*very true*). The present version of HCCQ-7 has previously been translated and applied in a Norwegian sample of adult exercisers (Solberg, Hopkins, Ommundsen, & Halvari, 2012).

Perceived competence

Perceived competence for PA was measured by the Perceived Competence in Exercise Scale (PCES; Williams and Deci, 1996), on a 7-point Likert-scale, ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The scale has previously demonstrated good psychometric properties related to exercise (Fortier et al., 2007). The questionnaire has previously been translated and applied in a Norwegian sample of adult exercisers (Solberg et al., 2013).

Motivational regulations

Motivational regulations for PA was assessed at all three time-points applying the Behavioral Regulation in Exercise Questionnaire (BREQ-2; Markland & Tobin, 2004). In paper I and II, the two subscales, intrinsic and identified motivation, were combined to form a single construct of *autonomous motivation for PA*. This was done in order to reduce the number and complexity of study variables applied in the statistical analyses. Studies have shown that autonomous motivation is consistently and positively associated with PA, whereas the association with controlled motivation is inconclusive (Teixeira et al., 2012). In paper III, all five subscales were measured for a more explorative analysis of the potential patterns of association between motivational regulations and latent trajectories of PA. Participants responded according to a 5-point Likert-scale, ranging from 1 (*not true*)

for me) to 5 (*very true for me*). The questionnaire has previously been translated and applied in a Norwegian sample of adult exercisers (Solberg et al., 2013).

Table 2. Overview of scales used in the study

Measures	Scale	Paper
Physical activity	IPAI; Kurtze et al., 2008	I, II, III
Somatic symptoms	PHQ-1 (PS); Kroenke et al., 2002	II
Sickness absence	SA; Aronsson & Lindh, 2004	II
Perceived competence	PCES; Williams & Deci, 1996	I, III
Motivational regulation	BREQ-2; Markland & Tobin, 2004	I, II, III
Perceived need support	HCCQ; Williams et al., 1996	I, II

PS = physical symptoms. SA = Sickness absence.

Power calculations

The study was designed to detect an estimated mean of true Cohen's *d* ES of 0.39 (90% probability at 5% significance level) between the two groups for change in CRF. This estimate was based on findings from a meta-analysis of worksite PA intervention studies (ES = 0.51, 95% CI = 0.39 to 0.63; Conn et al., 2009). In the present study, a conservative estimation was applied since PA was self-organized. An estimate of the intra-cluster correlation coefficient (ICC) was set to 0.040 (Eldridge, Ashby, Feder, Rudnicka, & Ukoumunne, 2004). SD was set to 0.5 based on a clinically relevant change in CRF of one MET or 3.5 mL·kg⁻¹·min⁻¹ (Myers et al., 2004). The sample size estimate computed was increased with 20% to compensate for attrition. For further details, see Pedersen, Halvari, and Williams (2018).

Attendance and fidelity

The rate of attendance per participant was assessed on all six sessions offered. Fidelity, defined as the percentage of all sessions carried out according to protocol, was measured for the intervention condition (Dzewaltowski, Estabrooks, Klesges, Bull, & Glasgow, 2004).

DESIGN AND METHOD

Statistical analyses

Behavioral change is a complex process. Health promotion programs designed to facilitate this process must target psychological, social, and contextual factors. We are curious as to *whether* the intervention was effective, *how*, and *why*. According to Duncan and Duncan (2009), "No single statistical procedure exists for the analysis of longitudinal data because different research questions dictate different data structures and thus, different statistical methods and models." (p. 979). The repeated measures data was analyzed using a traditional approach, repeated measures analysis of variance, in combination with both a simple and a more sophisticated modeling approach, path analysis and latent class growth analysis (LCGA) respectively. Parts of the datasets were used in more than one paper, but the analyses were unique for each paper.

Missing data analysis

Missing data is an undesirable albeit not unexpected problem with longitudinal designs, and a strategy for handling missing data should be established in advance. Participants were instructed to inform the researchers directly if they chose to withdraw or state the reason if they were not able to attend assessments. Of the 202 participants, 3.5% ($n = 7$) did not attend baseline assessments, whereas 22% ($n = 47$) were lost to post-test and 44% ($n = 88$) to follow-up at 12 months. Prior to analyses of intervention effects and structural equation modeling (SEM), the pattern of missing data was examined by means of Little's test of missing completely at random (MCAR) or not. Binary logistic regression and one-way ANOVA analysis was carried out to test whether the baseline assessments of the study variables could predict dropout rates. Further, subsamples were analyzed at baseline to compare those who chose to withdraw with those who were presumably willing but not able to attend. All analyses were executed in IBM SPSS Statistics 21 (Armonk, NY: IBM Corp). For details and results, see paper I-III.

Missing data and analysis of intervention effects: The missing data were accounted for by means of multiple imputations, as recommended when the proportion of missing data exceeds 10% (Little, Jorgensen, Lang and Moore, 2013). We used the Markov Chain Monte Carlo procedure, with $n = 15$ and $n = 20$ datasets (paper I and II respectively). Multiple imputations were executed in IBM SPSS Statistics version 21 (Armonk, NY: IBM Corp).

Missing data and structural equation modeling analysis: Full information maximum likelihood estimation (FIML; Enders & Bandalos, 2001) was applied in order to handle missing data, and analyses were performed using the maximum likelihood estimation with robust standard errors (MLR). In paper I, the analyses were done in *Mplus* version 7.4 (Muthén & Muthén, 1998-2012), and in paper II they were done in AMOS 20.0 (Chicago: IBM SPSS).

Attendance rates

We tested if any demographic characteristics or study variables, measured at baseline, could predict attendance. Hierarchical multiple regression analysis was applied in order to assess the percentage of total variance in primary outcome variables that could be explained by attendance rates. The analyses were done in IBM SPSS Statistics version 21 (Armonk, NY: IBM Corp).

Intervention effects

In order to assess the effectiveness of the intervention on primary, secondary, and motivational variables, repeated measures analysis of variance was used. Following the CONSORT recommendations, intervention effects were analyzed using both intention-to-treat and complete-case analyses, including all participants with baseline and/or posttest data (Moher et al., 2010). Repeated measures MANOVA and ANOVA were executed in IBM SPSS Statistics 21 (Armonk, NY: IBM Corp). Due to the small number of clusters ($n = 6$), multilevel modeling methods were considered unsuitable (Snijders & Bosker, 2012), and the clustering variable (worksite location) was included in the analyses as a covariate in order to control for the potential clustering effects. Effect sizes were calculated applying Cohen's d comparing two conditions, using pooled baseline SD (Morris, 2008).

Structural equation modeling

All three papers analyzed the relations between SDT constructs and health-related outcome variables using longitudinal SEM, a statistical methodology particularly suited for inferential purposes. According to Byrne (2012), the term *structural equation modeling* entails "(a) that the causal processes under study are represented by a series of structural (i.e., regression) equations, and (b) that these structural relations can be modeled pictorially to enable a clearer conceptualization of the theory under study." (p.

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3). SEM includes confirmatory factor analysis (CFA), path analysis, partial least squares path modeling, and latent growth modeling (Kline, 2016).

Confirmatory factor analysis

The motivational variables included in this thesis are theoretical constructs that we assume exists based on the pattern of relevant behaviors we are able to observe (i.e., self-reporting items). In order to test whether this pattern, the factorial validity of the theoretical construct, would appear in the present data we used first-order CFA (measurement model testing). Autonomous motivation for PA was tested in paper I and II, perceived competence for PA in paper I and III, perceived need support for PA in paper I and II, and motivational regulations for PA (intrinsic regulation, identified regulation, introjected regulation, extrinsic regulation, and amotivation) in paper III. The CFAs were done in Mplus version 7.4 (Muthén & Muthén, 1998-2012).

Path analysis

In order to test whether the study data supported the SDT model of health behavior change, we applied structural equation modeling (SEM). Paper I tested the model with primary and secondary outcome variables related to physical health, and paper II tested the model with the secondary outcome variable related to somatic symptoms and sickness absence. The two primary outcome variables, PA and CRF, were included in the models as manifest variables because they are both measured as an index rather than a latent construct. Motivational variables were included in both models, except for perceived competence for PA (paper I). We chose a rather simple analysis: path analysis at the level of manifest variables using change scores calculated by means of linear regression analysis (regression of the post-test mean score on the baseline score and saving the unstandardized residual values; Zumbo, 1999). The SDT models we tested were relatively complex mediation models with presumable direct and indirect effects between variables, and several dependent variables. This procedure increases the stability of models consisting of both objectively measured variables and self-reporting scales (Cole and Preacher, 2014). However, the strength of SEM is related to the use of latent variables incorporating all the indicator that constitutes the variable: "A latent path analysis has the advantage over manifest path analysis in that it takes random measurement error in the observed variables into account when estimating direct, indirect, and total effects between the constructs of interest" (Geiser, 2012, p. 73). We

applied a dataset where the intervention group and the control group were collapsed in order to increase the statistical power. The potential confounding effect of the cluster randomization variable, worksite location, was included in the analyses. We tested the structural model including all indirect and direct paths, according to the recommendations of Anderson and Gerbing (1988). We used a covariance-based analysis to account for the potential effects of the clustering randomization variable (worksite location). All models tested were evaluated using the following goodness-of-fit: The comparable fit index (CFI) ≥ 0.90 , the Tucker-Lewis index (TLI) ≥ 0.90 , standardized root mean square residual (SRMR) ≤ 0.08 , and root mean square error of approximation (RMSEA) ≤ 0.08 indices (Brown & Moore, 2012; Little, 2013). In paper I, the analyses were done in *Mplus* version 7.4 (Muthén & Muthén, 1998-2012), and in paper II they were done in AMOS 20.0 (Chicago: IBM SPSS). Indirect effects were performed using *Mplus* version 7.4 (Muthén & Muthén, 1998-2012) in paper I and RMediation (v1.1.4; Tofighi & MacKinnon, 2011) in paper II. Prior to the path analyses, zero order bivariate correlational analyses were performed with change scores in IBM SPSS Statistics 21 (Armonk, NY: IBM Corp) in order to assess the pattern of associations between study variables.

Latent class growth analysis

In order to assess the patterns of change in PA over a period of one year, including follow-up data at 12 months, we used LCGA (Paper III). Growth curve modeling techniques, such as LCGA, are statistical methods suited for the estimation of between-person differences in within-person change, often referred to as trajectories (Bollen & Curran, 2006). Growth curve modeling has become increasingly popular because it is highly flexible and able to incorporate complexity such as partially missing data, nonlinear change, unequal time-points, and heterogeneous growth processes (Curran, Obeidat, & Losardo, 2010). LCGA offer the possibility to “model unobserved heterogeneity in a population by identifying different latent classes of individuals based on their observed response pattern” (Clark & Muthén, 2009, p. 3). Data collected at all three time-points were applied in the analysis. A stepwise model comparison approach was conducted to compare a one-class model to models with successively more classes (Nylund, Asparouhov, & Muthén, 2007). According to recommendations, a combination of goodness of fit indices (GOF) should be considered together with class sizes ($> 5\%$), theoretical justification, and interpretability in order to decide on the appropriate model (Jung & Wickrama, 2008). These following GOF indices

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were considered: the smallest Bayesian information criteria (BIC) and Aikaike's information criterion (AIC) to assess model fit, the highest possible entropy to assess precision/quality of classification, and a significant p-value on the bootstrap likelihood ratio test (BLRT) and the Lo-Mendell-Rubin adjusted likelihood ratio test (L-M-R). The latter tests indicate whether the $k-1$ class model is rejected in favor of the k class model (Jung & Wickrama, 2008; Nylund et al., 2007). Because PA was measured with a summary index, a manifest variable was applied as a continuous indicator of a latent class variable.

Next, we conducted a series of analyses to explore whether there were significant differences in the mean levels of the distal outcome variables, perceived competence and motivational regulations for PA, between the classes. We applied the three-step BCH approach in *Mplus*. This approach offers an omnibus test that includes differences between the three classes on each distal outcome variable (Bolck, Croon, & Hagnaars, 2004). According to a comparative analysis of different approaches, the findings indicated that BCH was the most robust and flexible approach, yielding the least biased estimates (Bakk & Vermunt, 2016).

SUMMARY OF RESULTS

The present doctoral thesis consists of three papers. In paper I, detailed information about the study protocol and design procedure, originally planned to be published as a protocol paper, was included in the supplementary material, as required by the journal editor.

Demographic characteristics of the participants

The study sample consisted of predominantly male participants (76.2%). The participants were between 19 and 68 years, and mean age was 42.5 years. Education levels were relatively low, and only 14.3% had a college degree (Table 3).

Table 3. Demographic characteristic of participant at baseline (*M/SD/%*)

Variables	Total: n = 197	Intervention: n = 113	Control: n = 89
Gender			
Male	154 (76.2%)	80 (70.8%)	74 (83.1%)
Female	48 (23.8%)	33 (29.2%)	15 (16.9%)
Age (years)	42.49 (11.65)	43.47 (11.11)	41.26 (12.25)
Education levels			
Primary/secondary school	33 (16.9%)	22 (20.0%)	11 (12.9%)
High school	134 (68.7%)	75 (68.2%)	59 (69.4%)
College/university (1-4 years)	25 (12.8%)	12 (10.9%)	13 (15.3%)
College/university (5- years)	3 (1.5%)	1 (0.9%)	2 (2.4%)

RESULTS

Paper I: Effects of the intervention on physical health

Objectives: The aim of paper I was to test the hypothesis that a PA intervention in the worksite would lead to increases in autonomous motivation and perceived competence for PA, self-administered regular PA, and CRF, as well as improvements in health (i.e., reduced blood pressure (BP), waist circumference, and improved cholesterol levels). Moreover, the study tested a SDT model of health behaviour change.

Results: The analyses demonstrated an overall intervention effect (intention-to-treat: $F = 3.791$, $df = 10$, $p = .009$, complete case: $F = 5.415$, $df = 10$, $p = .000$). Cohen's d ES were small-to-moderate (complete case), and predominantly small (intention-to-treat) in favour of the intervention group on CRF, diastolic BP, and HDL-C (Table 4). Regular PA did not yield any significant intervention effect but a significant effect of time ($F = 7.60$, $p = .007$). Systolic BP, non-HDL-C, and waist circumference did not demonstrate any significant differences. The motivational variables (need support for PA, autonomous motivation for PA, and perceived competence for PA) all demonstrated small-to-moderate intervention effects in favour of the intervention group. Path analysis obtained a good fit between the data and the SDT model of health behaviour change (Figure 4).

Conclusions: The results in the present study, especially on CRF, support the assumption that a worksite intervention, offering a modest dose, can be effective in bringing about meaningful changes on important mediating and outcome variables. Changes in biomedical markers were mixed in terms of significant and clinically relevant change. The study also found that coworkers represent a valuable source for support of basic psychological needs.

RESULTS

Table 4. Test of between-groups effects: Repeated measures ANOVA

Variables	Complete case analysis				Intention-to-treat analysis			
	Baseline (M/SD)	Post-test (M/SD)	Time x Int. (F/p)	ES (d)	Baseline (M/SD)	Post-test (M/SD)	Time x Int. (F/p)	ES (d)
CRF								
Intervention	32.33 (7.97)	36.13 (9.31)	18.14/.000	0.49	31.82 (8.37)	36.51 (8.28)	7.82/.007	0.39
Control	38.28 (12.59)	37.09 (10.18)			36.25 (11.66)	36.99 (10.06)		
PA levels								
Intervention	3.73 (2.22)	4.41 (2.08)	0.32/.136	0.15	3.67 (2.19)	4.43 (1.99)	0.25/.686	0.07
Control	4.29 (2.27)	4.63 (2.15)			3.95 (2.33)	4.55 (1.96)		
Waist circumference								
Intervention	96.37 (11.90)	95.91 (12.24)	2.26/.136	-0.01	96.55 (13.16)	95.88 (10.98)	0.28/.642	0.02
Control	94.84 (12.83)	94.47 (12.63)			94.57(13.64)	93.69 (11.15)		
Non-HDL-C								
Intervention	5.11 (2.37)	5.13 (2.40)	4.12/.044	-0.04	5.07 (2.36)	5.12 (2.41)	1.56/.396	-0.01
Control	5.59 (2.32)	5.72 (2.42)			5.64 (2.36)	5.71 (2.48)		
HDL-C								
Intervention	1.26 /0.42)	1.31 (0.48)	10.73/.001	0.22	1.25 (0.40)	1.30 (0.52)	5.53/.006	0.12
Control	1.31 (0.37)	1.27 (0.41)			1.33 (0.42)	1.32 (0.51)		
Systolic BP								
Intervention	135.34 (16.85)	131.70 (14.80)	2.91/.091	-0.13	135.47 (16.15)	131.55 (13.15)	0.17/.710	-0.18
Control	131.29 (12.95)	129.61 (23.08)			131.26 (12.38)	129.97 (15.16)		
Diastolic BP								
Intervention	83.66 (9.82)	81.83 (10.10)	11.83/.001	-0.30	84.26 (9.37)	81.75 (9.12)	7.18/.015	-0.26
Control	80.26 (10.23)	81.48 (8.44)			81.06 (9.62)	81.06 (7.93)		
Need support								
Intervention	3.95 (1.29)	4.42 (1.26)	10.03/.002	0.59	4.00 (1.31)	4.39 (1.15)	4.70/.034	0.29
Control	4.38 (1.18)	4.11 (1.34)			4.08 (1.34)	4.09 (1.22)		
Perceived competence								
Intervention	4.46 (1.44)	4.59 (1.52)	7.72/.006	0.43	4.43 (1.50)	4.60 (1.39)	4.38/.043	0.24
Control	5.37 (1.36)	4.89 (1.34)			5.05 (1.43)	4.86 (1.18)		
Autonomous motivation								
Intervention	3.40 (0.85)	3.54 (0.80)	13.86/.000	0.45	3.32 (0.87)	3.55 (0.73)	5.85/.020	0.29
Control	3.82 (0.79)	3.59 (0.76)			3.61 (0.84)	3.59 (0.67)		

Note: CRF = cardiorespiratory fitness. PA = physical activity. Non-HDL-C = non-high-density lipoproteins cholesterol. HDL-C = high-density lipoproteins cholesterol. BP = blood pressure.

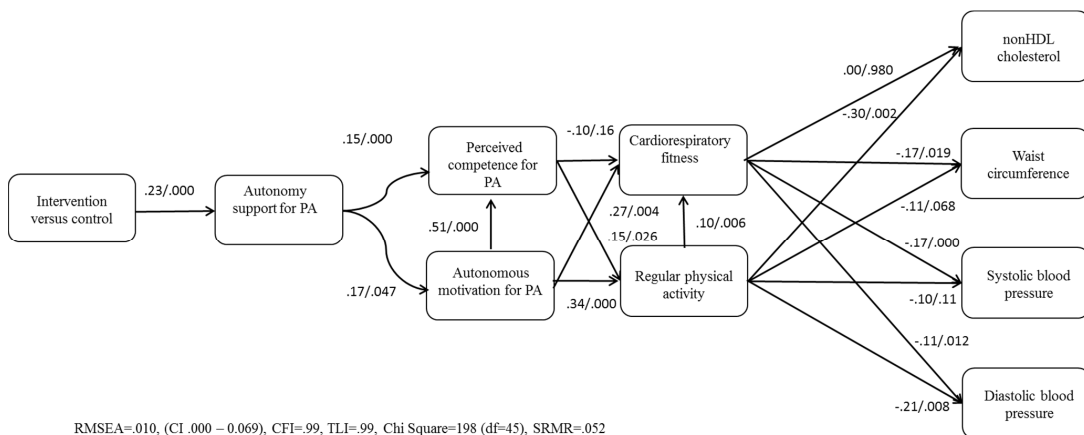


Figure 4. SDT model of health behavior change (change scores)

RESULTS

Paper II: Effects of the intervention on somatic symptoms and sickness absence

Objectives: The paper aimed to explore whether a worksite health promotion intervention, based on the tenets of SDT, was able to increase regular levels of PA and CRF, and to reduce somatic symptoms and sickness absence. Moreover, the paper explored whether the data supported the SDT model of health behavior change. A simplified model was tested, omitting perceived competence for PA, in order to assess the potential direct effects of coworker need support on primary and secondary outcome variables.

Results: Results revealed an overall intervention effect, and significant change between groups related to somatic symptoms in favor of the intervention group (complete case: $F = 4.22, p = .042$, intention-to-treat: $F = 4.69, p = .040$), and ES were small (complete case: -0.32 , intention-to-treat: -0.20). No effect was found for sickness absence (Table 5). The SDT model of health behavior change was tested with and without sickness absence. The models yielded acceptable and comparable fit indices. Since sickness absence was unrelated to the rest of the variables in the model, the model was presented without sickness absence (Figure 5). The model indicated that increase in PA was negatively associated with somatic symptoms. However, no significant association was found between CRF and somatic symptoms. We also found a direct association between perceived support for basic psychological needs from coworkers and reduced somatic symptoms. The same was found for CRF.

Conclusions: The results emphasize the importance of integrating social support at the worksite in health promotion programs aimed to increase PA and reduce somatic symptoms. Despite important improvements in PA, CRF, and somatic symptoms, a longer duration may have been required in order for these changes to affect sickness absence.

RESULTS

Table 5. Test of between-groups effects: Repeated measures ANOVA

Measures	Complete-case analysis				Intention-to-treat			
	Baseline (M/SD)	Post-test (M/SD)	T x G (F/p)	ES (d)	Baseline (M/SD)	Post-test (M/SD)	T x G (F/p)	ES (d)
Need support								
Intervention	3.95/1.29	4.42/1.26	11.60/.001	.59	4.00/1.33	4.41/1.30	6.36/.020	.33
Control	4.38/1.18	4.11/1.34			4.04/1.40	4.00/1.41		
Aut. motivation								
Intervention	3.40/0.90	3.54/0.83	8.50/.004	.45	3.35/0.92	3.50/0.84	6.57/.017	.29
Control	3.84/0.83	3.59/0.83			3.66/0.91	3.54/0.84		
PA								
Intervention	3.73/2.22	4.41/2.08	0.06/.802	.19	3.70/2.22	4.44/2.09	0.25/.725	.12
Control	4.29/2.27	4.63/2.15			4.00/2.39	4.47/2.17		
CRF								
Intervention	32.33/7.97	36.13/9.31	18.77/.001	.56	31.99/8.52	35.76/9.14	8.27/.017	.35
Control	38.27/12.59	37.09/10.18			36.02/12.25	36.17/9.97		
Somatic symptoms								
Intervention	6.37/3.80	5.15/3.52	4.22/.042	-.32	6.37/3.82	5.15/3.61	4.69/.040	-.20
Control	4.74/3.14	4.79/3.68			5.49/4.09	5.07/3.75		
Sickness absence								
Intervention	2.06/1.28	1.94/1.14	0.24/.626	-.01	2.09/1.26	1.94/1.14	0.78/.546	-.01
Control	1.75/0.74	1.62/0.64			1.95/1.07	1.81/0.98		

Note: CRF = cardiorespiratory fitness. PA = physical activity. T = time. G = group.

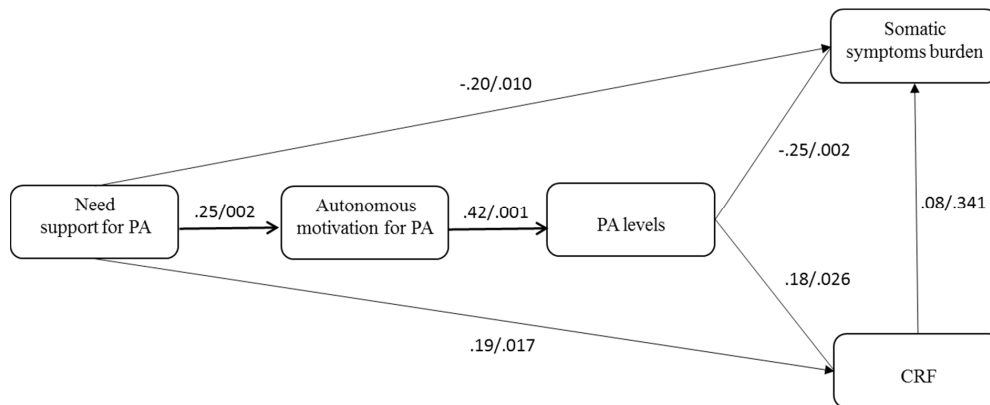


Figure 5. The SDT model of health behavior change demonstrated a good fit with the study data: $\chi^2/df = 1.55$, RMSEA = .052, 95% CI [.000, .139], CFI = .97. Single-tail *p*-values. PA = physical activity. CRF = cardiorespiratory fitness.

RESULTS

Paper III: Latent trajectories of physical activity and associations with motivation

Objectives: The study aimed to explore whether there were different patterns of PA among employees during and after participating in a worksite health-promotion intervention over a period of one year. Further, we aimed to assess whether potential patterns were associated with perceived competence and motivational regulations for PA according to the tenets of SDT.

Results: Four different models were tested with LCGA (Table 6). The model identifying three PA trajectories obtained the best model fit indices: (1) employees high at baseline who declined significantly (n = 16), (2) employees who remained stable at a moderate level (n = 55), and (3) the majority of employees who reported low levels at baseline and increased significantly (n = 128; Figure 6). High levels of PA were associated with higher levels of perceived competence and autonomous forms of motivation for, which is in line with the tenets of SDT. Contrary to study hypothesis, controlled forms of motivation increased in all three trajectories after the intervention.

Conclusions: Different trajectories of PA were found, and the intervention was able to attract employees with low levels of PA and help them increase their PA significantly. However, participants reported relatively moderate-to-high levels of perceived competence and autonomous motivation for PA at baseline. These findings are in line with other SDT-based PA promotion intervention studies in the context of health care (Fortier et al., 2012). We encourage future intervention studies to explore whether the recruitment process can be altered to attend to the needs of employees with low levels of perceived competence and autonomous motivation for PA.

RESULTS

Table 6. Fit indices for latent class growth models of physical activity.

No. of trajectories	No. of free par.	AIC	BIC	BLRT (p)	L-M-R (p)	Entropy	Latent class size (n)
1	6	2.164.125	2.183.885				
2	9	2.121.621	2.151.261	.000	.037	0.82	41/158
3	12	2.055.234	2.094.753	.000	.004	0.96	16/55/128
4	15	2.026.775	2.076.175	.000	.225	0.96	4/16/51/128

Note. N = 199. AIC = Akaike's information criterion, BIC = Bayesian information criterion, BLRT = bootstrap likelihood ratio test, L-M-R = Lo-Mendell-Rubin adjusted likelihood ratio test.

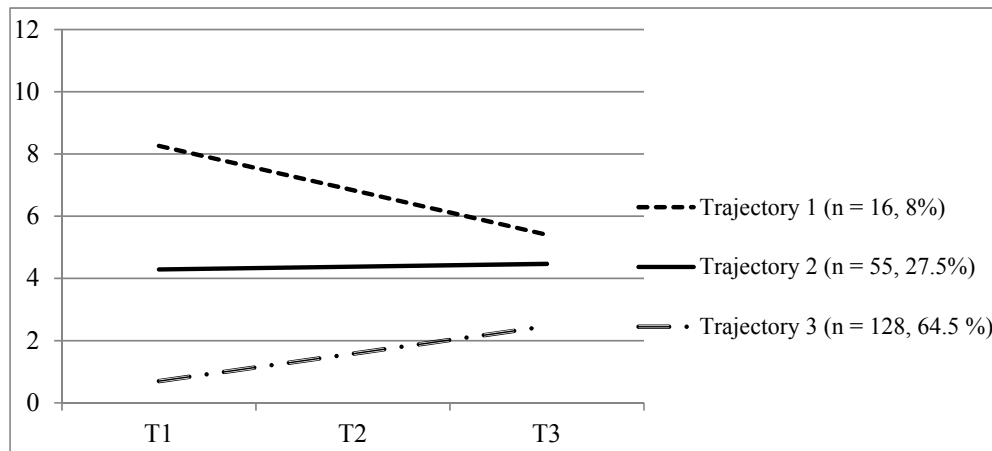


Figure 6. The three trajectories related to physical activity at baseline (T1), post-test (T2), and follow-up (T3).

DISCUSSION

DISCUSSION

In the following discussion, I will first consider very briefly whether the overall aims were achieved. Next, I will elaborate on a selection of key findings and methodological considerations in order to discuss the findings, and to consider the strengths and limitations of the present study. I will also discuss ethical considerations. Readers are advised to consult paper I-III for a comprehensive discussion of all study findings. Finally, I will consider the practical implications and state my conclusions.

Discussion of main results

The overall purpose of the doctoral thesis was to contribute to the understanding of how interventions can be designed to increase autonomous motivation for behavioral change and produce health benefits regarded as both clinically relevant, important to the individual employee, and to the employer. The intervention was moderately effective related to the primary outcome variable, CRF, albeit no between-groups effect was found for PA since both groups reported significant increases at post-test. The effectiveness of the intervention on secondary outcome measures was more mixed. Change in diastolic BP and HDL-C demonstrated a significant between-groups effect, albeit small effect sizes. However, changes in BP and HDL-C were considered clinically relevant (Chobanian et al., 2003) and compatible with interventions in general (Whelton, Chin, Xin, & He, 2002). Changes in non-HDL-C and waist circumference were non-significant and clinically irrelevant. The intervention was also effective related to self-reported levels of somatic symptoms, albeit with small effect sizes. However, the intervention was not able to produce a statistically significant between-groups effect on sickness absence.

The thesis also aimed to test the SDT model of health behavior change (Williams et al., 2002) for model fit with two different sets of secondary outcome variables; biomedical health markers (paper I) and somatic symptoms and sickness absence (paper II). For the most part, the hypothesized associations between study variables demonstrated the expected direction and significant strength, particularly among motivational variables and primary outcome variables. In paper I, perceived competence for PA was found to predict changes in autonomous motivation, contrary to the meta-analysis of Ng and colleagues (2012). This finding is in line with the results of the analyses in paper III, which

showed that perceived competence for PA was moderate-to-high in all three trajectories at baseline, and remained relatively stable at post-test and follow-up.

The thesis also aimed to explore whether the sample consisted of between-person differences in within-person change over a period of one year, before, during, and after the intervention. A model suggesting three distinct trajectories of PA obtained the best model fit. The three trajectories were tested for systematic differences related to motivational regulation and perceived competence for PA. The results were in line with the tenets of SDT, particularly related to autonomous forms of motivation and perceived competence. The intervention was able to attract a subsample of sedentary employees who increased their levels of PA considerably during one year.

Moreover, the thesis aspired to contribute to the theoretical understanding of peers as a provider of support for basic psychological needs. The moderate effect sizes indicated that the intervention was able to incorporate coworkers as an active ingredient. Finally, the thesis aimed to provide detailed and transparent descriptions of the design process in order to contribute to the growing body of SDT-based intervention studies targeting health behavior.

Intervention effects on physical activity and cardiorespiratory fitness

A key finding in the present study was the considerable increase in CRF among the participants in the intervention group ($M = 3.8 \text{ mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$), as reported in paper I and II. According to Myers et al. (2004), a change above $3.5 \text{ mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ (one MET) would be considered clinically relevant in terms of reduced risk of cardiovascular diseases and premature mortality. Moreover, the results are compatible with a meta-analysis of 122 exercise training RCT on healthy adults. The meta-analysis reported a weighted mean difference in relative CRF (corrected for weight) between the intervention group and the control group of $3.94 \text{ mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ (95% CI: 3.48 to 4.39; Lin et al., 2015). Intervention studies that offered behavioral change counselling, rather than structured exercise training, were excluded from the analyses. It is somewhat surprising that the present intervention produced improvements in CRF at the level of exercise training interventions. In the present study, PA was expected to be self-organized, and the intervention was designed to support the process of initiating and maintaining habitual PA. This strategy reduces the degree of experimental control, and possibly the short-term

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effectiveness because participants can find it difficult to adhere to PA recommendations on their own. In the following, I will propose and discuss some plausible explanations.

First, the intervention content included information about the importance of CRF and the benefits of high-intensity interval training (HIT; Gaesser & Angadi, 2011). The principles of HIT were presented during the workshops. The HEA was instructed to use nontechnical language and practical models in order to provide the participants with simple and easy-to-remember rules of thumb (e.g. to monitor PA intensity by their ability to talk while exhaling). Participants were also encouraged to explore and take advantage of naturally occurring possibilities for HIT during their PA sessions, and especially during low-threshold activities such as waking or stairclimbing. However, it was stressed that participants could decide for themselves whether they chose to follow the recommendations or not. The intervention elements were designed to support the need for autonomy (i.e., “Offer choices: Provide information about options, encouragements of choice making, and encouragements of the initiation of one’s own action”) and competence (i.e., “Present clear and neutral information about what to expect from exercising and what is needed to achieve the participant’s own goals”).

Higher PA intensity has been found to produce faster and larger improvements in CRF (Boulé, Kenny, Haddad, Wells, & Sigal, 2003). However, engaging in PA of vigorous intensity above the ventilatory threshold can elicit negative affect and reduces enjoyment, especially among inactive and overweight participants (Ekkekakis, Parfitt, & Petruzzello, 2011; Parfitt & Hughes, 2009). Findings indicate that HIT evokes less negative affect compared to continuous high-intensity training, possibly because the series of pauses increases the tolerability of unpleasant physiological and psychological responses during vigorous PA (Jung, Bourne, & Little, 2014). Affective reactions seems to be an important motivational determinant, and several studies have found that affective responses during PA, both positive and negative, predict PA levels several months later (Kwan & Bryan, 2010; Williams et al., 2008). Externally regulated intensity levels (imposed by an exercise instructor) were associated with higher levels of negative affect compared to self-regulated intensity levels, especially in terms of vigorous PA sessions (Oliveira, Deslandes, & Santos, 2015). The findings indicate that the satisfaction of basic psychological needs could possibly mediate the association between vigorous PA and negative affect. Future

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PA intervention studies should explore the effectiveness of combining SDT tenets with the recommendations and provision of HIT further.

Secondly, the substantial change in CRF could possibly be attributed to measurement error. In their meta-analysis, Lin and colleagues excluded studies that did not measure VO_{2max} directly (Lin et al., 2015). In the present study, a submaximal measure of CRF was applied due to practical considerations and the risk over overexertion and negative health reactions (ACSM, 2014). However, there are methodological limitations of a submaximal test as a basis for estimating peak oxygen uptake. Validation studies have demonstrated a consistent difference between submaximal estimations and direct measures (in standard deviation) of approximately +/- 15% in a population mixed in age and fitness level (Siconolfi, Cullinante, Carleton, & Thompson, 1982; Ekblom, Engstrom, & Ekblom, 2007). According to ACSM, submaximal tests are less precise and rely on certain assumptions to be achieved. Nevertheless, "virtually all evaluations can establish a baseline and be used to track relative progress" (ACSM, 2014; p. 94). Hence, results of the present study should be interpreted cautiously regarding the exact levels of CRF, but the relative changes in each condition are probably more accurate.

Third, the length of the intervention period and intensity of delivery could have contributed to the relatively large increases in CRF. The intervention lasted for 16 weeks with post-test assessments five months after baseline. The six sessions were delivered biweekly, allowing for a process of trial-and-error, increased competence, and internalization of PA motives to evolve over time. The majority of participants reported low levels of PA at baseline, and could be characterized as exercise initiates (paper III). A prospective study comparing exercise initiates to regular exercisers found that initiates reported lower levels of autonomous motivation to begin with, and that autonomous motivation increased after eight weeks (Rodgers, Hall, Duncan, Pearson, & Milne, 2010). These findings are in line with the results of a feasibility study comparing the effects of a SDT-based PA behavior change intervention with an exercise-only control group (Hsu, Buckworth, Focht, & O'Connell, 2013). At eight weeks, CRF (submaximal test) increased significantly in the control group, albeit no change was found in the intervention group. At 12 weeks, the opposite results were found: CRF increased significantly in the intervention group and decreased in the control group. Autonomous motivation increased in both groups at eight weeks and remained relatively stable, but mediation

DISCUSSION

analyses were not reported. Another study on exercise program participants found a considerable increase in physical fitness (VO_{2max}) after 12 weeks, and that exercise behavior mediated the relationship between autonomous motivation and physical fitness (Wilson, Rodgers, Blanchard, & Gessell, 2003). However, the exercise program was not designed as a SDT-based intervention.

Albeit the methodological limitations of these studies, the findings are interesting because they indicate that SDT-based PA promotion interventions should last at least 12 weeks in order to produce significant increases in CRF. The present study indicates that a study period of four to six months would be required for clinically relevant improvements in CRF to appear. Although the evidence for the utility of SDT-based interventions is growing, studies primarily measure PA behavior solely, and PA is usually measured with a self-reporting questionnaire. Teixeira and colleagues recommended that future studies include objective measures of physical fitness (Teixeira et al., 2012). In the present study, objective measures of PA, such as accelerometers, and assessments of CRF at follow-up one year after baseline would have contributed to the methodological rigor and the credibility of the results.

Intervention effects on somatic symptoms and sickness absence

In paper II, we hypothesized that increases in PA and CRF would predict reductions in somatic symptoms, and that these reductions would be associated with reduced levels of sickness absence. The study recruited participants employed in the logistics industry working in sorting, transport, or distribution of parcels and mail. In Norway, employees working with transport and storage have the largest prevalence of sickness absence among male employees (6.3%), and second largest among female employees (8.4%; NAV, 2018). High levels of sickness absence bear a burden on the individual employee, on the colleagues and managers who have to compensate for their absence, and on the company productivity and profitability, in addition to the national costs of health care. In Norway, the annual financial burden of sickness absence is estimated to be between 1.41 and 1.64 billion USD (Solberg, 2013). Understandably, reductions in absenteeism is one of the main reasons why employers initiate in worksite health promotion programs.

The analyses revealed that sickness absence did not change significantly, and that the outcome variable (change score) was unrelated to changes in all others study variables,

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even somatic symptoms. However, bivariate correlational analysis revealed that post-test assessments of sickness absence were significantly associated with baseline assessments of perceived need support for PA from coworkers ($r = -.19, p = .017$) and somatic symptoms ($r = -.41, p = .000$).

Sickness absence is a complex phenomenon characterized by a conglomerate of intertwined causes, such as national sick pay systems, the physicians' attitudes to certifying sick leave, work-related stressors (e.g., related to psychosocial working climate, managerial style, and job design), and the medical condition of the individual employee (Allebeck & Mastekaasa, 2004). Hence, despite clear and important health benefits of regular PA, we probably cannot expect large reductions in sickness absence as a direct and isolated effect of increases in PA.

Perceived support for basic psychological needs and need satisfaction at work have been found to predict autonomous motivation for work, work engagement, job satisfaction, and work performance (Gagné & Deci, 2005; Ryan & Deci, 2017). Growing research attention has been dedicated to the interface between work and health from the perspective of SDT (González, Niemiec, & Williams, 2014). Studies have included outcome variables related to ill-health known to represent an enhanced risk of sickness absence (Deci, Olafsen, & Ryan, 2017). However, only a few of them have included somatic or physical symptoms and sickness absence. A cross-sectional study on employees in four private Norwegian companies reported results showing that perceptions of autonomy support from managers were negatively associated with somatic symptoms, emotional exhaustion, and sickness absence (Williams et al., 2014). The same results were found for physical symptoms among employees in the banking and investment industry (Baard, Deci, & Ryan, 2004) and among police officers (Otis & Pelletier, 2005).

In summary, the findings are promising and support the assumption that an intervention, designed to support the employees' need satisfaction, could affect psychosomatic health and sickness absence. Several intervention studies have demonstrated that it is possible to train managers to behave more supportive of basic psychological needs, and that this increased the employees' autonomous motivation for work significantly (Deci, Connell, & Ryan, 1989; Hardré & Reeve, 2009; Lynch, Plant, & Ryan, 2005). However, to our knowledge, this was the first SDT-based intervention study to include assessments of somatic symptoms and sickness absence as outcome variables.

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It is likely that work-related need support has a stronger potential to affect sickness absence compared to worksite support for lifestyle changes. During the 16-week intervention period, the participants spent 7.5 hours together with the HEA and coworkers talking about PA, whereas 640 hours were spent working, alone or together with coworkers and the manager. Future studies on workplace PA programs should include assessments of work-related variables that can possibly moderate the effects of the intervention, such as perceived job-demands, perceived need support for work from coworkers and managers, need satisfaction for work, or motivational regulation for work.

Moreover, recent findings have indicated that need dissatisfaction may be less predictive of somatic symptoms and ill-health compared to need frustration. In their review, Van den Broeck and colleagues conclude that the satisfaction of basic psychological needs was more closely connected to autonomous than controlled forms of self-regulation, and to positive work and health-related outcomes (Van den Broeck et al., 2016). A negative association was also found between a supervisor interpersonal style perceived as need thwarting and well-being (Gillet, Fouquereau, Forest, Brunault, & Colombat, 2012). A longitudinal study on Norwegian health care unit managers found that need frustration was related to perceived work-stress, which increased somatic symptoms, emotional exhaustion, and sickness absence (Olafsen, Niemiec, Halvari, Deci, & Williams, 2016). Need frustration at work could possibly undermine the effect of health promotion programs targeting lifestyle changes when somatic symptoms and sickness absence are included as outcome variables. The present RCT was not merely situated in the worksite context; it incorporated an organization level component, coworkers, as an active ingredient in the intervention. However, additional covariates related to the perceived psycho-social work climate could have increased the explanatory strength of the study. Interventions must address both the work environment and individual health behavior in order to produce substantial improvements in employee health (Sorensen & Barbeau, 2012).

Recruitment of sedentary employees

Findings reported in paper III demonstrated that the present intervention was able to attract employees who initially did not comply with the PA recommendations (64.5% of the sample). Moreover, they belonged to a population considered to be underrepresented in health promotion interventions, particularly in the worksite context; male employees

with low educational levels and low occupational prestige (Marshall, 2004; Wong, Gilson, van Uffelen, & Brown, 2012). However, the large participation rate (68% of eligible) and moderate levels of autonomous motivation and perceived competence for PA at baseline indicated that this population of male employees are not that reluctant to worksite health promotion programs. A study using population-based data found that employees have unequal access to worksite health promotion programs (Grosch, Alterman, Petersen, & Murphy, 1998). Certain subgroups of employees, particularly nonprofessionals and people with low education levels, were in fact less likely to work in companies that offer programs. We know that large worksites (> 750 employees) are more inclined to offer health promotion programs. However, certain characteristics of the occupation and worksite in questions could also affect the decision. In the present worksite context, the employees worked shifts according to strict time limits. Their working schedule did not provide them with the flexibility to take longer breaks or continue with their work assignments at home after working hours. Hiring substitutes to cover for their attendance would increase the cost of the program considerably.

Longitudinal trajectories of physical activity

One of the strength of the present study (paper III) is the use of a person-centered approach to a longitudinal dataset applying LCGA, a sophisticated growth curve modeling method. Several studies have explored the associations between individual motivational profiles and PA among adult exercisers and athletes applying a more traditional person-centered approach; cluster analysis (e.g., Gillet, Vallerand, & Paty, 2013; Guérin & Fortier, 2012; Matsumoto & Takenaka, 2004). The studies based their clustering on motivational regulation, and reported cluster solutions between two and five (Friederichs, Bolman, Oenema, & Lechner, 2015). Friederichs and colleagues (2015) carried out a study on adults who did not comply with the PA recommendations, applying cluster analysis and one-way ANOVA to assess differences between clusters with regard to PA. Three clusters were found: (1) "autonomous motivation" (high on autonomous and low on controlled forms of motivational regulation), (2) "controlled motivation" (high on controlled and moderate on autonomous forms of motivational regulation), and (3) "low motivation" (moderate on controlled and low on autonomous forms of motivational regulation). Cluster (1) reported the highest levels of PA, and cluster (3) the lowest. The results indicate that low levels of autonomous motivation is more predictive of inactivity than

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high levels of controlled motivation. Moreover, the motivational profiles reported were in fact similar to those found in other studies, both among non-exercisers (Guérin & Fortier, 2012) and regular exercisers (Matsumoto & Takenaka, 2004). Cluster (1) accounted for 52.9% of the sample, and the sample could possibly be biased by the fact that the participants were recruited among individuals who had agreed to participate in a web-based PA intervention.

The present study applied PA levels as the basis for a person-centered approach and included the motivational regulations for PA as distal outcome variables. Moreover, the above-mentioned studies applied cross-sectional data, whereas the present study explored if there were latent classes explaining different patterns of PA change during the course of an intervention. At baseline, the motivational profiles of the present study sample resembled the profiles reported by Friederichs et al. (2015) and Guérin and Fortier (2012). However, there were some interesting differences as well. The trajectories in the present study were considerably more homogenous, despite large differences in PA. A trajectory resembling cluster (3) "low motivation" was also found in the study of Guérin and Fortier, albeit not in the present study. Moreover, in the present study, external regulation levels were somewhat higher at baseline, and particularly at post-test, compared to the other two studies. The present study also included perceived competence for PA as a distal outcome variable, contrary to the other studies. Interestingly, baseline levels of perceived competence for PA were moderate in the sedentary trajectory, and high in the other two. At follow-up, the latter remained high and the sedentary trajectory increased their perceived competence. In paper I, perceived competence for PA was included in the SDT model of health behavior change that was tested for model fit. Contrary to the original model (Williams et al., 2002) and the meta-analysis of SDT studies in the health care and treatment context (Ng et al., 2012), the findings indicated that perceived competence predicted autonomous motivation for PA. In line with Ng and colleagues, I recognize that the association could be bi-directional. Nevertheless, the finding indicated that the present intervention appealed to employees who already felt relatively competent and confident that they could increase their regular PA, possibly due to the support of a worksite PA program. LCGA and similar growth curve modeling techniques have the potential to explore the heterogeneity of participants and their individual change processes before, during, and particularly after the intervention period and in RCTs with a delayed-intervention control group.

Coworkers' support for basic psychological needs

Paper I and II reported small-to-moderate effect sizes (complete case: $ES = 0.59$, intention-to-treat: 0.29) in favor of the intervention group regarding perceived support for basic psychological needs from coworkers. Studies incorporating autonomy support from coworkers, in addition to managers, have reported that this amplifies the positive effects on psychological work satisfaction, health, and well-being (Moreau & Mageau, 2012). The opposite has also been found, that need-thwarting behavior from coworkers was associated with higher levels of burnout (Trépanier, Fernet, & Austin, 2013). However, to my knowledge, few SDT-based intervention studies have included assessments of peers separate from the general need supportive climate, and few have incorporated peers as an active ingredient. One of the main research questions of this doctoral thesis was whether coworkers can be used to provide support for basic psychological needs.

Support for lifestyle changes provided by social networks typically consists of emotional (trust, empathy, and care), informational (facts, advice, and suggestions), instrumental (aid and services), and appraisal support (feedback, affirmations, and observations; Heaney and Israel, 2008). In the present study, coworkers provided primarily emotional support and appraisal support. An example of emotional support, operationalized according to SDT tenets, is: "Listen to what the person says and try to see the situation from the person's point of view", and to "avoid interrupting and having a self-centered perspective on the situation". An example of appraisal support is: "Praise the person's effort and what he or she has actually achieved", and to avoid "criticizing what the person has achieved and the results he or she has obtained". To some extent, they also offered informational support in terms of suggestions based on their experiential competence, an example being: "Explore different alternatives and choices together with the person", rather than "declare strong opinions about what the person should do or chose." They were not instructed to offer any instrumental support. The four types of social support, suggested by Heaney and Israel (2008), do not explicitly state whether the person is a passive recipient of support or an active and autonomous agent molding the support to his or her needs. This aspect of social support is related to the attitude and manner in which the support is provide, not the content. SDT proclaims that support provided in a controlling manner, albeit the best intentions, will thwart the internalization of the

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behavior (Deci & Ryan, 1985, 2000). The pivotal importance of the need for autonomy is one of the key contributions of SDT to the field of health promotion theory.

The present study demonstrated that established, horizontal networks can be included as an active ingredient. A review of peer-delivered health promotion interventions reported that they were just as effective as professionally delivered interventions (Ginis, Nigg, & Smith, 2013). Peers often function as educators or mentors (Linnan et al., 2012). Mentors are designated due to their previous, primarily successful, experience with a behavioral change process. This experiential knowledge can be used to provide advice and emphatic understanding to people with similar characteristics or challenges (Borkman, 1976; Ginis et al., 2013). Commonly, peers are given training to enable the use of the experiential knowledge and to apply BCT (Dennis, 2003). In the present study, coworkers were instructed, rather than trained, to behave in a need supportive manner. They were asked to reflect on and discuss the instructions during the first one-hour PA support group meeting. The effectiveness of coworkers' need support was small-to-moderate ($ES = 0.29 - 0.59$), albeit not at the level reported by Su and Reeve (2011) in their meta-analysis of intervention studies (weighted $ES = 0.63$, 95% CI: 0.43 to 0.83). The latter study trained professionals, predominantly teachers, to behave in an autonomy supportive manner. Their professional training and previous experience as teachers would probably enhance their ability to assimilate and apply the training they received in the intervention.

The employees in the present study were peers with no formal training or role other than coworker. Three factors could possibly have contributed to the moderate effectiveness of coworkers in the present study. First, the participants reported moderate-to-high levels of perceived competence and moderate levels of autonomous motivation at baseline. A sample of employees who felt inexperienced or incompetent could possibly have been less responsive to the peer dialogue. Studies have shown that people preferred interactive, face-to-face delivered interventions when they were inexperienced, preferably with a health professional. Once they became more experienced and confident, passively delivered intervention elements (e.g. electronic) became more appealing (Letts et al., 2011). Second, the reciprocity of the peer dialog between members of a horizontal social network. Important others "represents a formidable opportunity to fulfill our psychological needs, not only through the caring they provide us, but also through the care we provide others" (Vallerand et al., 2008). Third, I question whether the structure

of the intervention was of pivotal importance to the provision of peer support. Peer mentors, formally trained and dedicated to the role, could possibly be able to provide support spontaneously and more individually, independent of sessions. However, given the nature of their occupations, shift work, and deadlines, their regular workday did not offer many possibilities for spontaneous support.

Methodological considerations

RCTs are prevalent in medicine, increasingly popular in social sciences, and commonly considered the “gold standard” of research designs when studies aim to make causal inferences. In the following, I will assess the operationalization of the theoretical framework according to the theory coding scheme by Michie and Prestwich (2010) in order to state whether the present intervention could be considered as *theory-based* as opposed to *theory-inspired*. Next, I will consider the methodological quality, drawing from the CONSORT checklist and a nine-item checklist, used by Rongen et al. (2013) in their meta-analysis of worksite health-promotion interventions.

Theory-based or just theory inspired?

“RCTs can play a role in building scientific knowledge and useful predictions, but they can only do so as part of a cumulative program, combining with other methods, including conceptual and theoretical development, to discover not just ‘what works’, but why things work” (Deaton & Cartwright, 2018, p. 2). The present RCT builds on a body of research investigating the tenets of SDT by means of cross-sectional, longitudinal, and experimental research designs. These studies aimed both to refine the theoretical clarity and coherence of SDT, and to test the practical applicability of the theoretical framework across a variety of populations, contexts, and behavioral outcomes. The present RDT aspired for the intervention to be considered as truly theory-based, not just theory inspired. Michie and Prestwich (2010) have proposed a framework of criteria, the theory coding scheme, in order to assess the rigor of the theory operationalization related to constructs, models, predictors, techniques, and measures (Table 7).

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Table 7. The theory coding scheme (Michie & Prestwich, 2010).

No.	Description of criteria	Compliance to criteria
1	Models and theories that specify relations among variables, in order to explain or predict behavior, are presented	Yes, SDT and the STD model for health behavior change
2	Psychological constructs that the intervention is hypothesized to change, are presented	Yes, perceived support for basic psychological needs, perceived competence, and motivational regulation were presented
3	Evidence that the psychological constructs are related (e.i., correlate, predict, or cause) the target behavior, is presented	Yes, theoretical rationale and empirical support from health promotion and PA studies are presented
5	Participants were screened/selected based on achieving a particular score or level on a theory-relevant construct.	No, participants were not pre-screened or selected based on SDT constructs
6	Theory used to select and develop intervention techniques	Yes, techniques selected and developed to support basic psychological needs according to a theoretical operationalization previously used in other intervention studies
7	Theory used to tailor intervention techniques to recipients, and specifically to sub-groups that vary on a construct at baseline	Yes, techniques were tailored to the recipients as a whole. No, techniques were not tailored to sub-samples
8	All, or at least one, intervention techniques explicitly linked to at least one theory-relevant constructs	Yes, the content/structure/delivery of all three intervention techniques explicitly linked to SDT (paper I, supplemental material, Table A2)
9	A cluster of techniques is linked to a cluster of constructs	Yes, motivational variables included in the SDT model of health behavior change could be regarded as a cluster of constructs. No, we did not define a specific cluster of BCT.
10	Every theoretical construct within a stated theory is linked to at least one intervention technique, or at least one	No, SDT incorporates constructs that were not included in the study (e.g., causality orientation). Yes, fundamental constructs were included
11	Theory-relevant constructs are measured, pre and post intervention, at least one	Yes, perceived support for basic psychological needs, perceived competence, and motivational regulation were measured pre and post. Satisfaction for basic psychological needs was measured bur not included as a study variable

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12	Quality of measures (evidence for reliability, previously validated) related to constructs and behaviors	Yes, all measures were assessed for reliability (Cronbach's alpha). In paper II and III, reliability was measured with CFA as well
13	Randomization of participants to condition and method applied. Analysis of significant differences between conditions at baseline	Yes, participants were randomized at the level of worksite location (cluster), albeit not at the individual level. A computer-generated list was applied for allocation. No stratification was applied. Conditions differed on several study variables. The statistical analyses controlled for the effect of the cluster-variable
14	Changes in measured theory-relevant constructs in favor of the intervention group	Yes, the intervention group improved significantly on CRF, HDL-C, diastolic BP, perceived need support from coworkers, autonomous motivation, and perceived competence relative to the control group. No, significant changes were not found for PA, non-HDL-C, systolic BP, and waist circumference. A significant effect of time was found for both groups related to PA
15	Mediational analysis of constructs	Yes, associations between theoretical constructs and outcome variables were tested by means of SEM, using path-analysis and LCGA with manifest variables. Hypotheses were formulated and tested based on the SDT model of health behavior change. No, not all hypothesized paths were significant, but the majority were and supported SDT tenets
16	Results discussed in relation to theory, and appropriate support was demonstrated	Yes, results were discussed in relation to the model and to the applicability of SDT tenets in behavioral change interventions, such as coworkers as the provider of need support for PA
17	Results used to refine theory by adding or removing constructs to the theory or specifying changes to the interrelationships between theoretical constructs	No, the results did not justify any suggestions related to adding, removing, or changing SDT constructs and their interrelationships. Some theoretical refinements were discussed related to peers as providers of need support

Based on the mapping of the present intervention to the theory coding scheme, I would consider the intervention to be predominantly theory-based. The study aimed to test the applicability of SDT in the worksite context rather than to refine theoretical tenets.

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Methodological quality

As Deaton and Cartwright (2018) point out, RCTs are not without shortcomings. We cannot assume that randomization equalizes all other factors apart from the treatment, and that an RCT automatically provides precise estimates of the average treatment effect and the confounding of measured and unmeasured covariates. Systematic review studies and meta-analyses have become more attentive to the quality of intervention studies, and often distinguish between high, fair, and poor quality RCTs. Methodological quality is basically about the risk of bias in their results, causing either overestimation or underestimation the true intervention effects (Higgins & Green, 2011). The present RCT followed the recommendations of the CONSORT statement (Moher et al., 2010), including the extension to cluster RCT (Campbell, Piaggio, Elbourne, & Altman, 2012). The completed checklist is included in the supplementary material of paper I (Appendix E). In the following, the methodological quality will be further examined according to the criteria used by Rongen et al. (2013) in their meta-analysis of worksite health-promotion interventions (Table 8). The list was based mainly on the Cochrane handbook for systematic reviews of interventions (Higgins & Green, 2011).

Table 8. The methodological quality criteria (Rongen et al., 2013).

No.	Criteria	Reported	Quality
1	Randomization correctly and clearly described.	Yes	Randomized in clusters (six worksite locations), by means of a computerized random number generator, after baseline assessments.
2	Similarity groups at baseline on outcomes.	Yes	30% of primary and secondary outcome variables differed at baseline, and 40% of all study variables included.
3	Blinding participants to intervention.	No	No blinding since the delayed intervention control group did not received any group-sessions between baseline and post-test.
4	Compliance to the intervention.	Yes	On average, participants in the intervention group attended half of the sessions offered.
5	Low lost to follow-up	Yes	3.2% were lost to baseline, 22% were lost to post-test, and 44% were lost to follow-up assessments.

6	Intention-to-treat analysis.	Yes	Missing data was handled with multiple imputations and FIML. Analyses were carried out with complete case and intention-to-treat.
7	Controlled for confounders.	Yes	All repeated measures ANOVA and MANOVA controlled for the clustering variable, worksite location.
8	Objective data collection	Yes	CRF, systolic BP, diastolic BP, waist circumference, non-HDL-C, and HDL-C were assessed objectively.
9	Long-follow-up	Yes	Follow-up assessments 12 months after baseline, only questionnaires.

Cluster randomization

The group-based intervention design and incorporation of established social networks (i.e., coworkers) as an active ingredient entailed that the whole worksite, rather than individual employees, were randomized to the intervention and control condition. The financial and practical constraints of the RCT did not allow for more than six worksite locations. The mean cluster size was $n = 34$ (range from $n = 23$ to 47, with 65% between $n = 30$ and 36). The small number of clusters enhanced the risk of bias in terms of high levels of intra-cluster correlation coefficient ICC and reduced statistical power resulting in inflated effect size estimates (Snijders & Bosker, 2012). The differences between clusters on various study variables at baseline indicated that there could be systematic differences between the clusters. Power calculations were based on an estimate of the ICC set to 0.040. This estimate was reported in a systematic review of RCTs in primary health care since no equivalent estimate was found in reviews of PA RCTs (Eldridge, Ashby, Feder, Rudnicka, & Ukoumunne, 2004). Six clusters did not allow for multilevel analyses, and the cluster variable was included as a covariate in all the analyses. However, more sophisticated methods for accommodating the clustering effects with very few clusters would have reduced the possible bias, such as Bayesian methods (Gelman, 2006).

Similarity of groups at baseline on outcomes

In the present study, we found significant differences both between clusters and between conditions (for details, see paper I and II) on several study variables, including outcome variables. The clusters differed significantly on the following variables: gender, age, CRF, BP, waist circumference, perceived competence for PA, autonomous motivation for PA,

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and somatic symptoms. The similarity-of-groups criterion is commonly believed to show whether the randomization was successful or not. However, as Altman (1985) pointed out, this is a question of procedure, not statistical analysis. In their meta-analysis, Rongen and colleagues (2013) compared the studies that met this similarity-of-groups criterion with the studies that did not. The average effect sizes were similar, 0.22 (95% CI from 0.12 to 0.31) and 0.21 (95% CI from 0.91. to 0.42) respectively, indicating that the bias was small.

Controlling for confounders

In the present study, all analyses controlled for the cluster variable, worksite location, albeit not for any others variables. Significant baseline differences are believed to compromise the internal validity, resulting in effect estimates that are further away from the "true" effects (de Boer, Waterlander, Kuijper, Steenhius, & Twisk, 2015). However, this belief has been subject to prolonged controversy, and the CONSORT guidelines state that "significance testing of baseline differences in RCTs should not be performed, because it is superfluous and can mislead investigators and their readers" (Moher et al., 2010). Ciolino and colleagues maintain that researchers should distinguish between statistically detectable and meaningful differences, whether they are statistically detectable or not (Ciolino et al., 2015). Meaningful differences are baseline characteristics that are known to confound the results of the intervention, and hence should be stated in the protocol a priori (de Boer et al., 2015). In the field of health promotion research, gender represents a characteristic previously found to affect intervention participation (Wong et al., 2012). In paper I, gender was not included as a covariate. For the purpose of this discussion, the data was reanalyzed (repeated measures MANOVA and ANOVA) including both the cluster variable and gender as covariates. The results differed somewhat on several variables, most of them increased in F -value and decreased in p -value, and non-HDL-C was the only variable to become non-significant. In paper II, gender was included as a covariate. However, the meta-analysis of Rongen et a. (2013) found clear differences between studies which controlled for confounders (ES = 0.20 (95% CI from 0.08 to 0.32) and studies that did not meet the criteria (ES = 0.33 (0.13 to 0.53)).

Attrition and dropout

In general, longitudinal studies often struggle with attrition, particularly at follow-up. In the present study, drop-out rates were 3.5% at baseline, 22% at post-test, and 44% at

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follow-up, and data were not missing completely at random. Attrition is a potential source of bias that has to be taken into consideration when the results are evaluated. However, modern statistical methods, such as multiple imputations and FIML, have contributed to compensate somewhat for the effects of attrition. The differences in effects sizes between the complete-case and the intention-to-treat analyses were evident, and contributes to complicate the interpretation of the effectiveness. However, in their meta-analysis, Rongen and colleagues (2013) reported that studies meeting the criteria of low attrition did not differ from studies that did not in terms of effect sizes, $ES = 0.22$ (95% CI from 0.14 to 0.30) and $ES = 0.22$ (95% CI from -0.06 to 0.52).

Attendance and compliance

Attendance rates were modest, participants attended 50% of the sessions on average. Low levels of autonomous motivation was the only study variable that significantly predicted low attendance rates. Participants could possibly be sensitive to the fact that the intervention was offered by their employer, and feel obligated to take part even though the intervention did not appeal to them. Participation rates were relatively high (68% of eligible), and the fact that participants were offered a health screening free of charge during working hours could possibly have motivated some to participate in the study albeit not attend the group sessions. Moreover, the sessions were offered immediately before or after working hours at the worksite premises, albeit during their leisure time. Participants could possibly feel too tired after their shift, or not willing to spend their leisure time at work. Worksite health promotion programs have been found to be less effective when they are offered during leisure time (Conn et al., 2009).

In sum, I would argue that the present RCT should be characterized as having a moderately fare methodological quality. However, I have commented on several methodological limitations which call for cautious interpretation of the results.

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Ethical considerations

Health promotion programs are often situated a gray zone related to medical research. Healthy adults are not regarded as a particularly vulnerable population compared to for instance children or patients. However, merely addressing specific attributes of a certain population can be a too narrow perspective, disregarding the context that the participants find themselves in (Eckenwiler, Ells, Feinholz, & Schonfeld, 2008). The context of a worksite health promotion program can possibly increase the vulnerability of employees, especially where the program is group-based and the whole team or worksite is invited to participate. Employees may feel a sense of pressure or obligation to participate, and may agree to participate against their wish or personal conviction. In order to reduce the risk of external pressure to participate, the following measures were implemented:

- Meetings were carried out with all team-managers and their superiors on each of the six worksites in advance, in order to ensure a common understanding of the fact that participation was to be informed and voluntary.
- The costs of the program and health screenings participation were covered by the corporate HR-HSE department, and not by the local worksite.
- Information about the program was provided by the researcher during face-to-face meetings, and not by the team-managers.
- If participants wished to withdraw from the study, they were instructed to contact the researcher, and not their manager.
- No incentives or other reactions related to participation or attrition was provided.

The formative research, carried out prior to the intervention design, revealed some ethical concerns. Analyses of former participants on a similar program in the same company revealed that there was a significant difference between employees who had only completed health screenings and those who were offered various team-based activities as well. The results indicated that health screenings alone did not stimulate health and lifestyle improvements. Considering their risk-prone occupation and the many restructurings, we found it unethical to postpone the sessions offered to the control group to after the follow-up assessments. Hence, participants in the control group were offered group-based sessions between post-test and follow-up (Figure 3). As a consequence, the two groups were collapsed at follow-up. We were not able to assess long-term between-groups effects of the intervention, and this is a methodological limitation.

Conclusions and future directions

Employers, especially in the private sector, initiate health promotion programs mainly because they expect a return on investment related to increased productivity and profitability. A comprehensive program, offering a considerable amount of contact time and delivered during working hours, could easily be perceived as too expensive. Especially if this would require hiring substitutes to cover for the absence. This is particularly the case in worksites where employees work shift and according to strict production deadlines, such as the transport and storage sector. Unfortunately, direct and immediate effects of health promotion programs related to productivity, sickness absence, and profitability are mixed and not easily calculated. Hence, employers can possibly be reluctant to invest large sums of money (Dugdill et al., 2008). As a consequence, employees with this kind of occupations are possibly less likely to be offered comprehensive health promotion programs compared to for instance office worker with higher educational levels, more flexible workdays, and already committed to regular exercise (Marshall, 2004).

A national survey among 730 worksites in the UK found that some form of program or initiative related to health promotion are common (66%). However, only 6.9% offered comprehensive programs. Studies have pointed to the fact that health behavior change is a complex process, and interactive, comprehensive programs designed to help employees increase their self-management skills and motivation are the most effective (Hutchinson & Wilson, 2011).

The present study demonstrated that a comprehensive intervention, offering a modest dose of contact time and provided after working hours, was able to attract relatively sedentary employees and help them make important lifestyle changes. Moreover, during the study period, participants developed a favorable motivational regulation for PA and achieved important health-related benefits, particular related to CRF and somatic symptoms burden. However, the return on invested capital of the intervention related specifically to sickness absence remains unclear.

The present thesis has pointed to the fact that PA promotion programs per se are probably not that effective in providing immediate reductions in sickness absence. However, the negative association between perceived need support from coworkers and somatic

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symptoms indicated that the needs supportive qualities of the climate amplified the effects of the program and the changes in PA. Future studies should explore how aspects of the psychosocial work environment can be targeted, in addition to individual lifestyle change, in order enhance support for basic psychological needs. For instance, managers could be trained in a general need supportive leadership style prior to the intervention, in line with previous SDT based intervention studies targeting managers (Deci & Ryan, 1989; Hardé & Reeve, 2009; Lynch, et al., 2005). After the intervention period, managers could arrange specific activities or provide structures such as monthly booster meetings in order to facilitate need supportive interaction between participants related to a healthy lifestyle (Rodgers et al., 2010). Involving employees in the process of suggesting and deciding on the activities could enhance their need for autonomy and ensure that the activities are suited to their preferences and level of competence. The present doctoral study offers a detailed description of the intervention components and how they were operationalized to offer support for basic psychological needs. Hopefully, future intervention studies can build on and adjust the components to novel worksite contexts and populations.

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Paper I

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

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ABSTRACT

Objectives: The current study tested the hypothesis that a 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 (CRF), as well as improvements in health (i.e., reduced blood pressure (BP), waist circumference, and improved cholesterol levels). Moreover, the study tested the self-determination theory (SDT) model of health behaviour change.

Design: Cluster randomized controlled trial.

Method: Participants from a population of employees working within the area of transport and distribution ($n = 202$) were cluster randomized ($n = 6$ worksites) to an intervention and a control condition. The 16-week group-based worksite intervention was designed based on the tenets of SDT combined with techniques from motivational interviewing (MI). Participants were assessed at baseline and at post-test five months later.

Results: Complete-case analyses applying multivariate and univariate analysis of variance indicated an overall intervention effect, and moderate to small effect sizes (Cohen's d) in favour of the intervention group on CRF, diastolic BP, and high-density lipoprotein cholesterol (HDL-C), as well as need support for PA, autonomous motivation for PA, and perceived competence for PA. Intention-to-treat analyses demonstrated the same pattern with smaller effect sizes. Path analysis obtained a good fit between the data and the SDT model of health behaviour change.

Conclusions: Offering need supportive interventions to enhance autonomous motivation and competence for PA among employees resulted in important improvements in CRF as well as positive changes in health.

Trial registration: "My Exercise. A Team-based Workplace Intervention for Increased Exercise", [clinicaltrials.gov](https://clinicaltrials.gov/ct2/show/study/NCT02429635), NCT02429635, April 14, 2015.

1. Introduction

Recommended levels of PA are known to prolong life, reduce risk for cardiovascular diseases (heart attack, stroke, and atherosclerosis), risk of type 2 diabetes, obesity, clinical depression, and certain types of cancer (American College of Sports Medicine [ACSM], 2014). The most recent national survey on PA habits among Norwegian adults found that only 32% satisfied the health authorities' recommendations of 150 min of moderate PA (in bouts of at least 10 min), or 75 min of high intensity PA per week (Hansen et al., 2015). Despite the public education campaigns and intensive media attention to health benefits of regular PA, the national survey demonstrated that improvements in activity levels among Norwegians have been surprisingly small over the last 10 years (Hansen et al., 2015). Considerable research effort has been dedicated

to the development of effective health promotion approaches building on relevant theoretical frameworks and incorporating behavioural change techniques. However, more studies are needed to understand how these approaches can be adjusted to specific community settings in order to be perceived as practical and sustainable, without compromising the effectiveness in terms of behavioural change and improved health conditions (Heath et al., 2012).

For several decades, the worksite has been regarded as an important community setting for health promotion initiatives aimed at increasing PA levels of the adult non-clinical population (Abraham & Graham-Rowe, 2009; Rongen, Robroek, van Lenthe, & Burdorf, 2013). Capitalizing on the presence of natural social networks, employer-initiated programs can potentially enhance the degree of commitment to lifestyle changes due to social support from co-workers and management (Conn,

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Hafdahl, Cooper, Brown, & Lusk, 2009). Despite the apparent advantages of the worksite context, employer-initiated health promotion programs can potentially be perceived as controlling and an intrusion to private life. Fear of negative reactions or pressure from co-workers and supervisors is a common reason for not participating in such programs (Linnan, Weiner, Graham, & Emmons, 2007). We find that SDT (Deci & Ryan, 1985, 2000) represents a theoretical framework for behavioural change especially relevant to the context of a group-based employer-initiated health promotion program. Employees can easily feel ambivalent or even reluctant about participating if the program is perceived as “one size fits all” with little room for individual adjustment and freedom of choice (Linnan, Fisher, & Hood, 2012; Ryan & Deci, 2002). Hence, carefully designing the programs to offer support in an autonomous supportive manner is of pivotal importance, both for long-term behavioural change and for the well-being of employees. Moreover, due to the existing social networks, a group-based program can be designed to incorporate interpersonal involvement and need support from significant others like co-workers or managers, in addition to the program providers, typically occupational healthcare professionals.

SDT is an organismic theory of human motivational processes encompassing all aspects of human social life (Ryan & Deci, 2017). According to SDT, individuals are most effective and persistent in pursuing a healthy lifestyle when they are autonomously motivated (Ryan & Deci, 2002). Autonomous motivation entails that they engage in the activity because they find it intrinsically satisfying or because they truly identify with and value the outcomes (Deci & Ryan, 2000). Further, SDT posits that individuals will develop autonomous motivation for a particular behaviour when significant others adopt a need-supportive approach toward the person (Ryan & Deci, 2002). When basic psychological needs for autonomy (i.e., feeling volitional and self-endorsed), competence (i.e., feeling mastery and effective), and relatedness (i.e., feeling of belonging and being cared for) 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).

The intervention was designed to provide the participants with a social environment perceived as need supportive according to three dimensions: autonomy support (Deci, Eghrari, Patrick, & Leone, 1994; Reeve, 2002; Williams, Cox, Kouides, & Deci, 1999), structure, and involvement (Markland, Ryan, Tobin, & Rollnick, 2005; Markland & Vansteenkiste, 2007). The operationalization of active ingredients was inspired by a model integrating SDT with motivational interviewing (MI; Markland et al., 2005), and previously applied in SDT-based PA intervention studies (Fortier, Duda, Guerin, & Teixeira, 2012). MI offer techniques that are inherently practical and process-oriented, and aim to increase the awareness of potentially conflicting motivations and explore the ambivalence related to making lifestyle changes (Markland et al., 2005). This process is important in order to help participants internalize autonomous forms of motivation, increase their readiness for change, and become self-regulated. This group-based intervention did not allow for individual in-depth counselling. Hence, suitable MI techniques were also incorporated into non-human material like plenary presentations held by a health and exercise advisor (HEA), and a booklet consisting of reflection tasks that were completed individually and discussed in small groups.

Autonomous motivation for PA has consistently shown to predict increased PA frequency, improved physical fitness, and increases in behaviour related to regular PA (Edmunds, Ntoumanis, & Duda, 2007; Teixeira, Carraca, Markland, Silva, & Ryan, 2012). Teixeira and colleagues call for more SDT-based randomized controlled trials that include biomedical markers, like CRF or health risk factors such as high blood pressure, in order to assess the success of behavioural changes (Teixeira et al., 2012). Moreover, there is a need for more intervention studies that last for at least 12 weeks, preferably more than six months, allowing the internalization process to unfold (Rodgers, Hall, Duncan, Pearson, & Milne, 2010). SDT-based intervention studies aimed at

increasing PA among adults have primarily been carried out in the context of community health services and primary care (Ng et al., 2012; Teixeira et al., 2012). SDT has previously been applied in the context of a worksite PA promotion intervention among university staff members with a sedentary lifestyle (Thøgersen-Ntoumani, Loughren, Duda, Fox, & Kinnafick, 2010; Thøgersen-Ntoumani, Ntoumanis, Shepherd, Wagenmakers, & Shaw, 2016). The studies obtained promising results related to increased PA, and autonomous motivation for PA was positively associated with adherence, which predicted higher levels of CRF and lower levels of body fat. However, the present study is the first SDT-based intervention designed specifically to suit employees working shifts doing manual labour. According to Quintiliani, Sattelmair, and Sorensen (2007), consistent findings indicate that male, blue collar workers are less likely to take part in worksite health promotion program, compared to white collar workers and women in general. There are structural barriers to participation like shift work, time pressure, and productivity demands related to working within logistics and production lines. Moreover, according to Norwegian national surveys, people working within transport have the highest levels of sickness absence among male employees, and the second highest among female employees (Nygård, 2015).

Due to financial and practical reasons, worksite health promotion programs are often offered to organizational teams or groups of employees rather than individually. In general, meta-analyses and review studies have reached inconclusive and often contradictory results regarding the effectiveness of individually-based versus group-based approaches (Carron, Hausenblas, & Mack, 1996; Van der Bij, Laurant, & Wensing, 2002). Meta-analytic findings make an argument for the importance of personal contact and group cohesion, rendering group-based programs that incorporate principles of group dynamics the most effective in terms of adherence and physiological effects (Burke, Carron, Eys, Ntoumanis, & Estabrooks, 2006).

In the current worksite context, a group-based intervention was designed to offer a need supportive environment that would facilitate the participants' autonomous motivation for self-organized PA sessions. This was preferred over collective PA classes since employees worked shifts and a majority were “on the road” during working hours. This was supported by interviews with representatives of the target population, carried out prior to the intervention design phase, who were found to be reluctant to the idea of collective PA classes because of the lack of onsite facilities and irregular working hours. In addition, they felt uncomfortable exercising with co-workers because they perceived them to differ too much in terms of exercise habits and PA competence levels.

Incorporating co-workers as an active ingredient in worksite health promotion programs is rather common (Linnan et al., 2012). Co-workers are expected to offer support that facilitates behavioural change during the intervention period, and to develop a culture that supports the maintenance of change after program termination. Intervention studies assessing the effects of co-worker peer support on health behaviour outcomes have obtained promising results; however peers are rarely evaluated separately from the overall intervention effects (Linnan et al., 2012). In the majority of SDT based intervention studies the provider of need support, the “significant other”, is represented by a figure of authority such as a physician (Williams, McGregor, Zeldman, Freedman, & Deci, 2004), an exercise instructor (Edmunds, Ntoumanis, & Duda, 2008), or a dentist (Münster Halvari, Halvari, Bjørnebekk, & Deci, 2012). The core of their profession is the expert helper, which makes them a natural and efficient source of need support, especially in terms of competence, assuming they are able to provide the required time. There are considerably fewer SDT-based studies where peers, someone who is of equal standing, are targeted as agents of need support. Peers are known to play an important role in terms of need support during team sports or collective PA sessions (Ntoumanis, Vazou, & Duda, 2007; Wilson & Rodgers, 2004). Rouse and colleagues assessed the unique contributions of several significant others on PA intentions

prior to intervention start-up. Results indicated that both physicians as well as partners were more effective contributors compared to offspring (Rouse, Ntoumanis, Duda, Jolly, & Williams, 2011). However, there are few SDT based PA intervention studies designed specifically to influence the need supportive behaviour of peers, and none in the context of worksite health promotion.

1.1. Study aim and research questions

The main aim of the intervention was to increase participants' level of regular PA as well as their CRF (ACSM, 2014). The pivotal role of regular PA and CRF in terms of lowering the risk of cardiovascular diseases and premature mortality has been supported in both intervention trials and epidemiological studies (Gill & Malkova, 2006; Lee et al., 2012). This is especially the case for individuals with a risk profile defined as metabolic syndrome: abdominal obesity, raised triglycerides, an unfavourable 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 (Alberti, Zimmet, & Shaw, 2006). Despite the importance of regular PA, recent studies have indicated that the cardio-metabolic benefits are negligible in terms of reduced risk of cardiovascular disease and premature mortality if CRF remains poor (Aspenes et al., 2011; Lee et al., 2012). Health promotion initiatives will have a stronger impact on physical health if they target the participants' motivation (e.g. awareness, willingness and ability) to engage in activities with moderate to vigorous intensity. In the present study, it was recommended that participants exercised at moderate intensity, and to explore whether they could increase their intensity levels in short bouts when the opportunity presented itself naturally, for instance increase their pace uphill during walks, and apply the principles of high-intensity interval training (HIT; Gaesser & Angadi, 2011). Accumulated evidence indicates that the effectiveness of HIT is surprisingly close to continuous PA in terms of cardio-metabolic adaptations (Gibala & McGee, 2008).

The present study tested the hypotheses that a need-supportive group-based PA intervention (relative to a standard control condition) would lead to increases in regular PA and CRF, as well as improvements in biomedical outcome variables related to health (i.e., reduced systolic and diastolic BP, waist circumference, increased HDL-C, and lower non-HDL-C levels). Moreover, the study assessed whether the data supported an SDT model of health behaviour change (Williams, Gagné, Ryan, & Deci, 2002) previously supported in a meta-analysis on studies in health related settings (Ng et al., 2012). The current adaption of the model posits that perceived need support for PA would have a positive effect on the participants' degree of autonomous motivation and perceived competence for PA, leading to increases in PA levels and CRF. These changes were expected to improve health related outcome variables (systolic and diastolic BP, waist circumference, and non-HDL-C). In order to reduce the complexity of the model, only non-HDL-C was chosen to represent the secondary outcome measure, cholesterol. Recent guidelines indicate that a change in non-HDL-C is a stronger predictor of cardiovascular disease risk compared to a change in HDL-C (Piepoli et al., 2016).

2. Method

2.1. Design and procedures

This was a parallel group randomized controlled trial with two conditions. Baseline assessments were carried out in January 2015, followed by a 16-week group-based intervention, and post-test assessments in June 2015. Cluster randomization was preferred due to the group-based nature of the intervention sessions and the role of co-workers as a source of need support for PA. In addition, individual-level randomization would considerably increase the risk of contamination and crossover between groups, and hence geographic worksite was

chosen as the unit of randomization. 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.

2.2. Participants and recruitment

All participants were employed by the Norwegian Post delivering mail and logistic services. All participants did manual labour as terminal workers, drivers, and mail carriers. However, their level of regular occupational PA was expected to differ somewhat related to whether they applied vehicles and technical ergonomic equipment during working hours. All workplace locations were situated in the East of Norway, both rural and urban areas. First, local worksite management was presented to the research study, and approval was obtained prior to recruitment of local employees. Participants were recruited by means of information meetings at the workplace premises during working hours. Written information including the informed consent form was handed out and administered by the researcher. Inclusion criteria were defined as worksites that consisted of teams working shifts, and employees working full time or part time (a position of at least 20%). Having a health condition was not a criterion for exclusion as long as the employees were fit for work.

2.3. Sample size calculations

The study was powered in order to detect behavioural changes of clinical relevance to the participants' health, not just statistically significant changes (Campbell, Thomson, Ramsay, MacLennan, & Grimshaw, 2004). Sample size calculations were based on estimated Cohen's *d* effect size (ES) of CRF 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). Based on this study, a conservative estimation of *d* = 0.39 was expected in the present study since participants initiated and organized their exercise sessions individually. An estimate of the intra-cluster correlation coefficient (ICC) was set to 0.040. This was 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 in CRF of one MET or 3.5 mL kg⁻¹·min⁻¹ (Myers et al., 2004) combined with results from a large Norwegian study on healthy adults (*M* = 40 mL kg⁻¹·min⁻¹, *SD* = 7; Aspenes et al., 2011). In order to achieve a detectable effect size of *d* = 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 (<http://www.sample-size.net/>).

2.4. 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 a computer generated list offered at a randomization service website for clinical trials.

2.5. Intervention design

The groups received identical onsite health screening consisting of

baseline assessments and an individual talk where health personnel offered explanations and health recommendations based on a written, individual health profile. Following randomization, the intervention group was offered six sessions of group-based intervention elements: two workshops and four PA support group meetings, a total of 7.5 h. All sessions were offered at the worksite premises. The intervention consisted of three sources of need support: co-workers, a health and exercise advisor (HEA), and a booklet consisting of reflection tasks. The workshops were provided and facilitated by a HEA. Initially, the HEA gave short talks on PA and health, and on health behaviour change and motivation according to the tenets of SDT. Participants received a booklet consisting of reflection tasks based on a combination of SDT and techniques from MI. Participants completed each individually, and discussed their answers in small groups of 2–3 participants in order to increase awareness, competence and relatedness, followed by plenary discussions facilitated by the HEA. The two HEAs were physiotherapists employed by the company occupational health service. They were both experienced and professionally trained in behavioural change counselling and facilitation of group processes. They 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 (4–5 participants with similar PA levels and interests) were structured to facilitate mutual sharing of experiential knowledge connected to PA lifestyle changes. The groups were instructed to put one participant in focus at the time, and to offer support for autonomy, competence, and relatedness in their response and comments. During the first one hour meeting, participants were offered an introduction to the concept of need supportive behaviour, operationalized according to the short version of the Health Care Climate Questionnaire (HCCQ; Williams, Grow, Freedman, Ryan, & Deci, 1996), and structured as descriptions of need supportive or need thwarting behaviour. An example is “Explore different options and choices together with the person” versus “Offer strong opinions about what the person should choose or do”. The groups were self-directed, and contacted the researcher present for questions or comments.

Participants in the control group were not offered any employer-initiated group-sessions between baseline and post-test assessments. However, for ethical reasons, they were encouraged to follow the recommendations they received during the individual health screening. In addition, they were offered similar group-based sessions after post-test. Both groups received a second identical health screening after five months where post-test assessments were compared to baseline. For a complete description of the intervention content and design, see supplementary material, Appendix A.

2.6. Primary outcome measures

CRF 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 (ACSM, 2014). Since participants were not excluded on the basis of their health condition, a submaximal test was considered less strenuous with a lower risk of overexertion and negative health reactions (ACSM, 2014). The Astrand-Rhyming ergometer bicycle test, a single-stage test lasting for six minutes, was administered by qualified health occupational therapists (ACSM, 2014; Astrand, 1960). An electronic cycle ergometer with a cadence meter and a heart rate monitor with chest strap was applied. CRF levels were estimated based on a steady pace with a heartrate between 120 and 170 bpm, and workload determined by the participants' gender and physical condition. An adjusted $\text{VO}_{2\text{max}}$ value was estimated using the modified Astrand-Rhyming monogram, correcting for age, gender, and weight. Validation studies have demonstrated a consistent difference between submaximal estimations and direct measures (in standard deviations) of approximately $\pm 15\%$ in a population mixed in age and fitness level

(Ekblom, Engstrom, & Ekblom, 2007).

Habitual PA in terms of the average frequency, duration, and intensity per week was assessed applying the three-item questionnaire International Physical Activity Index (IPAQ), previously validated in a compatible population in Norway (i.e., the HUNT study; Kurtze, Rangul, Hustvedt, & Flanders, 2008). According to protocol, weighted scores are summed in a total index. In the present study, the reliability test obtained a satisfactory level at baseline (Cronbach's $\alpha = .80$), albeit a somewhat low level at post-test ($\alpha = .67$).

2.7. Secondary biomedical outcome measures

Systolic and diastolic BP were measured manually applying an auscultatory technique with a mercury column or mechanical aneroid sphygmomanometer. Blood samples were collected by means of capillary puncture. Non-HDL-C was calculated by subtracting HDL-C from total cholesterol. Blood samples were collected during working hours, and participants were not advised to fast before attending the test due to work safety considerations.

2.8. Motivation measures

Autonomous motivation for PA was measured by a composite construct of the two subscales intrinsic (e.g., “I exercise because it's fun”) and identified motivation (e.g., “I value the benefits of exercise”) from the Behavioural Regulation in Exercise Questionnaire (BREQ-2; Markland & Tobin, 2004). Participants responded according to a 5-point Likert-scale, ranging from 1 (*not true for me*) to 5 (*very true for me*). The reliability coefficients of the scales combined were satisfactory ($\alpha = .89$), and the two subscales highly correlated ($r = .75$). Perceived competence for PA was measured by the Perceived Competence in Exercise Scale (PCES; Williams & Deci, 1996), on a 7-point Likert-scale, ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). An example item being: “I feel confident in my ability to exercise on a regular basis”. The scale obtained high levels of reliability ($\alpha = .90$). Perceived need support for PA was assessed with the short version (seven items) of the Health Care Climate Questionnaire (HCCQ; Williams et al., 1996) adjusted to co-workers (e.g., “My co-workers listen to how I would like to do things regarding my regular exercise”). The items were completed on a 7-point Likert-scale, ranging from 1 (*not true*) to 7 (*very true*), and the scale obtained high levels of reliability ($\alpha = .92$).

2.9. Data analysis

Descriptive analyses of baseline data were executed by means of independent sample t-tests in order to assess significant differences between conditions and clusters after randomization. Attritions checks were carried out by means of binary logistic regression in order to assess whether baseline measurements predicted dropout or not. Due to attrition, analyses of intervention effects between conditions over time, multivariate (MANOVA) and univariate (ANOVA) analyses of variance repeated measures were executed on both intention-to-treat and complete-case samples. Missing data were accounted for by means of multiple imputation ($n = 15$ imputations). All analyses were undertaken using IBM SPSS Statistics 21 (IBM Corp., Boston, Mass, USA). Multilevel modelling methods were considered inappropriate due to the small number of clusters ($n = \text{six}$) and cluster sample sizes ($n = 23\text{--}47$; Snijders & Bosker, 2012). All analyses applied worksite location as a covariate in order to control for the effects of the cluster randomization. Effect sizes were calculated applying Cohen's d comparing two conditions (Morris, 2008).

The SDT model of health behaviour change was tested with a path analysis. The model consisted of five objective constructs (CRF, systolic and diastolic BP, waist circumference, and non-HDL-C) and one index construct (PA). As a consequence, change scores, calculated by linear regression, were preferred to latent constructs because a combination of

latent and manifest constructs decreases the stability of complex models due to large reliability differences (Cole & Preacher, 2014). First, a zero order correlational analysis of linear regressions (change scores) was performed in SPSS applying the complete-case sample, in order to assess the pattern of relationships. Secondly, the motivation measures were assessed for model fit in *Mplus* 7.4 (Muthén & Muthén, 1998–2012) by means of confirmatory factor analysis (CFA). Missing data were handled using full information maximum likelihood (FIML) estimation, and analyses were performed using the robust MLR-estimator (Muthén & Muthén, 1998–2012). 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., six), “type is complex” was chosen above a multilevel analysis, in accordance with the recommendations of McNeish and Stapleton (2016). Process evaluations and assessments of fidelity were included in the study, in accordance with RE-AIM. Results of these data will be published in a future paper.

3. Results

3.1. Baseline analyses

Six worksite locations were invited to participate, consisting of 320 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 group, and $n = 89$ (44%) to the control group (Fig. 1). The mean cluster size was $n = 34$ (range from $n = 23$ to 47, with 65% between $n = 30$ and 36). The sample had a mean age of 42.5 years (SD 11.65), and consisted of 76.2% men. Independent sample *t*-test indicated there were no significant differences between the study sample and eligible employees who declined to participate ($n = 97$) in terms of age ($t = 0.98$, $p = .328$) and gender ($t = 0.70$, $p = .482$). There were significantly more men in the control group (13%, 95% CI = .00 to .24) at baseline. In addition, the control group obtained significantly higher levels of CRF (4.68 mL kg⁻¹ min⁻¹, 95% CI = 1.72 to 7.64), and significantly lower levels of both systolic BP (1.89 mmHg, 95% CI = -8.37 to -.29) and diastolic BP (1.43 mmHg, 95% CI = -6 to -.54). In terms of motivation measures, both perceived competence for PA (0.64, 95% CI = 0.21 to 1.06) and autonomous motivation for PA (0.14, 95% 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).

3.2. Attrition checks and missing data

A total of 22% ($n = 45$) were lost to post-test assessments. The Little's test did not support the hypothesis that data were missing completely at random (MCAR): $\chi^2 = 300$, $df = 233$, $p = .002$. Analysis of the groups separately demonstrated a MCAR pattern in the intervention group ($\chi^2 = 166$, $df = 152$, $p = .20$); however this was not the case in the control group ($\chi^2 = 266$, $df = 205$, $p = .003$). 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 the 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 [OR] = .402, CI = .174 to .932) significantly predicted dropout rates. However, comparing those who completed with those who actively withdrew, the latter were lower

in education levels (Wald = 5.66, $p = .017$, OR = .372, 95% CI = .165 to .840) and this group included more men (Wald = 7.29, $p = .007$, OR = .291, 95% CI = .119 to .713). Moreover, participants in this latter group were considerably less autonomously motivated for PA (Wald = 9.75, $p = .002$, OR = .463, 95% CI = .286 to .751) and perceived themselves to be less competent related to PA (Wald = 5.26, $p = .022$, OR = .711, 95% CI = .531 to .952).

3.3. Intervention attendance rates

In the intervention group, average attendance rate was 50%, or three sessions ($M = 2.75$, $SD = 1.76$). A total of 56% ($n = 62$) attended the first and 44% ($n = 49$) the second workshop. Binary logistic regression analysis indicated that autonomous motivation for PA was the only baseline characteristic significantly predicting whether the participants attended sessions or not ($\chi^2 = 10.54$, $p = .001$). Moreover, hierarchical multiple regression analysis indicated that only 0.8% ($p = .42$) of the total variance in post-test CRF was explained by attendance rates, equivalent values for PA was 0% ($p = .92$).

3.4. Analysis of intervention effects

MANOVA repeated measures including all variables demonstrated an overall Intervention x Time effect in both intention-to-treat analysis ($F = 3.791$, $df = 10$, $p = .009$) as well as complete-case analysis ($F = 5.415$, $df = 10$, $p = .000$). ANOVA repeated measures for each of the variables are listed in Table 1. Regular PA did not yield any significant intervention effect but a significant effect of time ($F = 7.60$, $p = .007$). The secondary biomedical outcome measures related to health all indicated a positive development in the intervention group compared to the control group. Changes in systolic BP and waist circumference were non-significant and did not yield significant effects of time or intervention.

3.5. Testing the SDT model of health behaviour change

The zero order correlational analysis indicated a pattern that was in accordance with the research hypotheses, except that perceived competence for PA did not correlate with CRF (supplementary material, Appendix C). CFA demonstrated an acceptable model fit for *need support for PA* omitting three items (HCCQ2, HCCQ6, and HCCQ7): $\chi^2/df = 1.61$, RMSEA = .056 (95% CI = .000 to .164), CFI = .99, TLI = .99, SRMR = .012. The 4-items scale measuring *perceived competence for PA* received a good fit: $\chi^2/df = 1.36$, RMSEA = .043 (95% CI = .000 to .155), CFI = .99, TLI = .99, SRMR = .013. *Autonomous motivation for PA* obtained a strong model fit by omitting one item (BREQ3) from the identified motivation subscale: $\chi^2/df = 0.77$, RMSEA = .000 (95% CI = .000 to .075), CFI = 1, TLI = 1, SRMR = .048.

The direct effects over time among constructs in the model were assessed applying linear regressions. Attendance rates were excluded from the model due to the lack of significant effects on the primary outcome variables. The specified model obtained a good fit to the sample data: $\chi^2/df = 1.01$, RMSEA = .010 (95% CI = .000 to .069), CFI = .99, TLI = .99, SRMR = .052. Furthermore, 13 of 17 hypothesized links in the model were supported (Fig. 2). The hypothesized link between perceived competence for PA and CRF was not statistically significant ($p = .150$). Likewise, PA levels did not demonstrate significant links with diastolic BP ($p = .110$). Moreover, CRF had significant links with all secondary outcome measures except non-HDL-C ($p = .470$). Additional significant indirect effects were found from changes in autonomous motivation via PA on CRF ($Z = 2.445$, 95% CI = .005 to .061), systolic BP ($Z = -2.90$, 95% CI = -.123 to -.023), and non-HDL-C ($Z = -2.92$, 95% CI = -.166 to -.030; see supplementary material, Appendix D). Indirect effects were also found from changes in autonomous motivation via CRF on systolic BP

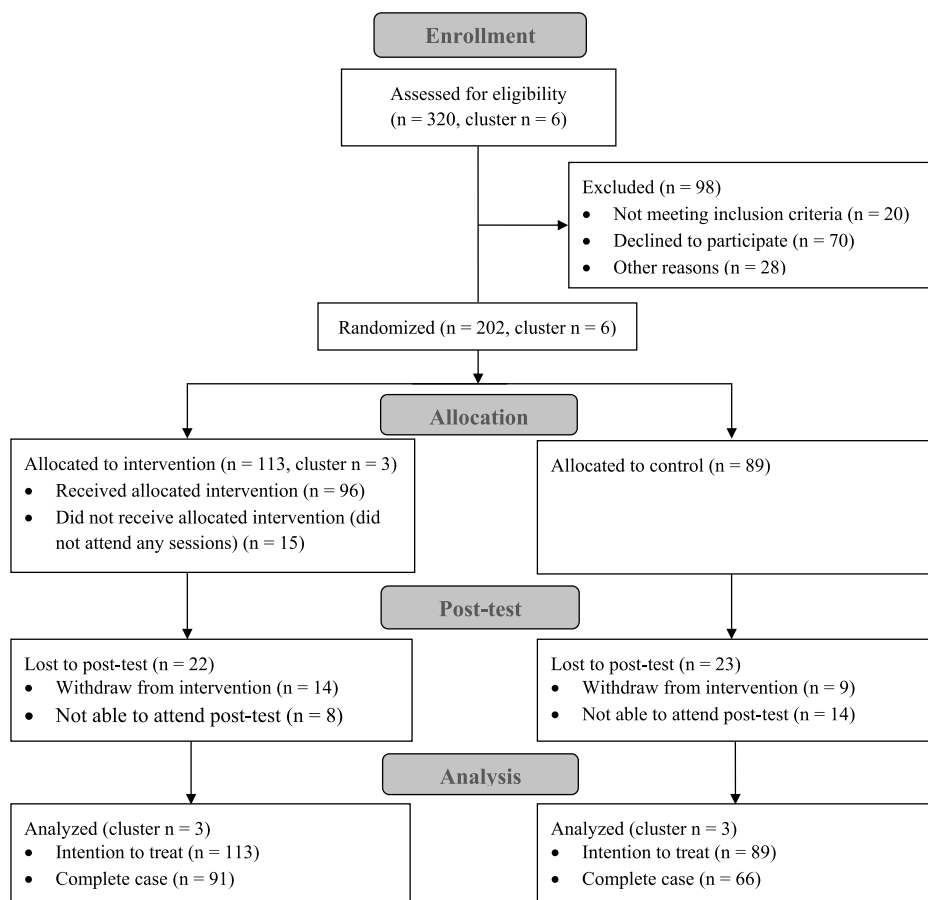


Fig. 1. CONSORT study flow diagram.

($Z = -3.36$, 95% CI = $-.050$ to $-.014$), and diastolic BP ($Z = -2.06$, 95% CI = $-.096$ to $.000$). In addition, the intervention had indirect effects on perceived competence for PA ($Z = 3.93$, 95% CI = $.017$ to $.053$), albeit not on autonomous motivation for PA.

4. Discussion

The present study offers important information on how the worksite and the community of co-workers can be incorporated in an intervention designed to move participants towards autonomous motivation for behavioural change, and the potential effects such an intervention has on PA, CRF 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 need-supportive group-based PA intervention (relative to a standard control condition) would lead to increases in regular PA and CRF, as well as improvements in health (i.e., reduced BP, waist circumference, and improved cholesterol levels). Findings are in line with reviews of previous PA intervention studies in the worksite context reporting moderate albeit mixed effect sizes on CRF (Abraham & Graham-Rowe, 2009; Conn et al., 2009; Rongen et al., 2013). A key finding in the present study was the effectiveness of the intervention to help participants increase their CRF, with a mean increase in the intervention group of

$3.8 \text{ mL kg}^{-1}\cdot\text{min}^{-1}$. According to Myers et al. (2004), a change above $3.5 \text{ mL kg}^{-1}\cdot\text{min}^{-1}$ (one MET) 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. Collective PA sessions, offering one kind of activity, were expected to be perceived as less autonomy supportive, and were not included. Findings indicate that the participants responded positively to the focus on autonomous motivation, as well as the information about the importance of CRF. We may also assume that they felt competent enough to increase the intensity of their activities of choice, possibly by means of HIT, which may explain their increases in CRF.

The intervention group reported a significant increase in regular PA from baseline to post-test, contrary to the control group. However, significant between-group effects comparing the two conditions were not found. This finding was somewhat surprising given the relatively strong between-group effects on CRF. Several studies have found a relatively small correlation between self-reported levels of PA and objective measures of fitness (Dyrstad, Hansen, Holme, & Anderssen, 2014). In the current study, 49.4% of the participants in the intervention group and 59.0% in the control group described their PA levels as high at baseline, something which increased to 62.9% at post-test in

Table 1
ANOVA Repeated Measures with means (M) and standard deviations (SD): Motivation variables, primary and secondary outcome measures.

Variable	Complete case analysis				Intention-to-treat analysis			
	Baseline (M/SD)	5 months (M/SD)	Time x Interv. (F/p)	Effect size (Cohen's d)	Baseline (M/SD)	5 months (M/SD)	Time x Interv. (F/p)	Effect size (Cohen's d)
CRF (mL.kg ⁻¹ .min ⁻¹)								
Intervention (n = 85)	32.33 (7.97)	36.13 (9.31)	18.14/.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)	0.32/.136	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)	2.26/.136	-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)	4.12/.044	-0.04	5.07 (2.36)	5.12 (2.41)	1.56/.396	-0.01
Control (n = 53)	5.59 (2.32)	5.72 (2.42)			5.64 (2.36)	5.71 (2.48)		
HDL-C (mmol/L)								
Intervention (n = 87)	1.26 (0.42)	1.31 (0.48)	10.73/.001	0.22	1.25 (0.40)	1.30 (0.52)	5.53/.006	0.12
Control (n = 53)	1.31 (0.37)	1.27 (0.41)			1.33 (0.42)	1.32 (0.51)		
Systolic BP (mmHg)								
Intervention (n = 89)	135.34 (16.85)	131.70 (14.80)	2.91/.091	-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)	11.83/.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)		
Need support for PA (peers)								
Intervention (n = 88)	3.95 (1.29)	4.42 (1.26)	10.03/.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)		
Perceived competence for PA								
Intervention (n = 88)	4.46 (1.44)	4.59 (1.52)	7.72/.006	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)		
Autonomous motivation for PA								
Intervention (n = 88)	3.40 (0.85)	3.54 (0.80)	13.86/.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)		

Note: CRF = cardiorespiratory fitness. PA = physical activity. Non-HDL-C = non-high-density lipoproteins cholesterol. HDL-C = high-density lipoproteins cholesterol. BP = blood pressure.

both groups. Comparing these findings to CRF 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 (Astrand, 1960). Doing manual labour could possibly mask their perceptions 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. Findings have indicated that there are systematic differences between occupational and leisure-time PA, especially when PA could be described as high. Occupational PA typically consists of heavy lifting and

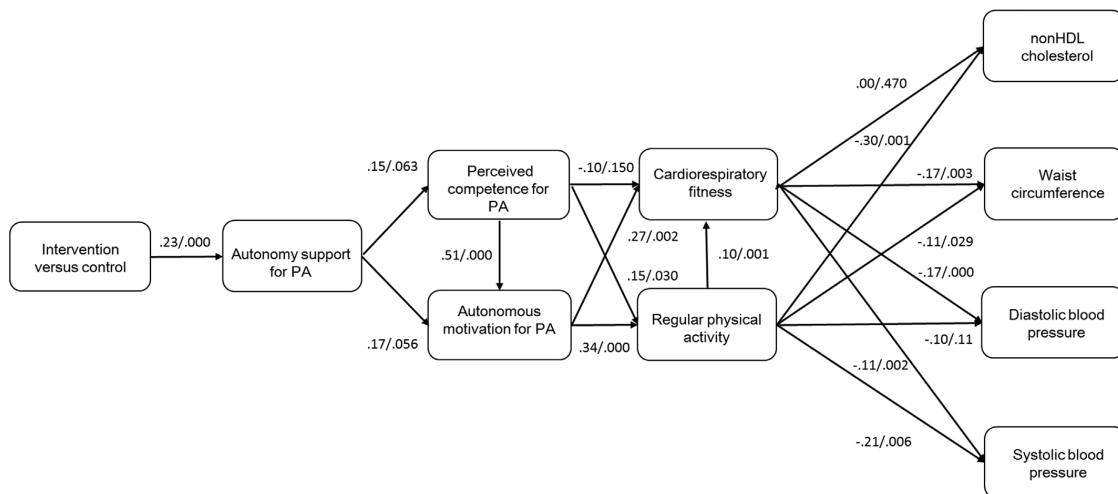


Fig. 2. The SDT health model of behaviour change. Path analysis of associations between change scores. Maximum likelihood estimation with robust standard errors to account for missing values. $\chi^2/df = 1.01$, RMSEA = .010 (95% CI = .000 to .069), CFI = .99, TLI = .99, SRMR = .052. Single-tail p-values. CRF = cardiorespiratory fitness. PA = physical activity. Non-HDL-C = non-high-density lipoproteins cholesterol. HDL-C = high-density lipoproteins cholesterol. BP = blood pressure.

repetitive work, whereas leisure-time PA is often characterized by “dynamic contractions of large muscle groups increasing whole-body metabolism and cardiac output with ability to rest when fatigue requires so” (Holtermann, Hansen, Burr, Søgaard, & Sjøgaard, 2012, pp. 293–294).

All secondary biomedical outcome measures demonstrated a positive development in the intervention group, and between group changes were significant for diastolic BP and HDL-C. Waist circumference, non-HDL-C, and systolic BP did not demonstrate any significant between-group changes (intention-to-treat); however, systolic BP did demonstrate a significant within subject effect. In terms of clinical relevance, the improvements in the intervention group on BP (systolic BP = -3.64 mmol/L and diastolic BP = -1.83 mmol/L) were compatible to the mean values found in a review study of randomized controlled trials related to PA (systolic BP = -3.84 mmol/L, 95% CI = -4.97 to 2.72 , and diastolic SP = -2.58 mmol/L, 95% CI = -3.35 to -1.81 ; Whelton, Chin, Xin, & He, 2002). In addition, these changes are consistent with the hypertension guideline expected effect of regular PA (Chobanian et al., 2003). Hence, the intervention proved effective in terms of clinically relevant changes in BP that reduced the risk of myocardial infarction, stroke, heart failure, and premature mortality. Changes in HDL-C levels in the intervention group (0.050 mmol/L) were close to, albeit somewhat lower than the findings in the review of Kodama and colleagues on PA intervention studies (0.065 mmol/L; Kodama et al., 2007).

Changes in waist circumference and non-HDL-C were too small to represent any clinically relevant changes in terms of reduced risk for diseases related to lifestyle. However, other factors besides regular PA have proven to determine these biomedical markers including calorie balance, macronutrient intake (saturated fats, carbohydrates) and genetic factors responsible for insulin resistance and non-HDL-C (Piepoli et al., 2016). In addition, blood samples were non-fasting which could obscure a possible effect on non-HDL-C.

The secondary aim of the study was to assess whether the data supported the SDT model of health behaviour change (Williams et al., 2002). The path analyses of both direct and indirect effects demonstrated an overall support; most of the paths are in line with the findings of the meta-analysis by Ng et al. (2012). The association between changes in need support from peers and autonomous motivation for PA was borderline significant, albeit considerably weaker than the findings in the above-mentioned review reporting $r = .40$. The relatively moderate dose offered in the current intervention, combined with the brief introduction (one hour) to need supportive behaviour that the participants received, could possibly explain the results. Direct and indirect paths indicated that the intervention as a whole, including two additional sources of need support (the booklet and the HEA), added to the effect on perceived competence for PA and autonomous motivation for PA. The current study offers a better understanding of need support in terms of who could effectively constitute the “significant other” in a non-treatment worksite setting. Results indicate that it is possible to effectively train co-workers to behave in a manner that is perceived as need supportive. Compared to health-care professionals, co-workers 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 co-workers, may be more prone to offer need support in a reciprocal manner, sharing their own experience with PA and lifestyle changes, unlike most experts.

4.1. Limitations and concerns

Despite 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 & Bosker, 2012). This risk is enhanced by the relatively large number of dropouts, albeit the fact that only the 12% who actively chose to withdraw were significantly different at baseline 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, 2016). However, the effects of the intervention should be interpreted cautiously and replications of the intervention study with a sufficient number of clusters are recommended.

Self-reported measures of regular PA are prone to bias like over-reporting due to social desirability (Dyrstad et al., 2014). Moreover, recalling regular PA, including organized exercise, occupational PA, and everyday activities like commuting to work, is a complex task (Sallis & Saelens, 2000). Objective assessment methods, like accelerometers, would have strengthened the present study, and possibly contributed to explain the discrepancy between changes in CRF and self-reported PA (ACSM, 2014). However, the study did not have the financial resources available to include accelerometers.

Attendance rates related to the workshops and PA support group sessions were modest, albeit similar to other group-based PA intervention studies (Hardcastle, Taylor, Bailey, Harley, & Hagger, 2013). Findings indicate that the group sessions failed to attract participants with low levels of autonomous motivation for PA. However, their general health status related to for instance CRF or blood pressure did not seem to affect their willingness to attend the sessions. Participation rates were relatively high (68% of eligible), and the fact that participants were offered a health screening free of charge during working hours could possibly have motivated some to participate in the study albeit not attend the group sessions. 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 paid working hours were more effective on some outcome measures like CRF. The results in the present study, especially on CRF, 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 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 need supportive interaction between participants (Rodgers et al., 2010). 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.

4.2. Strengths

Worksite health promotion interventions are characterized by rather low participation rates. A review study found participation levels from 10 to 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, participants’ health status was compared to a reference population of healthy Norwegian adults (men $n = 13.604$ and female $n = 16.909$; Aspenes et al., 2011). Although the sample in the current study was 5.61 years younger than the reference population, mean values on waist

circumference, HDL-C, and BP were compatible. Non-HDL-C level were higher in the current study sample compared to the HUNT population (male = 4.27 mmol/L, female = 4.04 mmol/L; Aspnes et al., 2011). CRF was considerably higher in the male reference population (40.0 mL kg⁻¹·min⁻¹, SD = 9.5), compared to the current study sample (33.85 mL kg⁻¹·min⁻¹, SD = 10.45). CRF among females were compatible in the two samples. In conclusion, we argue that the current intervention managed to attract employees of average health, including those with low fitness levels. This strengthens the generalizability of the intervention in terms of acceptance among occupational groups susceptible to health risk, such as drivers and storage workers, and possibly to similar occupational groups.

5. Conclusions

Present study findings contribute to the understanding and

Appendix. Equation used to estimate repeated measures Cohen's d ES with pooled SD:

$$d_{pp2} = C_p \left[\frac{(M_{post, I} - M_{pre, I}) - (M_{post, C} - M_{pre, C})}{SD_{pre}} \right]$$

Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.psychsport.2017.11.004>.

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

Supplementary material - Appendix A

Intervention description

Description of intervention content and design

The study design is a cluster randomized controlled trial, consisting of a parallel intervention and a control condition. Participants are randomized to the groups in six clusters based on workplace locations (three in each) in order to avoid the risk of contamination and crossover between the groups. For ethical reasons, the control group receives a delayed group-based intervention eight months after baseline assessments. Following randomization, the intervention group is offered six sessions of group-based intervention sessions during a period of 16 weeks: two workshops and four physical activity (PA) support group meetings, a total of 7,5 hours (Table A1). The intervention consists of three strategies designed to offer needs support: a health and exercise advisor (HEA), peer dialogue (co-workers), and a booklet. Peer dialogue is incorporated in the design of both workshops and PA support group meetings. Group sessions are designed to help each participant decide on the kind of PA they will engage in based on their preferences, life situation, level of PA competence, and what activities they enjoy the most. All sessions included in the intervention are situated at the worksite premises in conference rooms suitable for training purposes. Sessions are offered immediately before or after working hours.

Operationalization of theoretical tenets into intervention strategies

The intervention design is developed based on an understanding of human motivation processes as described in Self-determination theory (SDT) combined with techniques from Motivational interviewing (MI) suitable for self-reflection and dialogue among peers in a group setting. A need supportive environment is defined according to three dimensions. The first dimension, autonomy support, is defined as "Providing meaningful rationales", "Acknowledge negative feelings", and "Use non-controlling language" (Deci, Eghrari, Patrick, & Leone, 1994), in addition to "offer choices" (Reeve, 2002), and "Nurture inner motivational resources" (Williams, Cox, Kouides, & Deci, 1999). The second and third dimensions, provision of structure and interpersonal involvement, are both adapted from the works of Markland and colleagues integrating the tenets of SDT with the practice of MI (Markland, Ryan, Tobin, & Rollnick, 2005; Markland & Vanteenkiste, 2007). Examples of these dimensions being "Offer advice when appropriate but avoid imperatives (e.g., 'you must', 'you should')" and "Demonstrate understanding of the participants' position". Table A2 describes in detail how the dimensions are operationalized related to the three intervention strategies: HEA talks and dialogue with participants during workshop I and II, peer dialogue during workshop I and II, and during PA support group meetings, and the reflection booklet (task 1-6 completed during workshop I, and task 7 during workshop II).

Workshop 1

The first session is a two hours workshop provided and facilitated by a HEA. Initially, the HEA gives short talks on PA and health, and on lifestyle change and motivation according to the tenets of SDT. The booklet is introduced and handed out to participants during the introduction. The booklet consists of reflection tasks based on a combination of SDT and techniques from MI. Participants complete one reflection task at the time individually, and then share and discuss their answer in small groups of 2-3 participants. At the end of the

workshop, participants complete an evaluation and feedback form. In addition, they are offered the possibility of a short, confidential conversation with the HEA in case there are issues or questions they are reluctant to share during the sessions.

PA support group meeting

Participant are divided into groups of 4-5, and each session lasts for one hour. The groups are instructed to support each other in their efforts to establish new PA habits according to the PA plan they developed during workshop 1. The six instructional behaviors are presented in a bipolar format with the need supportive behaviors on the left side and the need thwarting behaviors on the right side, both accompanied by illustrative descriptions (Reeve, Jang, Carrell, Jeon, & Barch, 2004). Instructions are operationalized according to the short version of the Health Care Climate Questionnaire (Williams, Grow, Freedman, Ryan, & Deci, 1996). Focus is on one of the participants at the time (10-15 minutes per person). The sessions are structured according to a list of relevant topics:

- What were my PA plans?
- What did I actually achieve?
- What worked well?
- Were there any obstacles, and how did I handle them?
- Do I want to make any changes in the future?
- What are my plans for the coming weeks?

The groups consist of participants with similar PA levels and interests in order to enhance their ability to relate to one another and give each other feedback and support. In addition, they have the possibility to exercise together if they wish, however they are not expected to.

Workshop 2

The second workshop lasts for 1,5 hour, and is provided and facilitated by a HEA. Prior to the workshop, participants are invited to suggest topics they would like on the agenda related to PA, health, and lifestyle changes. Based on the suggestions, the researchers together with the two HEA discuss and prioritize the topics most relevant for the majority of the participants and develop the content of the talks and the reflection tasks. This is done to support the participants' need for autonomy, to enhance their competence on topics they find especially relevant at the current stage in the process, and to make them feel seen and understood.

Training of intervention providers

The training consists of an introduction to the tenets and principles of SDT and MI, and how these are operationalized and adjusted to the current intervention design and research sample. The intervention pilot is used as an opportunity for training, and the two HEAs participate in the refinement of the intervention design (Table A3). The HEAs are trained to exhibit this need supportive behaviour from the moment the participants arrive at the workshop (greeting everyone by the door), during their talks (how they present the material, respond to questions and comments), when they facilitate plenary discussions, and during their conversations with individual participants or small groups during reflection task dialogue.

The two HEA are recruited from a Norwegian occupational health service company, Unicare. They are both professionally trained as physiotherapists, and experienced with training and counselling of both individuals and groups. Their ability to facilitate group processes that were interactive in nature is important to this project.

Table A1 *Description of the two conditions during the study period.*

	Intervention group	Control group
Sep – Nov 2014	Recruitment: information meetings.	Recruitment: information meetings.
Jan/Feb 2015	Baseline assessments/health screening: physiological tests and questionnaires, 15 minutes individual talk with health personnel.	Baseline assessments/health screening: physiological tests and questionnaires, 15 minutes individual talk with health personnel.
Feb 2015	Randomization	
Feb 2015	Workshop I.	No group-based intervention.
Mar 2015	PA support group meeting I.	No group-based intervention.
Mar 2015	PA support group meeting II.	No group-based intervention.
Apr 2015	Workshop II.	No group-based intervention.
Apr/May 2015	PA support group meeting III.	No group-based intervention.
May 2015	PA support group meeting IV.	No group-based intervention.
Jun 2015	Post-test/health screening: physiological tests and questionnaires, 15 minutes individual talk with health personnel.	Post-test/health screening: physiological tests and questionnaires, 15 minutes individual talk with health personnel.
Oct 2015	No group-based intervention.	Delayed group-based intervention.
Feb-apr 2016	Follow-up: questionnaires.	Follow-up: questionnaires.

Table A2 Operationalization of a basic needs supportive environment related to the three intervention strategies.

Dimensions of a need supportive environment (SDT/MI)	HEA talks, response to questions/comments, and interaction with participants Workshop I and II	Booklet Workshop I and II PA support group meetings I-IV	Peers in small groups Workshop I and II PA support group meetings I-IV
Autonomy support			
<p>1 Providing meaningful rationales:</p> <p>Verbal explanations that help the other person understand why self-regulation of the activity would have personal utility.</p>	<p>The HEA presents the concept of autonomous motivation, including each motivational quality - from amotivation to intrinsic motivation. The importance of autonomous motivation, in general and specifically related to PA, for quality of life, well-being, engagement, and sustained effort is stressed.</p> <p>The issue is visualized as a continuum of motivational regulation with examples of each motivational quality.</p> <p>Participants are asked to reflect for a moment on their current motivation for PA related to this continuum.</p> <p>The HEA offers examples from his or her personal life related to PA and the importance of autonomous motivation and enjoyment.</p> <p>The HEA focuses on providing meaningful rationales in their response to comments and questions.</p>	<p>Reflection task no.1: Participants are asked to reflect on their personal PA history:</p> <ul style="list-style-type: none"> • What kind of PA did they enjoy growing up? • Have their preferences and PA habits changed as an adult? • If any, what were the reasons for these changes? • What can they learn from their own PA history? <p><u>Reflection task no.3:</u> Participants are asked to reflect on personal preferences and enjoyment related to PA. They are offered a list of alternatives to help them reflect.</p> <p>After an individual written reflection, participants are asked to share and discuss this with a small group of co-workers.</p>	<p>Not relevant.</p>
<p>2 Acknowledge negative feelings:</p> <p>Tension-alleviating acknowledgements that the request one is making of the other is in conflict with his or her personal inclinations and</p>	<p>The HEA talks about ambivalence or conflicting thoughts and feelings related to PA and lifestyle changes, and that these are normal reactions.</p> <p>The issue is visualized as a weighing scale. Both positive and negative reasons for doing</p>	<p>Reflection task no.2: Participants are asked to consider 10 different consequences of exercise, both positive and negative, and to rate them in terms of personal importance.</p>	<p>Behavior no.2: The participants are instructed to support the need for autonomy by listening to what the other person says and try to see the situation from the person's point of view.</p>

that his or her feelings of conflict are legitimate (yet not necessarily inconsistent with activity engagement).

PA are listed on each side of the weighing scale.

The HEA acknowledges and actively invites participants to share both positive and negative reactions to the information they are given, and to PA in general.

The HEA tries to answer questions in a neutral manner, and asks for permission before offering advice when this is relevant.

Participants are also asked to write down what they personally see as benefits and disadvantages of increasing their level of PA.

After an individual written reflection, participants are asked to share and discuss this with a small group of co-workers.

They are instructed to avoid interrupting and having a self-centered perspective on the situation.

- 3 Use non-controlling language: Communications that minimize pressure (absence of “shoulds”, “musts”, and “have tos”) and convey a sense of choice and flexibility in the location of behavior.**

The HEA delivers information about the health benefits of regular PA, and the PA levels recommended by the Norwegian Health authorities in a neutral manner.

The HEA repeats several times that participants are not required to follow these recommendations. The choice is theirs.

All the text in the speaker notes is proofread to make sure that non-controlling language is applied.

The HEA focuses on using a non-controlling language in their response to comments and questions.

All the text in the booklet is proofread to make sure that non-controlling language is applied.

Behavior no 4:
The participants are instructed to support the need for autonomy by the use of open questions, and formulations such as "maybe you could.." or "what are your thoughts on....".

They are instructed to avoid the use of controlling language such as "you must..." or "you should..." .

- 4 Offer choices: Provide information about options, encouragements of choice making, and encouragements of the initiation of one's own action.**

The HEA presents participants with different PA contexts: recreational activities (e.g., hiking, playing with kids), commuting, everyday activities (e.g., taking the stairs instead of the elevator, housework etc.), work, organized exercise, and sports.

The HEA explains the principles of high-intensity interval-training (HIT), and how these can be applied in a variety of PA contexts,

Reflection task no 3:
After reflecting on their personal preferences and what they think will increase their enjoyment of PA, participants are asked to consider what kind of activity they would like to do related to 1) cardiorespiratory fitness, 2) muscular strength, and 3) everyday PA.

Behavior no 3:
The participants are instructed to support the need for autonomy by contributing to explore different alternatives and choices together with the person.

They are instructed to avoid declaring strong opinions about what the person should do or choose.

<p>taking advantage of naturally occurring possibilities (e.g., a hilly terrain).</p> <p>The HEA focuses on encouragement of choice making in their response to comments and questions.</p>	<p>After an individual written reflection, participants are asked to share and discuss this with a small group of co-workers.</p>
<p>5 Nurture inner motivational resources:</p> <p>Vitalization of the other's interest, enjoyment, psychological needs satisfaction (autonomy, competence, challenge or curiosity during engagement of a requested activity.</p>	<p>The HEA talks about the importance of enjoyment related to PA.</p> <p>Participants are asked to reflect on three factors they think would increase their enjoyment related to PA.</p> <p>Participants are asked to share their reflections on enjoyment with co-workers and in plenary.</p> <p>Reflection task no 3: Participants are asked to reflect on personal preferences and enjoyment related to PA. They are offered a list of alternatives to help them reflect.</p> <p>After an individual written reflection, participants are asked to share and discuss this with a small group of co-workers.</p> <p>Not relevant.</p>

Provision of structure

<p>6 Help participants generate and set appropriate, realistic and achievable exercise goals.</p>	<p>The HEA explains the PA recommendations, and emphasizes the fact that for some this is easily achieved. For others this will be a long-term goal. Participants are encouraged to be realistic in their goalsetting.</p> <p>A pyramid model consisting of three levels, including recommended duration/repetitions, visualizes this issue: Bottom level: everyday activities Middle level: fitness training Top level: resistance training.</p>	<p>The participants are instructed to offer support for competence through sharing of experiential knowledge:</p> <ul style="list-style-type: none"> • What were my PA plans? • What did I actually achieve? • What worked well? • Were there any obstacles, and how did I handle them? • Do I want to make any changes? • What are my plans for the coming weeks?
<p>Reflection task no 5: Participants are asked to reflect on both their short-term and long-term PA goals. The short-term goals are related to what they think they can realistically achieve. The long-term goals are related to the effects and benefits they hope to obtain from regular PA.</p> <p><u>Weekly PA plan:</u> The booklet consists of 4 weekly PA plans. Participants are asked to fill in a plan, and to update their plan if necessary.</p>	<p>Reflection task no 5: Participants are asked to reflect on both their short-term and long-term PA goals. The short-term goals are related to what they think they can realistically achieve. The long-term goals are related to the effects and benefits they hope to obtain from regular PA.</p> <p><u>Weekly PA plan:</u> The booklet consists of 4 weekly PA plans. Participants are asked to fill in a plan, and to update their plan if necessary.</p>	<p>The participants are instructed to offer support for competence through sharing of experiential knowledge:</p> <ul style="list-style-type: none"> • What were my PA plans? • What did I actually achieve? • What worked well? • Were there any obstacles, and how did I handle them? • Do I want to make any changes? • What are my plans for the coming weeks?

<p>7 Present clear and neutral information about what to expect from exercising and what is needed to achieve the participant's own goal.</p>	<p>The HEA focuses on helping participants to set appropriate, realistic, and achievable goals in their response to comments and questions.</p> <p>The HEA presents information about the importance of cardiorespiratory fitness for health and well-being.</p> <p>The HEA explains the principles of high-intensity interval-training (HIT), and how these can be applied in a variety of PA contexts, taking advantage of naturally occurring possibilities (e.g., a hilly terrain).</p> <p>The HEA demonstrates how participants can assess whether they are physically active at a low, moderate or high level related to breathe, perspiration, and the ability to talk in short and long sentences.</p> <p>The HEA presents information about the health benefits of regular PA, and the PA levels recommended by the Norwegian Health authorities in a neutral manner.</p> <p>The HEA repeats several times that participants are not required to follow these recommendations. The choice is theirs.</p> <p>The HEA answers questions in a neutral manner, and asks for permission before offering advice when this is relevant.</p>	<p>The participants share and discuss their PA plans with co-workers, and decide whether they would like to alter their plans.</p> <p>The participants are instructed to offer support for competence through sharing of experiential knowledge.</p>
<p>8 Offer advice when appropriate but avoid imperatives.</p>	<p>All the text in the booklet is proofread to make sure that imperatives are not applied.</p>	<p>A summary of the information related to PA is included in the booklet for repetition:</p> <ul style="list-style-type: none"> • Benefits of regular PA • What is moderate PA • Recommended PA habits
<p>9 Ensure that the participants can receive regular positive feedback.</p>	<p>Weekly PA plan: Participants are asked to plan their PA sessions by means of a weekly plan. They can revise the plan during every meeting in order to adjust the plan to their experiences and reflections.</p> <p>The HEA invites participant to share their reflections and small group discussions related to task no 7 in plenary.</p> <p>The HEA offers emphatic comments and positive feedback on the participants' contributions.</p>	<p>Behavior no 4: The participants are instructed to support the need for autonomy by the use of open questions, and formulations such as "maybe you could.." or "what are your thoughts on...".</p> <p>Behavior no 5: The participants are instructed to support the need for competence by sharing their thoughts and feedback in a respectful manner.</p>

Reflection task no.7:
 During workshop II, participants are asked to reflect on:

- What they have learned so far?
- What they want to continue to do?
- What they want to change?

After an individual written reflection, participants are asked to share and discuss this with a small group of co-workers.

Reflection task no.7:
 During workshop II, participants are asked to reflect on:

- What they have learned so far?
- What they want to continue to do?
- What they want to change?

After an individual written reflection, participants are asked to share and discuss this with a small group of co-workers, and in plenary.

10 Affirm participants' efforts as well as their successes.

The HEA invites participants to share their experiences and honors their efforts.

Behavior no.6:
 The participants are instructed to support the need for competence by praising their efforts and what they have actually achieved.

Behavior no.1:
 They are instructed to avoid criticism of what the personal has achieved or the results they have obtained.

Interpersonal involvement

11 Demonstrating a genuine interest in participants and their well-being.

The HEA makes participants feel welcome by greeting everyone individually at the door upon arriving, and shaking their hand.

The HEA invites participants to share their thoughts and feelings in plenary, and when circulating during small group discussions.

The HEA offers emphatic comments and positive feedback on the participants' contributions.

Behavior no.1:
 The participants are instructed to support the need for relatedness by acting in a manner that makes the others feel comfortable and welcome.

They are instructed not to inflict a feeling of uncertainty, a negative climate, not greeting the others, or not taking the groups seriously.

<p>12 Explore and acknowledge the participants' concerns and worries in order to truly understand and respecting the difficulties they are facing.</p>	<p>The HEA talks about ambivalence or conflicting thoughts and feelings related to PA and lifestyle changes, and that these are normal reactions.</p> <p>The issue is visualized as a weighing scale. Both positive and negative reasons for doing PA are listed on each side of the weighing scale.</p> <p>The HEA acknowledges and actively invite participants to share both positive and negative reactions to the information they are given. Moreover, the HEA tries to answer questions in a neutral manner, and ask for permission before offering advice when this is relevant.</p> <p>The participants are invited to suggest topics they find especially relevant in order to help them change PA habits. Workshop II is developed based on these suggestions.</p> <p>The participants are invited to share their reflections/score on task no 6 with the HEA and the rest of the group in plenary. The HEA asks the participants who share:</p> <ul style="list-style-type: none"> • What made them choose this score, and not a lower score? • What would it take for them to choose a higher score? 	<p>Reflection task 4: Participants are asked to reflect on and write down three possible barriers to regular PA, and how they plan to handle these barriers.</p> <p>Reflection task no 6: As a conclusion at the end of workshop I, participant are asked to rate themselves on a scale from 1(not important at all) to 10 (very important):</p> <ul style="list-style-type: none"> • How important is it for you to change your PA habits? <p>Participants are asked to rate themselves on a scale from 1(not sure at all) to 10 (completely sure):</p> <ul style="list-style-type: none"> • How certain are you that you are able to make the PA changes you have decided? <p>The task is commonly called "The Ruler" (MI).</p> <p>After an individual written reflection, participants are asked to share and discuss this with a small group of co-workers, an in plenary.</p>	<p>Behavior no 2: The participants are instructed to support the need for relatedness by listening to what the person says and try to see the situation from the person's point of view.</p> <p>They are instructed to avoid interrupting and having a self-centered perspective on the situation.</p>
<p>13 Showing that significant others can be trusted to provide material and emotional support.</p>	<p>The HEA invites participants to comment and share their thoughts and feelings, listens and tries to see the situation from the participants' point of view.</p> <p>The participants are offered the opportunity to an individual talk with the HEA immediately</p>	<p>Nor relevant.</p>	<p>A combination of the following elements supports a trusting climate:</p> <ul style="list-style-type: none"> • The startup reflection task, facilitated by the researcher, regarding their expectations, aims and hopes for participating in the PA support groups.

after the workshops if there are subjects they are reluctant to discuss in plenary.

- Each group decides on 3 behavioral rules.
- The 6 behaviors that participants are instructed to exhibit.
- The confidentiality of a small group (4-5 participants).
- The structure where one participant is put in focus at the time (10-15 minutes per person).
- The researcher is present in case there are questions, comments, or the groups need help to understand and follow the structure.

14 Demonstrate understanding of the participants' position.

The HEA invites participants to comment and share their thoughts and feelings, listens and tries to see the situation from the participants' point of view.

Not relevant.

Participants are divided into small groups of 4-5 based on similar levels of PA habits and activities. This increases their ability to relate to each other, provide empathic support, and relevant experiential competence.

Workshop II content is developed based on input from participants related to the topics they feel most relevant at the present moment in the process (immediately after PA support group meeting no 2).

Behavior no 2:

The participants are instructed to support the need for relatedness by listening to what the person says and try to see the situation from the person's point of view.

They are instructed to avoid interrupting and having a self-centered perspective on the situation.

15 Avoid judgment and blame.

The HEA does not offer any judgement of the participants' questions and comments, even if they are critical or negative.

Not relevant.

Behavior no 6:
The participants are instructed to support the need for relatedness by acclaiming their efforts and what they have actually achieved.

The HEA offers emphatic comments and positive feedback on the participants' contributions.

They are instructed to avoid criticism of what the personal has achieved or the results they have obtained.

Notes: CRF = cardiorespiratory fitness. PA = physical activity. SDT = Self-determination theory. MI = Motivational interviewing.

Table A3 *The HEA underwent the following training:*

Time	Content	Duration
Training in the study protocol prior to piloting and implementation of workshops	<ul style="list-style-type: none"> • The theoretical background related to SDT and MI. • The intervention material related to their talks (power point presentation), and the booklet. • Instructions on how they should behave and respond during workshops in order to supports the participants' basic psychological need for autonomy, competence, and relatedness. • Training in how to facilitate individual reflection, group dialogue, and plenary discussions, and how to respond to participants in terms of PA advice and recommendations. • Use of the booklet as an instrument for self-reflection, self-regulation and planning. 	8 hours (two 4 hours sessions)
Piloting the workshops with an organizational team (not included in the study sample)	<ul style="list-style-type: none"> • Preparing for the pilots • Facilitating the pilots • Debriefing after pilots – discussing the participants' written and oral evaluations, their own implementation, and adjustments to the concept 	6 hours in total
Workshop I and II with the study samples	Debrief with discussions and review of participants evaluations after each workshop	1.5 hours (30 min / workshop)
Preparations to workshop II based on suggested topics from participants	Review of suggested topics, discussions related to need support, and development of content (talks) and reflection tasks	3 hours

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Supplementary material – Appendix B

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

Table B1

Means and standard deviations of baseline measures for total sample and by treatment group. Significant differences between the groups at baseline represented by t-values and confidence intervals.

Variables	Total (n = 197)	Intervention (n = 111)	Control (n = 86)	Mean difference (95% CI)
Gender (male)	154 (76.2%)	78 (70.3%)	75 (83.3%)	13% (0.00 to 0.24)
Age (years)	42.49 (11.65)	43.64 (11.02)	40.08 (12.30)	1.15 (-5.47 to 1.04)
CRF (mL·kg ⁻¹ ·min ⁻¹)	33.85 (10.45)	31.81 (8.44)	36.49 (12.22)	4.68 (1.72 to 7.64)
PA levels	3.80 (2.27)	3.67 (2.18)	3.97 (2.39)	0.30 (-0.35 to 0.95)
Waist circumference (cm)	95.69 (13.67)	96.58 (13.33)	94.55 (14.09)	2.03 (-5.95 to 1.90)
Non-HDL-C (mmol/L)	5.31 (2.36)	5.11 (2.37)	5.59 (2.32)	0.02 (-0.19 to 1.16)
HDL-C (mmol/L)	1.29 (0.39)	1.24 (0.40)	1.33 (0.38)	0.07 (-0.04 to 0.19)
Systolic BP (mmHg)	133.58 (14.84)	135.47 (16.15)	131.14 (12.62)	1.89 (-8.37 to -0.29)
Diastolic BP (mmHg)	82.83 (9.68)	84.26 (9.37)	80.99 (9.82)	1.43 (-6.00 to -0.54)
Need support PA	4.03 (1.34)	4.00 (1.31)	4.08 (1.38)	0.08 (-0.29 to 0.47)
Perceived competence PA	4.71 (1.52)	4.43 (1.51)	5.07 (1.47)	0.64 (0.21 to 1.06)
Autonomous motivation PA	3.47 (0.92)	3.33 (0.90)	3.66 (0.90)	0.14 (0.07 to 0.59)

Note: CRF = cardiorespiratory fitness. PA = physical activity. Non-HDL-C = non-high-density lipoproteins cholesterol. HDL-C = high-density lipoproteins cholesterol. BP = blood pressure.

Supplementary material – Appendix C

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

Table C1

Zero order analysis of variables in the Self-determination theory model of health behaviour change, Pearson's correlation coefficients between change scores ($T1 - T2$).

	1	2	3	4	5	6	7	8	9
1. CRF									
2. PA levels	.18*								
3. Waist circumference	-.20*	-.14*							
4. Non-HDL-C	-.05	-.28***	.08						
5. Systolic BP	-.15*	-.23**	.21**	.11					
6. Diastolic BP	-.19*	-.13	.19*	.00	.43***				
7. Needs support for PA (peers)	.20**	.05	.00	.08	.06	.04			
8. Perceived competence for PA	.07	.33***	-.12	-.05	-.08	-.05	.15*		
9. Autonomous motivation for PA	.24**	.30***	-.17*	.06	-.09	-.09	.45***	.28**	
10. Intervention	.23**	.03	.00	.01	-.02	-.13	.10	.23**	.22**

Notes: Change scores (standardized residuals) were estimated by regression of post-test (T2) measures onto baseline (T1) measures. CRF = cardiorespiratory fitness. PA = physical activity. Non-HDL-C = non-high-density lipoproteins cholesterol. HDL-C = high-density lipoproteins cholesterol. BP = blood pressure. P-values are: * $p < .05$. ** $p < .01$. *** $p < .001$ (two-tailed).

Supplementary material – Appendix D

Table D1
Tests of indirect paths emerging in Figure 2.

Independent variable (IV)	Mediator (M)	Dependent variable (DV)	Point estim.	SE	a*b-path Z	Bootstrapping BC 95% CI	
						Lower	Upper
1. Intervention	Needs support	Autonomous motivation X	0.039	0.030	1.300	-0.021	0.099
2. Intervention	Needs support	Perceived competence X	0.035	0.009	3.933***	0.017	0.053
3. Needs support	Perceived competence	Autonomous motivation X	0.079	0.025	3.151**	0.029	0.129
4. Needs support	Perceived competence	Exercise activity X	0.023	0.013	1.743*	-0.003	0.049
5. Needs support	Autonomous motivation	Exercise activity X	0.058	0.039	1.497	-0.020	0.136
6. Needs support	Autonomous motivation	Cardiorespiratory fitness X	0.047	0.029	1.596	-0.011	0.105
7. Autonomous motivation	Exercise level	Cardiorespiratory fitness X	0.032	0.016	1.999*	0.000	0.048
8. Autonomous motivation	Exercise level	Systolic blood pressure X	-0.072	0.023	-3.178***	-0.118	-0.026
9. Autonomous motivation	Exercise level	HDL cholesterol X	-0.064	0.031	-2.090*	-0.126	-0.002
10. Autonomous motivation	Cardiorespiratory fitness	HDL cholesterol X	0.042	0.009	4.399***	0.024	0.060
11. Autonomous motivation	Cardiorespiratory fitness	Waist X	-0.047	0.040	-1.999	-0.127	0.033
12. Autonomous motivation	Cardiorespiratory fitness	Diastolic blood pressure X	-0.048	0.029	-1.648*	-0.106	0.010
13. Autonomous motivation	Cardiorespiratory fitness	Systolic blood pressure X	-0.031	0.010	-3.000***	-0.051	-0.011
14. Perceived competence	Autonomous motivation	Exercise activity X	0.174	0.041	4.245***	0.092	0.256
15. Perceived competence	Exercise level	Cardiorespiratory fitness X	0.014	0.012	1.212	-0.010	0.038
16. Perceived competence	Exercise level	HDL cholesterol X	-0.028	0.022	-1.277	-0.072	0.016
17. Perceived competence	Exercise level	Systolic blood pressure X	-0.031	0.022	-1.419	-0.075	0.013

Note. a-path = IV → M; b-path = M → DV. * $p < .05$; ** $p < .01$; *** $p < .001$.

Supplementary material, Appendix E

CONSORT 2010 checklist

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

Section/Topic	Item No	Standard Checklist item	Extension for cluster designs	Page No *
Title and abstract				
	1a	Identification as a randomised trial in the title	Identification as a cluster randomised trial in the title	1
	1b	Structured summary of trial design, methods, results, and conclusions (for specific guidance see CONSORT for abstracts) ^{1,2}	See table 2	2
Introduction				
Background and objectives	2a	Scientific background and explanation of rationale	Rationale for using a cluster design	3-8
	2b	Specific objectives or hypotheses	Whether objectives pertain to the the cluster level, the individual participant level or both	7
Methods				
Trial design	3a	Description of trial design (such as parallel, factorial) including allocation ratio	Definition of cluster and description of how the design features apply to the clusters	8
	3b	Important changes to methods after trial commencement (such as eligibility criteria), with reasons		N/A
Participants	4a	Eligibility criteria for participants	Eligibility criteria for clusters	8
	4b	Settings and locations where the data were collected		8

Interventions	5	The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	Whether interventions pertain to the cluster level, the individual participant level or both	8-9 and supplemental material, Appendix A
Outcomes	6a	Completely defined pre-specified primary and secondary outcome measures, including how and when they were assessed	Whether outcome measures pertain to the cluster level, the individual participant level or both	10-11
	6b	Any changes to trial outcomes after the trial commenced, with reasons		N/A
Sample size	7a	How sample size was determined	Method of calculation, number of clusters(s) (and whether equal or unequal cluster sizes are assumed), cluster size, a coefficient of intracluster correlation (ICC or k), and an indication of its uncertainty	8
	7b	When applicable, explanation of any interim analyses and stopping guidelines		N/A
Randomisation:				
Sequence generation	8a	Method used to generate the random allocation sequence		8
	8b	Type of randomisation; details of any restriction (such as blocking and block size)	Details of stratification or matching if used	N/A
Allocation concealment mechanism	9	Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	Specification that allocation was based on clusters rather than individuals and whether allocation concealment (if any) was at the cluster level, the individual participant level or both	N/A
Implementation	10	Who generated the random allocation sequence, who	Replace by 10a, 10b and 10c	

		enrolled participants, and who assigned participants to interventions		
	10a		Who generated the random allocation sequence, who enrolled clusters, and who assigned clusters to interventions	8
	10b		Mechanism by which individual participants were included in clusters for the purposes of the trial (such as complete enumeration, random sampling)	8
	10c		From whom consent was sought (representatives of the cluster, or individual cluster members, or both), and whether consent was sought before or after randomisation	7
Blinding				
	11a	If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes) and how		N/A
	11b	If relevant, description of the similarity of interventions		N/A
Statistical methods				
	12a	Statistical methods used to compare groups for primary and secondary outcomes	How clustering was taken into account	11-13
	12b	Methods for additional analyses, such as subgroup analyses and adjusted analyses		11-13
Results				
Participant flow (a diagram is strongly recommended)	13a	For each group, the numbers of participants who were randomly assigned, received intended treatment, and were	For each group, the numbers of clusters that were randomly assigned, received intended	29

		analysed for the primary outcome	treatment, and were analysed for the primary outcome	
	13b	For each group, losses and exclusions after randomisation, together with reasons	For each group, losses and exclusions for both clusters and individual cluster members	29
Recruitment	14a	Dates defining the periods of recruitment and follow-up		Supplemental material, Appendix A
	14b	Why the trial ended or was stopped		N/A
Baseline data	15	A table showing baseline demographic and clinical characteristics for each group	Baseline characteristics for the individual and cluster levels as applicable for each group	Supplemental material, Appendix B
Numbers analysed	16	For each group, number of participants (denominator) included in each analysis and whether the analysis was by original assigned groups	For each group, number of clusters included in each analysis	29
Outcomes and estimation	17a	For each primary and secondary outcome, results for each group, and the estimated effect size and its precision (such as 95% confidence interval)	Results at the individual or cluster level as applicable and a coefficient of intracluster correlation (ICC or k) for each primary outcome	27-28
	17b	For binary outcomes, presentation of both absolute and relative effect sizes is recommended		N/A
Ancillary analyses	18	Results of any other analyses performed, including subgroup analyses and adjusted analyses, distinguishing pre-specified from exploratory		N/A
Harms	19	All important harms or unintended effects in each group (for specific guidance see CONSORT for harms ³)		N/A
Discussion				

Limitations	20	Trial limitations, addressing sources of potential bias, imprecision, and, if relevant, multiplicity of analyses	18-19
Generalisability	21	Generalisability (external validity, applicability) of the trial findings	Generalisability to clusters and/or individual participants (as relevant) 19-20
Interpretation	22	Interpretation consistent with results, balancing benefits and harms, and considering other relevant evidence	14-20
Other information			
Registration	23	Registration number and name of trial registry	3
Protocol	24	Where the full trial protocol can be accessed, if available	Available on request from researchers
Funding	25	Sources of funding and other support (such as supply of drugs), role of funders	7

* Note: page numbers optional depending on journal requirements

REFERENCES

- 1 Hopewell S, Clarke M, Moher D, Wager E, Middleton P, Altman DG, et al. CONSORT for reporting randomised trials in journal and conference abstracts. *Lancet* 2008, 371:281-283
- 2 Hopewell S, Clarke M, Moher D, Wager E, Middleton P, Altman DG at al (2008) CONSORT for reporting randomized controlled trials in journal and conference abstracts: explanation and elaboration. *PLoS Med* 5(1): e20
- 3 Ioannidis JP, Evans SJ, Gotzsche PC, O'Neill RT, Altman DG, Schulz K, Moher D. Better reporting of harms in randomized trials: an extension of the CONSORT statement. *Ann Intern Med* 2004; 141(10):781-788.

The TIDieR (Template for Intervention Description and Replication) Checklist:**

Information to include when describing an intervention and the location of the information

Item number	Item	Where located **	
		Primary paper (page or appendix number)	Other † (details)
1.	BRIEF NAME Provide the name or a phrase that describes the intervention.	1	_____ - _____
	WHY		
2.	Describe any rationale, theory, or goal of the elements essential to the intervention.	3 - 7	8 - 9
	WHAT		
3.	Materials: Describe any physical or informational materials used in the intervention, including those provided to participants or used in intervention delivery or in training of intervention providers. Provide information on where the materials can be accessed (e.g. online appendix, URL).	8 - 9	Appendix A
	PROCEDURES: Describe each of the procedures, activities, and/or processes used in the intervention, including any enabling or support activities.	8 - 9	Appendix A
5.	WHO PROVIDED For each category of intervention provider (e.g. psychologist, nursing assistant), describe their expertise, background and any specific training given.	9	Appendix A
	HOW		
6.	Describe the modes of delivery (e.g. face-to-face or by some other mechanism, such as internet or telephone) of the intervention and whether it was provided individually or in a group.	8 - 9	Appendix A
	WHERE		
7.	Describe the type(s) of location(s) where the intervention occurred, including any necessary infrastructure or relevant features.	9	Appendix A

WHEN and HOW MUCH	
<p>8. Describe the number of times the intervention was delivered and over what period of time including the number of sessions, their schedule, and their duration, intensity or dose.</p>	<p>__8-9__ + 29__ __Appendix A__</p>
<p>TAILORING</p> <p>9. If the intervention was planned to be personalised, titrated or adapted, then describe what, why, when, and how.</p>	<p>__N/A__</p>
<p>MODIFICATIONS</p> <p>10.* If the intervention was modified during the course of the study, describe the changes (what, why, when, and how).</p>	<p>__N/A__</p>
<p>HOW WELL</p> <p>11. Planned: If intervention adherence or fidelity was assessed, describe how and by whom, and if any strategies were used to maintain or improve fidelity, describe them.</p>	<p>Data published in paper 4</p>
<p>12.* Actual: If intervention adherence or fidelity was assessed, describe the extent to which the intervention was delivered as planned.</p>	<p>Data published in paper 4 Protocol at request Protocol at request</p>

** **Authors** - use N/A if an item is not applicable for the intervention being described. **Reviewers** – use ‘?’ if information about the element is not reported/not sufficiently reported.

† If the information is not provided in the primary paper, give details of where this information is available. This may include locations such as a published protocol or other published papers (provide citation details) or a website (provide the URL).

‡ If completing the TIDieR checklist for a protocol, these items are not relevant to the protocol and cannot be described until the study is complete.

* We strongly recommend using this checklist in conjunction with the TIDieR guide (see *BMJ* 2014;348:g1687) which contains an explanation and elaboration for each item.

* The focus of TIDieR is on reporting details of the intervention elements (and where relevant, comparison elements) of a study. Other elements and methodological features of studies are covered by other reporting statements and checklists and have not been duplicated as part of the TIDieR checklist. When a **randomised trial** is being reported, the TIDieR checklist should be used in conjunction with the CONSORT statement (see www.consort-statement.org) as an extension of **Item 5 of the CONSORT 2010 Statement**. When a **clinical trial protocol** is being reported, the TIDieR checklist should be used in conjunction with the SPIRIT statement as an extension of **Item 11 of the SPIRIT 2013 Statement** (see www.spirit-statement.org). For alternate study designs, TIDieR can be used in conjunction with the appropriate checklist for that study design (see www.equator-network.org).

TIDieR checklist

Paper II

Pedersen, C., Halvari, H., & Olafsen, A.H. (In press). Worksite physical activity intervention and somatic symptoms burden: The role of coworker support for basic psychological needs and autonomous motivation. *Journal of Occupational Health Psychology*, Doi:10.1037/ocp0000131. [Epub ahead of print].

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Paper III

Pedersen, C., Halvari, H., & Bentzen, M. (submitted and under review in *Psychology of Sport and Exercise*). Longitudinal trajectories of physical activity among employees participating in a worksite health promotion intervention: A latent class growth approach.

Longitudinal trajectories of physical activity among employees participating in a worksite
health promotion intervention: A latent class growth approach.

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ABSTRACT

Objectives: This study investigated different patterns of physical activity (PA) among employees during and after participating in a worksite health-promotion intervention over a period of one year. The study aimed to assess whether potential patterns were associated with perceived competence and motivational regulations for PA.

Design: A cluster randomized controlled trial with a delayed-intervention control group. The design of the group-based intervention was based on the tenets of Self-determination theory (SDT).

Method: The study consisted of employees ($N = 202$, M age = 42.5) working with manual labor in an (*Anonymized*) transport and logistics company. A person-centered approach was applied in order to explore if there were different latent trajectories within the sample related to PA. The data was analyzed with latent class growth analysis (LCGA) and the modified BCH method.

Results: The LCGA identified three PA trajectories: (1) employees high at baseline who declined significantly ($n = 16$), (2) employees who remained stable at a moderate level ($n = 55$), and (3) the majority of employees who reported low levels at baseline and increased significantly ($n = 128$). High levels of PA were associated with higher levels of perceived competence and autonomous forms of motivation for, which is in line with the tenets of SDT. Contrary to study hypothesis, controlled forms of motivation increased in all three trajectories after the intervention.

Conclusions: Different trajectories of PA were found, and the intervention was able to attract employees with low levels of PA.

Keywords: Worksite health promotion; physical activity; motivational regulations; LCGA.

Trial registration: “My exercise. A Team-based Workplace Intervention for Increased Exercise,” [clinicaltrials.gov](https://clinicaltrials.gov/ct2/show/study/NCT02429635), NCT02429635, April 14, 2015.

Introduction

Despite great media attention and increased public awareness, people struggle to be physically active at the level required to maintain their health and well-being, and reduce their risk of chronic diseases. A national survey among (*Anonymized*) adults revealed that only 35% reported being sufficiently physically active as recommended by the (*Anonymized*) health authorities (150 minutes of moderate physical activity [PA], or 75 minutes of high intensity PA, per week; Hansen et al., 2015). Participating in a health promotion program can provide the necessary structure and support to initiate changes. Composite interactive interventions that apply self-management and motivational enhancement approaches have demonstrated the most promising results in terms of effectiveness (Hutchinson & Wilson, 2011; Michie, Abraham, Whittington, McAteer, & Gupta, 2009). However, program participation is typically limited in time, particularly in non-treatment contexts. In order to produce changes in health and well-being of clinical relevance to the individual and to society in general, participants must be able to persist with lifestyle changes over a longer period of time – and on their own. Consequently, it is of importance that they develop a sense of competence and an autonomous motivation to persist with PA.

Over the last four decades, the field of health promotion research has called attention to the worksite context because programs here have the potential to reach a large number of people, usually before they develop health problems (Abraham & Graham-Rowe, 2009; Rongen, Robroek, van Lenthe, & Burdof, 2013). Employers are willing to invest financial resources in programs because they appreciate the potential benefits of increased PA for health and well-being, such as decreased sickness absence (Cancelliere, Cassidy, Ammendolia, & Côté, 2011) and improved work productivity (Pronk & Kottke, 2009). Moreover, the presence of natural and lasting social networks offers a source of social support that can be incorporated into programs, and may persist after the program has finished (Linnan, Fisher, & Hood, 2012).

Meta-analyses have demonstrated that worksite PA interventions can offer important albeit variable changes in health, well-being, and certain worksite outcome measures such as reduced job stress (Conn, Hafdahl, Cooper, Brown, & Lusk, 2009). However, a systematic review concluded that worksite programs had relatively low participation rates ($M = 33\%$, the majority below 50%), and males, blue-collar workers, and smokers were less likely to participate (Robroek, van Lenthe, van Empelen, & Burdorf, 2009). Studies have revealed that employees have mixed feelings towards worksite health-related PA programs. For example, Fletcher, Behrens, and Domina (2008) found that employees perceived social support and their own levels of PA self-regulation to be the most important enabling factors for participating in worksite PA programs. The most frequently reported barriers, apart from lack of time, were increased self-consciousness and a lack of belief in their own ability to perform PA. Rossing and Jones (2015) found that employees were sensitive to the possible loss of credibility and stigmatization from colleagues if they appeared less competent or fit during collective exercise sessions at work. We argue that in order to attract employees broadly, and particularly those who will benefit the most due to their low levels of PA and an unfavorable health risk profile, PA promotion programs must offer support in a manner that makes employees comfortable, and increases their competence, and self-regulation regarding PA.

The design of the present worksite PA intervention was based on the tenets of Self-determination theory (SDT; Deci & Ryan, 1985; 2000) in combination with elements from Motivational interviewing (MI; Markland, Ryan, Tolbin, & Rollnick, 2005; Miller & Rollnick, 2013). SDT is a theory of motivation that emphasizes the importance of the *quality* of motivation towards a specific behavior, or what people hope to obtain by doing the behavior. SDT presents a multidimensional approach to motivation, distinguishing between three types of motivational qualities: autonomous, controlled, and amotivation (Deci & Ryan, 2000). Autonomous motivation is characterized by a sense of choice and freedom from external

pressure. Here, people engage in a behavior because they find it inherently satisfying (intrinsic regulation) or because they identify with the behavior and find it personally meaningful (identified regulation). When motivation for a specific behavior is contingent on the presence of external factors, such as a reward or the expectations or demands of others, it is termed extrinsic regulation. Once the external control is partially assimilated, people will typically experience a sense of guilt or shame if they fail to perform the behavior in question. This is termed introjected regulation. Both extrinsic and introjected regulations are controlled forms of motivation, and are characterized by a low level of internalization (Deci & Ryan, 1985; 2000). Amotivation is characterized by a lack of motivation for a behavior, and hence a lack of intention to act (Markland & Tobin, 2004). According to SDT, these different forms of motivation are not mutually exclusive, and people can simultaneously endorse controlled and autonomous motives for a behavior (Deci & Ryan, 1985; 2000). However, review studies have demonstrated that autonomous motivation has a consistent and positive effect on outcome variables related to health and well-being (Ng et al., 2012). The SDT based health model of behavior change postulates that in order to make lifestyle changes, such as increased PA, people need to perceive themselves as sufficiently competent as well as motivated (Williams, Gagné, Ryan, & Deci, 2002). When people feel unfit, unskilled, inexperienced, or restricted by health limitations or lifestyle situations that they struggle to overcome, their sense of competence will be affected (Ryan, Williams, Patrick, & Deci, 2009).

A review of 53 PA studies demonstrated a consistent and rather strong association between autonomous forms of motivation for PA and prolonged PA (Teixeira, Carraça, Markland, Silva, & Ryan, 2012). However, the presence of a strong association between controlled forms of motivation and PA has not received consistent empirical support. The majority studies (57%) found no significant association, whereas the remainder (43%) reported a negative relation (Teixeira et al., 2012). The same was found for the association between

amotivation and PA. Teixeira and colleagues revealed that studies reporting negative associations between extrinsic regulation and PA considered regular exercisers, as opposed to non-exercisers. In line with SDT, regular exercisers have been found to report higher levels of autonomous motivation for PA compared to exercise initiates and non-exercisers (Thøgersen-Ntoumani & Ntoumanis, 2006). A study of four longitudinal datasets investigated the process of becoming a regular exerciser and how this is related to motivational regulation (Rodgers, Hall, Duncan, Pearson, & Milne, 2010). PA intervention program completers reported increases in intrinsic and identified regulation eight weeks after baseline. Despite a steady increase, autonomous motivation remained significantly lower among completers compared to regular exercisers six months after baseline. Changes in controlled motivation were non-significant during the study period.

To date, there are a limited number of SDT-based intervention studies that incorporate follow-up assessments of motivational regulation and PA several months or years after the intervention. Silva and colleagues found that autonomous motivation predicted an enhanced maintenance of behavioral change two years after the intervention (Silva et al., 2011). Sweet, Fortier, and Blanchard (2014) investigated the longitudinal effects of a PA intervention on sedentary patients by means of hierarchical linear modelling of growth trajectories. The study found a curvilinear trend for PA (increased at 13 weeks, and decreased post-intervention between 13 and 25 weeks). In line with the tenets of SDT, both intrinsic and identified regulation demonstrated a pattern of linear increase during the 25-week study period. However, the changes in extrinsic regulation followed the same curvilinear trend as PA. No fluctuation was found for introjected regulation, and the two controlled forms of motivation were not significantly related to changes in PA. We need more knowledge about the nuances of longitudinal fluctuations in PA and their relationships with motivational regulations,

particularly in the period after PA interventions when participants are expected to persist with their PA habits without the support of a program.

The majority of SDT-based PA intervention studies have been carried out in the context of health care, often incorporating patients in need of treatment, such as those who are overweight or obesity (Silva et al., 2011), have type 2 diabetes (Sweet, 2009), or require cardiac rehabilitation (Mildestvedt, Meland, & Eide, 2008). Fortier and colleagues recommend that future studies assess intervention effects on groups that are more diverse in terms of demographic characteristics, such as age and gender, motivational regulation, and physical characteristic related to health (Fortier, Duda, Guerin, & Teixeira, 2012). Two SDT-based PA interventions have been carried out in the worksite context, and they both reported increases in PA in addition to positive associations between adherence, autonomous motivation for PA, and increases in cardiorespiratory fitness (Thøgersen-Ntoumani, Loughren, Duda, Fox, & Kinnafick, 2010; Thøgersen-Ntoumani, Ntoumanis, Shepherd, Wagenmakers, & Shaw, 2016). Both studies incorporated university administrative personnel. This study is the first to include a sample of employees working with manual labor.

In the present study, we applied latent class growth analyses (LCGA) in order to examine long-term PA patterns among employees in the form of latent trajectories during and after participating in a worksite health-promotion program. LCGA is a modelling-based method that integrates variable- and person-centered analyses (Muthén & Muthén, 2000). A recent study applied person-centered analysis to the PA levels of senior citizens resident in assisted living facilities (Park et al., 2018). Three distinct profiles were found in relation to autonomous motivation and perceived support for PA. The profile characterized as “high in both” also reported significantly higher levels of PA and more favorable impressions of exercise facilities in their physical neighborhood. The study indicates that person-centered approaches are

suitable for detecting and analyzing differences in PA and their relationship to SDT based constructs, such as motivational regulations.

Study aim and research questions

First, we aimed to explore, over a period of one year, whether there were latent trajectories in the sample that were related to PA levels. Second, we aimed to explore whether the intervention was able to recruit employees with different levels of PA, particularly those with low levels. Third, we aimed to assess whether these potential patterns of PA differences were associated with the employees' perceived competence and motivation for PA at baseline and follow-up. The following hypotheses were tested:

- (1) Employees reporting higher levels of PA are expected to have higher levels of perceived competence for PA, and higher levels of autonomous motivation for PA (intrinsic and identified regulation) compared to those employees reporting lower levels of PA.
- (2) Employees reporting higher levels of PA are expected to have lower levels of controlled motivation (introjected and extrinsic regulation) and amotivation for PA compared to employees reporting lower levels of PA.
- (3) Changes in PA from baseline to follow-up are expected to be associated with changes in perceived competence and motivational regulation for PA, in line with hypotheses 1 and 2.

Method

Participants and procedures

The study sample consisted of employees participating in a worksite health promotion program designed to support them in increase their PA. They were employed in the logistics sector working as drivers, mail carriers, and terminal workers. Participants were recruited during team-based information meetings at six worksites. A total of $n = 320$ were defined as

eligible (working more than 20%), and $N = 202$ (68%) agreed to participate (written informed consent). The baseline and post-test assessments were in the form of health screenings that assessed their cardiorespiratory fitness, biomedical health markers (e.g., blood pressure, waist circumference, and cholesterol levels), and their lifestyle. A health practitioner presented them with the results (health status and risk factors), recommended lifestyle changes, and in some cases advised them to consult their physician for further testing and medical treatment. They received an individual, written report of their health profile. After baseline assessments in January, participants were randomized by means of six clusters (worksites) into an intervention condition ($n = 113$, 56%) and a control condition ($n = 89$, 44%). The former received a group-based intervention consisting of six sessions (two workshops and four exercise support-group meetings) and a booklet. The sessions were dialogue-based, and PA was expected to be self-organized, primarily during leisure time due to shift work and a lack of onsite exercise facilities.

The design of the intervention elements were based on a model that combined the tenets of SDT with techniques from MI, which had previously been applied in PA intervention studies (Fortier, 2012). The workshops were facilitated by two health and exercise advisors (physiotherapist) who were trained to provide the workshops in a manner that supported basic psychological needs according to study protocol. Pre-post intervention effects related to cardiorespiratory fitness, PA, cholesterol, blood pressure, and waist circumference have previously been published together with statistical power calculations and detailed intervention protocol descriptions (*Anonymized*).

Participants in the control condition were offered a delayed group-based intervention eight months after baseline. The delayed intervention consisted of standard group-based sessions offered by the worksite health promotion program. Both conditions were presented with a follow-up assessment 12 months after baseline, and a total of $n = 114$ (55%) agreed to participate, of these $n = 62$ (55%) were from the intervention condition and $n = 52$ (45%) were

from the control (delayed intervention) condition. A total of $n = 195$ participants completed the assessments at baseline, $n = 155$ completed at post-test, $n = 114$ completed at follow-up, and $n = 101$ (50%) completed all three assessments. The study was approved by the Data Protection Official for Research in (*Anonymized*).

Measures

Physical activity

PA was measured with the three-item questionnaire International Physical Activity Index (IPAI), which was previously applied and validated on a large sample in (*Anonymized*) (the HUNT study; Kurtze, Rangul, Hustvedt, & Flanders, 2008). The questionnaire assesses the frequency of PA during a regular week, in addition to the intensity and duration of a typical PA session. According to protocol, each item's score was multiplied with a weighing factor, and the three items were then multiplied to calculate a summary index (Kurtze et al., 2008).

Perceived competence for PA

Participants rated their sense of perceived competence regarding PA by means of the Perceived Competence in Exercise Scale (PCES; Williams & Deci, 1996). The questionnaire consists of four items (e.g., "I feel confident in my ability to exercise on a regular basis", Cronbach's $\alpha_{\text{time1}} = .90$; $\alpha_{\text{time3}} = .94$), and was answered on a seven-points Likert-scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*).

Motivational regulations for PA

The quality of motivational regulations was measured with the Behavioral Regulation in Exercise Questionnaire (BREQ-2; Markland and Tobin, 2004). The questionnaire consists of five subscales: intrinsic regulation for PA by four items (e.g., "I exercise because it's fun", $\alpha_{\text{time1}} = .86$; $\alpha_{\text{time3}} = .89$); identified regulation for PA by four items (e.g., "I value the benefits of exercise", $\alpha_{\text{time1}} = .76$; $\alpha_{\text{time3}} = .73$); introjected regulation for PA by three items (e.g., "I feel guilty when I don't exercise", $\alpha_{\text{time1}} = .64$; $\alpha_{\text{time3}} = .77$); extrinsic regulation for PA four items

(e.g., “I exercise because other people say I should”, $\alpha_{\text{time1}} = .80$; $\alpha_{\text{time3}} = .83$; and amotivation for PA by four items (“I don't see the point in exercising”, $\alpha_{\text{time1}} = .78$; $\alpha_{\text{time3}} = .80$).

Data analysis

Preliminary analyses were performed to identify possible patterns of missing data. Dropout rates were $n = 7$ (3.5%) at baseline, $n = 47$ (23%) at post-test (5 months), and $n = 88$ (44%) at follow-up (12 months). Little's test of missing completely at random (MCAR) indicated that the data were not missing completely at random ($\chi^2 = 1036$, $df = 917$, $p = .004$). One-way ANOVA, performed using IBM SPSS Statistics 21 (IBM Corp., Boston, Mass, USA), tested whether there were significant differences regarding the study variables between those participants who completed all three assessments and those who completed one or two. No significant differences were found, and data was assumed to be missing at random (MAR). We decided to include all $N = 202$ participants in the subsequent analyses applying *Mplus* version 8 (Muthén & Muthén, 1998-2012), and the missing data were handled by means of full information maximum likelihood estimation (FIML; Enders & Bandalos, 2001).

LCGA were conducted in *Mplus* on data collected at all three time-points to explore the different trajectories. Mixture modelling techniques, such as LCGA, offer the possibility to “model unobserved heterogeneity in a population by identifying different latent classes of individuals based on their observed response pattern” (Clark & Muthén, 2009, p. 3).

A stepwise model comparison approach was conducted to compare a one-class model to models with successively more classes (Nylund, Asparouhov, & Muthén, 2007). According to recommendations, a combination of goodness of fit indices (GOF) should be considered together with class sizes (> 5%), theoretical justification, and interpretability in order to decide on the appropriate model (Jung & Wickrama, 2008). These following GOF indices were considered: the smallest Bayesian information criteria (BIC) and Akaike's information criterion (AIC) to assess model fit, the highest possible entropy to assess precision/quality of

classification, and a significant p-value on the bootstrap likelihood ratio test (BLRT) and the Lo-Mendell-Rubin adjusted likelihood ratio test (L-M-R). The latter tests indicate whether the $k-1$ class model is rejected in favor of the k class model (Jung & Wickrama, 2008; Nylund et al., 2007). Because PA was measured with a summary index, a manifest variable was applied as a continuous indicator of a latent class variable.

Next, we conducted a series of analyses to explore whether there were significant differences in the mean levels of distal outcome variables related to perceived competence and motivational regulations for PA between the classes. First, confirmatory factor analysis (CFA) was conducted to evaluate the scale factor structure. The following model fit indices were assessed: the comparative fit index (CFI) ≥ 0.90 , the Tucker-Lewis index (TLI) ≥ 0.90 , the standardized root mean square residual (SRMR) ≤ 0.08 , and the root mean square error of approximation (RMSEA) ≤ 0.06 (Brown, 2006).

All distal outcome variables demonstrated an acceptable fit to the data (Appendix A, Table A1). Perceived competence for PA was the only variable with an RMSEA value above the recommended level of 0.08. We then applied the three-step BCH approach in *Mplus*, which offers an omnibus test that includes differences between the three classes on each distal outcome variable (Bolck, Croon, & Hagenaars, 2004). According to a comparative analysis of different approaches, the findings indicated that BCH was the most robust and flexible approach, yielding the least biased estimates (Bakk & Vermunt, 2016).

In order to test whether the patterns of change in PA found in the three trajectories coincided with changes in perceived competence and motivational regulation from baseline to follow-up, we applied a Pearson's chi-square (X^2) test of nominal variables (Greenwood & Nikulin, 1996). We calculated the changes in X^2 values (delta) representing the strength of differences between trajectories from baseline to follow-up. Delta X^2 values were assessed for significance (95% CI, $df = 1$) by applying the X^2 distribution table.

Results

The stepwise comparisons of the LCGA favored a solution with three classes (Table 1). The entropy values of .96 indicated that both a three-class and a four-class model were able to accurately place subjects into classes. Both the AIC and the BIC decreased consistently for one-class to four-class models. However, the four-class model did not obtain a significant p-value on the L-M-R test, favoring the three-class model. In addition, the four-class model contained a class with a sample size of 4.2%, which is less than the recommended level of 5% (Jung & Wickrama, 2008). The identified classes represented three distinctly different and meaningful course trajectories (Figure 1):

- (1) Trajectory 1 (prevalence: $n = 16$, 8% of the total sample) is labelled “Decrease from high”, and refers to subjects with the highest levels of PA and with scores significantly decreasing over a period of one year (intercept: $M = 8.269$, $SE = 0.294$, $p < .001$; slope: $M = -1.433$, $SE = 0.579$, $p = 0.013$).
- (2) Trajectory 2 (prevalence: $n = 55$, 27.5% of the total sample) is labelled “Stable moderate”, and refers to subjects with moderate levels of PA and no significant change over a period of one year (intercept: $M = 4.288$, $SE = 0.115$, $p < .001$; slope: $M = 0.090$, $SE = 0.227$, $p < 0.691$).
- (3) Trajectory 3 (prevalence: $n = 128$, 64.5% of the total sample) is labelled “Increase from low”, and refers to subjects with the lowest levels of PA and with scores significantly increasing over a period of one year (intercept: $M = 0.700$, $SE = 0.070$, $p < .001$; slope: $M = 0.882$, $SE = 0.126$, $p < 0.001$).

Characteristics of the trajectories

Sociodemographic and intervention variables

We controlled for the onset of the intervention period (between baseline and post-test: primary intervention group; between post-test and follow-up: delayed intervention group). The

differences were non-significant between trajectories (1) “Decrease from high” and (2) “Stable moderate” ($X^2=0.03, p = .859$), between trajectories (1) “Decrease from high” and (3) “Increase from low” ($X^2= 0.76, p = .385$), and between trajectories 2 and 3 ($X^2= 2.97, p = .085$). We proceeded to test whether sociodemographic variables differed according to class membership. There were no significant differences between the trajectories (1) “Decrease from high” and (2) “Stable moderate” related to age ($X^2= 1.53, p = .215$), gender ($X^2= 1.82, p = .178$), or level of education ($X^2= 0.04, p = .850$). The same was found for the difference between (1) “Decrease from high” and (3) “Increase from low”: related to age ($X^2= 2.36, p = .124$), gender ($X^2= 1.45, p = .228$), and level of education ($X^2= 0.43, p = .512$). The difference between (2) “Stable moderate” and (3) “Increase from low” demonstrated the same pattern: related to age ($X^2= 0.08, p = .775$), gender ($X^2= 0.15, p = .695$), and level of education ($X^2= 0.30, p = .581$).

The trajectories demonstrated a linear pattern of PA across three time-points. Hence, distal outcome variables were analyzed at baseline (T1) and at follow-up 12 months after baseline (T3). Several sets of analyses, which applied the BCH method, were carried out in order to assess whether the distal outcome variables (perceived competence for PA and motivations for PA) differed across the three trajectories (Table 2).

Distal outcome variables at baseline

At baseline, five of the six omnibus tests were significant ($p < .05$), with the exception of extrinsic regulation for PA. Employees in trajectory (3) “Increase from low” were significantly lower in perceived competence for PA compared to employees in trajectory (1) “Decrease from high” and (2) “Stable moderate”, and Cohen's d effect sizes (ES) were very large (1.20 - 1.57). Moreover, employees in trajectory (3) “Increase from low” reported significantly lower levels of autonomous motivation compared to the other two, and the ES were large to very large (intrinsic: 1.13 - 1.37; identified: 0.98-1.05; Sawilowsky, 2009). Regarding the more controlled forms of motivation, the differences were not as consistent.

Employees in trajectory (3) “Increase from low” demonstrated significantly lower levels of introjected motivation, and ES were moderate (0.46 - 0.51). However, there were no significant differences between the trajectories related to extrinsic regulation. Employees in trajectory (3) “Increase from low” were considerably higher on amotivation compared to the two others, and ES were large (0.80 - 0.89). None of the distal outcome variables demonstrated a significant difference between trajectory (1) “Decrease from high” and trajectory (2) “Stable moderate”, and ES were small to very small (0.01 - 0.22).

Distal outcome variables at follow-up

At follow-up, the pattern of significant differences between trajectories related to autonomous motivation for PA remained the same. Employees in trajectory (3) “Increase from low” reported considerably higher levels of autonomous motivation, and ES were moderate compared to baseline (intrinsic: 0.46 - 0.74; identified regulation: 0.65 - 0.71). The same pattern was found for perceived competence for PA, but ES were still moderate to large (0.49 - 0.87). Considering introjected regulation, the difference between trajectories (1) “Decrease from high” and (3) “Increase from low” was no longer significant. All the differences between trajectories that were related to extrinsic regulation were still non-significant. At follow-up, employees in trajectory (3) “Increase from low” reported lower levels of amotivation for PA compared to baseline. The difference between trajectories (1) “Decrease from high” and (3) “Increase from low” was no longer significant, and ES were small (0.25 - 0.37). Differences between employees in trajectories (1) “Decrease from high” and (2) “Stable moderate” remained non-significant on all distal outcome variables, and ES were very small to small (0.01 - 0.44).

Differences in changes on distal outcomes between trajectories from baseline to follow-up

There were no significant changes in the differences between trajectories (1) “Decrease from high” and (2) “Stable moderate” on any of the distal outcome variables (Table 3). The

same was found for introjected and extrinsic regulation comparing all three trajectories. However, the significant X^2 delta values between trajectory (3) “Increase from low” and the two other trajectories indicated that trajectory 3 had approached the two others in regard to perceived competence and autonomous motivation for PA.

Discussion

First, we aimed to explore whether the program was able to recruit employees with different levels of PA, particularly low levels. The large majority of employees who decided to participate in the worksite PA intervention, (3) “Increase from low”, reported low levels of PA at baseline: one third of participants would be characterized as inactive according to the measurement protocol (Kurtze et al., 2008). Combined with a relatively large participation rate, this indicated that the intervention was able to initially attract a relatively large number of employees with low levels of PA. In addition, the sample consisted of so-called blue-collar workers (predominately male) who were previously found to be less likely to attend worksite health promotion programs (Robroek et al., 2009). Moreover, the findings indicate that the program was able to recruit a diverse sample, including a number of employees with moderate levels of PA, as represented by (2) “Stable moderate”. However, we question whether the intervention appealed to employees who were already highly active, as represented by (1) “Decrease from high”. This group could possibly have been underrepresented in the present context of eligible employees. However, this population of highly active employees was not the primary target of the program.

The participation rate (68%) was considerably higher than mean values previously reported for worksite intervention programs (33%; Robroek et al., 2009). This could indicate that employees felt obligated to take part, possibly because the whole team was invited. If this was the case, we would expect the participants to exhibit relatively high levels of controlled motivation and amotivation for PA at baseline, particularly among employees in (3) “Increase

from low”, in line with the tenets of SDT. However, all three trajectories reported low levels of amotivation and extrinsic regulation at baseline, although (3) “Increase from low” did exhibit somewhat higher levels of extrinsic regulation compared to the rest. Their initial level of introjected regulation was more apparent: the participants reported moderate levels, particularly employees in trajectories (1) “Decrease from high” and (2) “Stable moderate”. These findings indicate that participants were sensitive to and partially recognized the importance of taking part in the program and making lifestyle changes. Employees in (1) “Decrease from high” and (2) “Stable moderate” reported relatively high levels of autonomous motivation for PA, particularly intrinsic regulation. This could possibly counteract their moderate levels of introjected regulation, reflecting a wish to participate in the program for their own reasons. The fact that they were not expected to participate in collective PA sessions during the intervention could have made them more comfortable since they may have felt less exposed to social comparison and loss of credibility from co-workers (Rossing & Jones, 2015).

Employees in (3) “Increase from low” initially reported considerably lower levels of PA, compared to the other employees. However, their baseline levels of perceived competence for PA would be characterized as moderate. According to Standage and Ryan (2012, p.263) “feelings of competence are essential for any intentional behavior, irrespective of whether the action is motivated by extrinsic, introjected, identified, integrated, or intrinsic regulations”. The finding indicates that the present intervention was unable to attract employees who felt inexperienced, incompetent, or unable to exercise on a regular basis. Employees in (3) “Increase from low” also reported moderate levels of autonomous motivation, albeit significantly lower than the rest. These findings are in line with other SDT-based PA promotion intervention studies in the context of health care, which mainly attracted participants with elevated levels of autonomous motivation (Fortier et al., 2012).

Second, we aimed to examine whether and how participating in the program influenced the participants' levels of PA over a period of one year. The changes in PA demonstrated a linear but heterogeneous development among employees. Overall, the sample reported a significant increase. The large majority, represented by (3) "Increase from low", reported significantly higher levels of PA at baseline and follow-up. The three trajectories were compared to a large and representative sample of the male Norwegian population (the HUNT study; Kurtze et al., 2008). At baseline, 36.6% of the study sample reported PA levels equal to or higher than the HUNT mean value ($M = 2.66$, $SD = 2.83$; Kurtze et al., 2008). One year later, the percentage had increased to 52.2%. Despite the considerable PA increases, employees in (3) "Increase form low" remained somewhat below the HUNT study sample at follow-up ($M = 2.50$, $SD = 2.63$).

Third, the study aimed to test whether the associations between perceived competence, motivational regulation, and PA were in line with the tenets of SDT. Employees in trajectory (3) "Increase form low" exhibited a motivational profile and development comparable to exercise initiates previously found in a study comparing exercise initiates to regular exercisers (Rodgers et al., 2010). Both samples reported moderate levels of intrinsic and identified regulation at baseline. A review of worksite health promotion programs reported that positive effects were mainly found in samples of motivated employees who volunteered to participate (Marshall, 2004).

Employees in (1) "Decrease from high" reported significantly lower levels of PA at follow-up compared to baseline. We find it somewhat surprising that their levels of perceived competence and autonomous motivation for PA remained relatively high and consistent throughout the whole period of one year. The results indicate that employees high on perceived competence and autonomous motivation for PA seem less vulnerable to fluctuations in PA and

remain self-endorsed and confident that they are able to be physically active on a regular basis. This is in line with the findings of Sweet et al. (2014).

Given their moderate levels of PA at follow-up, it is not surprising that employees in the sample reported very low levels of amotivation at all three time-points. However, they reported considerably higher levels of controlled motivation at follow-up compared to baseline, particularly extrinsic regulation. Employees in (2) “Stable moderate” and (3) “Increase from low” demonstrated the same pattern with regard to extrinsic regulation. Given their diverse development in PA over a period of one year, the findings did not support hypothesis 3, which was related specifically to controlled forms of motivation. Furthermore, the findings are not in line with other PA intervention studies in the health care context which found non-significant changes in controlled forms of motivation (Rodgers et al., 2010; Sweet et al., 2014). We question whether participating in the program could actually have enhanced their controlled motivation for PA, even though their autonomous motivation remained relatively strong. The health screening results and recommendations together with the information, discussions and response they received during the intervention sessions could possibly have increased their awareness of the opinions and expectations of important others in their environment (e.g., family, co-workers, health practitioners, and health and exercise advisors). Participating in the program is likely to make them more sensitive to the fact that their employer invested time and money on the program in order to obtain organizational benefits, such as reduced sickness absence and increased work productivity. Although the intervention was designed to support basic psychological needs and thereby increase autonomous motivation, it appears that aspects of the context were perceived as controlling. This is not surprising given the element of professionalism and mutual dependency between employer and employee. We argue that this is a challenge inherent in the worksite context, particularly at follow-up after the intervention

period. This must be taken into consideration when designing worksite health promotion programs.

Limitations and future direction

The present study has methodological limitations. First, the moderate sample size did not provide sufficient statistical power to explore the intricate relationships between study variables including all distal outcome variables in the structural model (Andruff, Carraro, Thompson, & Gaudreau, 2009). The analyses applied were limited to exploring the associations between trajectories and each distal outcome variable separately. Second, the dropout rates were considerable, particularly at follow-up, and data were not missing completely at random. Information not included in the study, such as general health condition or reasons given for not attending, may have provided a better understanding of what caused employees to drop out and what characterized those who were able or willing to participate at all three time-points. The present study also has limitations related to study design. We question whether the recruitment process could have been altered to better attend to the needs of employees with low levels of perceived competence and autonomous motivation for PA. For example, the information meetings, during which participants were recruited, could have been more dialogue-based, inviting participants to express their doubts and ambivalence more explicitly. Participants and co-workers may perceive such dialogue as being supportive of basic psychological needs, and it may encourage them to reflect on their motivation toward PA before a decision to participate is made (Markland et al., 2005).

Conclusions

To our knowledge, this is the first study to apply LCGA to the investigations of the associations between longitudinal developmental trajectories of PA and SDT-based concepts of motivational regulation and perceived competence for PA using data from a PA intervention in the worksite context. The findings indicate that LCGA is a useful approach for detecting

longitudinal trajectories in heterogeneous samples of both exercise initiates and regular exercisers. The present findings emphasize the effectiveness of the SDT-based intervention design and the generalizability of the results to non-treatment populations.

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Table 1.

Fit indices for latent class growth models of physical activity.

No. of trajectories	No. of free par.	AIC	BIC	BLRT (<i>p</i>)	L-M-R (<i>p</i>)	Entropy	Latent class size (<i>n</i>)
1	6	2.164.125	2.183.885				
2	9	2.121.621	2.151.261	.000	.037	0.82	41/158
3	12	2.055.234	2.094.753	.000	.004	0.96	16/55/128
4	15	2.026.775	2.076.175	.000	.225	0.96	4/16/51/128

Note. *N* = 199. AIC = Akaike's information criterion, BIC = Bayesian information criterion, BLRT = bootstrap likelihood ratio test, L-M-R = Lo-Mendell-Rubin adjusted likelihood ratio test.

Table 2.

Distal outcome variables at baseline and follow-up

Distal outcome variables	Trajectory 1 n = 16 M/SD	Trajectory 2 n = 55 M/SD	Trajectory 3 n = 128 M/SD	Global χ^2 / p-value	1vs2 χ^2 / p-value	1vs2 Cohen's d ES	1 vs 3 χ^2 / p-value	1 vs 3 Cohen's d ES	2 vs 3 χ^2 / p-value	2 vs 3 Cohen's d ES
T1 Perceived competence	6.00 (0.92)	5.64 (1.11)	4.08 (1.47)	83.69***	1.73/.189	0.35	52.37/.000	1.57	58.79/.000	1.20
T1 Intrinsic motivation	3.28 (0.48)	3.20 (0.74)	2.19 (1.02)	81.13***	0.25/.620	0.01	54.61/.000	1.37	58.53/.000	1.13
T1 Identified motivation	2.83 (0.76)	2.84 (0.67)	2.01 (0.90)	48.90***	0.00/.962	0.01	15.02/.000	0.98	43.69/.000	1.05
T1 Introjected motivation	2.03 (0.72)	2.01 (0.82)	1.61 (0.90)	10.43**	0.01/.907	0.03	4.72/.000	0.51	8.19/.004	0.46
T1 Extrinsic motivation	0.42 (0.48)	0.55 (0.67)	0.64 (0.90)	2.38	0.65/.421	0.22	2.31/.128	0.30	0.63/.427	0.11
T1 Amotivation	0.11 (0.20)	0.14 (0.37)	0.69 (0.90)	44.45***	0.12/.725	0.10	38.78/.000	0.89	35.87/.000	0.80
T3 Perceived competence	5.98 (1.04)	5.40 (1.56)	4.45 (2.26)	22.85***	2.94/.086	0.44	21.07/.000	0.87	10.30/.001	0.49
T3 Intrinsic motivation	3.22 (0.52)	3.03 (1.11)	2.46 (1.36)	19.79***	0.93/.335	0.22	18.47/.000	0.74	8.33/.004	0.46
T3 Identified motivation	2.82 (0.84)	2.92 (0.96)	2.18 (1.12)	22.24***	0.14/.704	0.11	7.94/.005	0.65	19.30/.000	0.71
T3 Introjected motivation	2.37 (0.72)	2.38 (1.04)	1.96 (1.36)	6.17*	0.00/.972	0.01	3.54/.060	0.38	4.78/.029	0.35
T3 Extrinsic motivation	1.46 (0.40)	1.49 (0.96)	1.36 (0.90)	0.98	0.04/.836	0.04	0.58/.447	0.14	0.73/.394	0.14
T3 Amotivation	0.27 (0.48)	0.17 (0.52)	0.47 (1.02)	6.40*	0.54/.461	0.20	1.63/.202	0.25	6.39/.011	0.37

Notes: p-value * < .05, ** < .01, *** < .001. Cohen's d effect size (ES): 0.01-0.19 (very small), 0.20-0.49 (small), 0.50-0.79 (moderate), 0.80-1.19 (large), 1.20-1.99 (very large), and 2.00 (huge). T1 = baseline. T3 = follow-up.

Table 3.

Comparing class means from baseline to follow-up

Distal outcome variables	Time-point	Trajectory 1	Trajectory 2	Trajectory 3	Trajectories 1 vs 2 ΔX^2 change	Trajectories 1 vs 3 ΔX^2 change	Trajectories 2 vs 3 ΔX^2 change
Perceived competence	T1	6.00 (0.92)	5.64 (1.11)	4.08 (1.47)	-1.21	31.30***	48.49***
	T3	5.98 (1.04) ↓	5.40 (1.56) ↓	4.45 (2.26) ↑			
Intrinsic motivation	T1	4.28 (0.48)	4.20 (0.74)	3.19 (1.02)	-0.68	36.14***	50.20***
	T3	4.22 (0.52) ↓	4.03 (1.11) ↓	3.46 (1.36) ↑			
Identified motivation	T1	3.83 (0.76)	3.84 (0.67)	3.01 (0.90)	-0.14	7.08**	24.39***
	T3	3.82 (0.84) ↓	3.92 (0.96) ↑	3.18 (1.12) ↑			
Introjected motivation	T1	3.03 (0.72)	3.01 (0.82)	2.61 (0.90)	0.01	1.18	3.41
	T3	3.37 (0.72) ↑	3.38 (1.04) ↑	2.96 (1.36) ↑			
Extrinsic motivation	T1	1.42 (0.48)	1.55 (0.67)	1.64 (0.90)	0.61	1.73	-0.10
	T3	2.46 (0.40) ↑	2.49 (0.96) ↑	2.36 (0.90) ↑			
Amotivation	T1	1.11 (0.20)	1.14 (0.37)	1.69 (0.90)	-0.42	37.15***	24.48***
	T3	1.27 (0.48) ↑	1.17 (0.52) ↑	1.47 (1.02) ↓			

Notes: *p*-value * < .05, ** < .01, *** < .001. ΔX^2 change = change in chi-square from baseline to follow-up. T1 = baseline. T3 = follow-up.

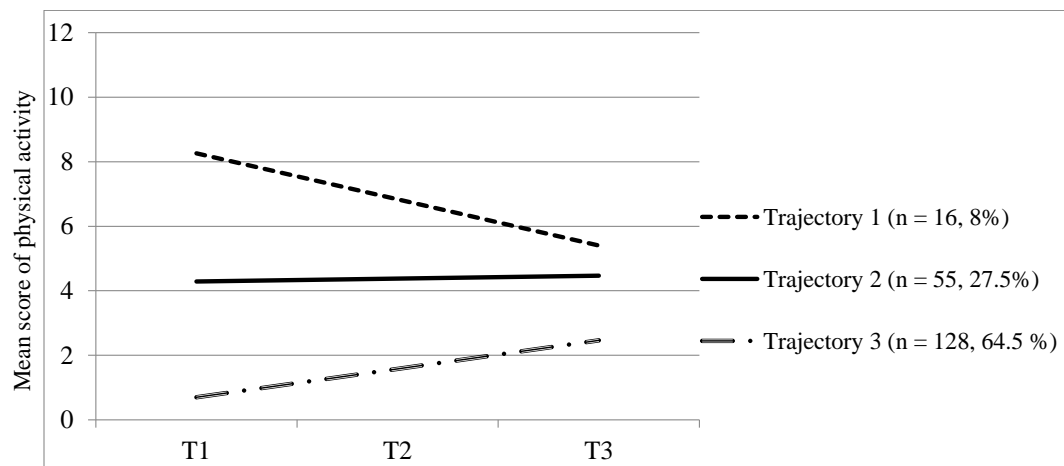


Figure 1. The three trajectories related to physical activity at baseline (T1), post-test (T2), and follow-up (T3).

Supplementary material, Appendix A

Table A1.

Confirmatory factor analyses of distal outcome variables at baseline and follow-up

Covariate	$\chi^2/df/p$	RMSEA	CFI	TLI	SRMR
T1 Perceived competence for PA	2.722/2/.256	.043 (.000 - .155)	1.00	.99	.013
T1 Intrinsic motivation for PA	0.003/1/.957	.000 (.000 - .000)	1.00	1.02	.000
T1 Identified motivation for PA	2.712/2/.258	.043 (.000 - .155)	0.99	0.98	.018
T1 Introjected regulation for PA*	0.00/0/.000	.000 (.000 - .000)	1.00	1.00	.000
T1 Extrinsic regulation for PA	3.699/2/.157	.066 (.000 - .171)	0.99	0.97	.021
T1 Amotivation for PA	3.092/2/.213	.053 (.000 - .161)	0.99	0.97	.026
T3 Perceived competence for PA	3.672/2/.159	.086 (.000 - .223)	0.99	0.97	.012
T3 Intrinsic motivation for PA	0.013/1/.909	.000 (.000 - .103)	1.00	1.04	.002
T3 Identified motivation for PA	1.880/2/.391	.000 (.000 - .183)	1.00	1.00	.012
T3 Introjected regulation for PA*	0.00/0/.000	.000 (.000 - .000)	1.00	1.00	.000
T3 Extrinsic regulation for PA	0.380/1/.538	.000 (.000 - .212)	1.00	1.05	.012
T3 Amotivation for PA	1.267/2/.531	.000 (.000 - .164)	1.00	1.05	.029

Notes: PA = physical activity. T1 = baseline assessments. T3 = follow-up assessments. * Introjected regulation for PA consists of only three items, and a proper test of model fit is not possible (factor loadings: 0.475, 0.638, and 0.729).

Appendix I

Approval letter from the Norwegian Centre for Research Data (NSD)

Letter from the Regional Committee for Medical and Health Research Ethics (REK)

Norsk samfunnsvitenskapelig datatjeneste AS

NORWEGIAN SOCIAL SCIENCE DATA SERVICES



Harald Hårfagres gate 2
N-5007 Bergen
Norway
Tel: +47-55 58 21 17
Fax: +47-55 58 96 50
nsd@nsd.uib.no
www.nsd.uib.no
Org.nr. 985 321 884

Cathrine Pedersen
Seksjon for coaching og psykologi
Norges idrettshøgskole
Postboks 4014 Ullevål Stadion
0806 OSLO

Vår dato: 23.12.2014

Vår ref:41035 / 3 / MSS

Deres dato:

Deres ref:

TILBAKEMELDING PÅ MELDING OM BEHANDLING AV PERSONOPPLYSNINGER

Vi viser til melding om behandling av personopplysninger, mottatt 05.12.2014. Meldingen gjelder prosjektet:

41035
Behandlingsansvarlig
Daglig ansvarlig

*Min trening – en intervensjonsstudie på arbeidsplassen
Norges idrettshøgskole, ved institusjonens øverste leder
Cathrine Pedersen*

Personvernombudet har vurdert prosjektet, og finner at behandlingen av personopplysninger vil være regulert av § 7-27 i personopplysningsforskriften. Personvernombudet tilrår at prosjektet gjennomføres.

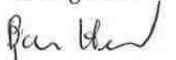
Personvernombudets tilråding forutsetter at prosjektet gjennomføres i tråd med opplysningene gitt i meldeskjemaet, korrespondanse med ombudet, ombudets kommentarer samt personopplysningsloven og helseregisterloven med forskrifter. Behandlingen av personopplysninger kan settes i gang.

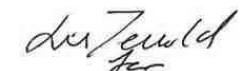
Det gjøres oppmerksom på at det skal gis ny melding dersom behandlingen endres i forhold til de opplysninger som ligger til grunn for personvernombudets vurdering. Endringsmeldinger gis via et eget skjema, <http://www.nsd.uib.no/personvern/meldeplikt/skjema.html>. Det skal også gis melding etter tre år dersom prosjektet fortsatt pågår. Meldinger skal skje skriftlig til ombudet.

Personvernombudet har lagt ut opplysninger om prosjektet i en offentlig database, <http://pvo.nsd.no/prosjekt>.

Personvernombudet vil ved prosjektets avslutning, 01.11.2017, rette en henvendelse angående status for behandlingen av personopplysninger.

Vennlig hilsen


Bjørn Henrichsen


Marie Strand Schildmann

Kontaktperson: Marie Strand Schildmann tlf: 55 58 31 52

Vedlegg: Prosjektvurdering

Avdelingskontorer / District Offices

OSLO: NSD, Universitetet i Oslo, Postboks 1055 Blindern, 0316 Oslo. Tel: +47-22 85 52 11 nsd@uio.no
TRONDHEIM: NSD, Norges teknisk-naturvitenskapelige universitet, 7491 Trondheim. Tel: +47-73 59 19 07 kyrie.svarva@svt.ntnu.no
TROMSØ: NSD, SVF, Universitetet i Tromsø, 9037 Tromsø. Tel: +47-77 64 43 36 nsdmaa@svt.uil.no

Personvernombudet for forskning



Prosjektvurdering - Kommentar

Prosjektnr: 41035

FORMÅL

Prosjektet er meldt inn av Norges Idrettshøgskole (NIH) som en forskningsdel i Postens helsefremmende program. Hensikten med forskningsprosjektet og postens helsefremmende program er å hjelpe deltakerne til å gjøre livsstilsendringer. Posten har inngått et samarbeid med NIH for å forske på hvilke effekter et slikt program kan ha.

Det helsefremmende programmet fokuserer på livsstil generelt, mens forskningsprosjektet vil spisse seg inn mot fysisk aktivitet og trening. Forskningsprosjektet vil undersøke om deltakelse på programmet påvirker jobbfungering og holdninger til arbeidsgiver.

REKRUTTERING

Alle ansatte i Posten/Bring (ansatte i drift: postbud, terminalarbeidere og sjåfører) inviteres til å delta i programmet og forskningsprosjektet. Man kan velge å delta i programmet uten å samtykke til deltakelse i forskningsprosjektet. Informasjon og forespørsel om deltakelse formidles til ansatte i forbindelse med et informasjonsmøte. Dette er organisert via HR-seksjon og linjeledere.

INFORMASJON

Informasjonsskrivet vedrørende deltakelse i forskningsprosjektet er godt utformet. Det er avtalt med forsker at det legges til en setning i beskrivelsen av den individuelle screeningen, at rådata overføres på sikker måte til forsker, samt at selve rapporten vil omfatte mer enn forsker får tilgang til.

DATAINNSAMLING

Deltakerne i forskningsprosjektet deles inn i team som skal samarbeide gjennom hele prosessen. Det skal gjennomføres en helsescreening på to tidspunkt. Halvparten av teamene gjennomfører tiltak etter første screening. Den andre halvparten utgjør kontrollgruppen og vil av forskningsetiske hensyn få tilbud om tiltak etter at forskningsprosjektet er gjennomført.

Helsescreeningen består av følgende:

- Måling av kondisjon
- Måling av kroppssammensetning
- Måling av kroppsmasseindeks
- Spørreskjema om livsstil og helse
- Spørreskjema om motivasjon, trening, ulike plager, trivsel og den enkeltes forhold til jobben.

Tiltakene består av:

- Team-samling noen uker etter første screening
- Inndeling i treningsgrupper som skal støtte hverandre, planlegge sammen og møtes jevnlig for å diskutere erfaringer.
- Team-samling etter noen måneder og før re-test (ny screening)

Det behandles sensitive personopplysninger om helseforhold, personopplysningsloven § 2, punkt 8 c).

REGISTRERING OG INFORMASJONSSIKKERHET

Resultatene fra testene og spørreskjemaene på livsstil og helse vil samles i en rapport kalt en Helse- og livsstilsprofil. Dette er del av det helsefremmende programmet og helsefaglige rådgivere fra bedriftshelsetjenesten gjennomfører testene. Screening gjennomføres individuelt og det er kun rådgiver og den registrerte som får tilgang til rapporten. Rådata skal imidlertid overføres til forsker som også vil få tilsendt koblingsnøkkel og navneliste for å kunne sammenstille data.

Datamaterialet som innhentes i forbindelse med Postens helsefremmende program, innhentes via Aktimed som har avtale med Posten. Det er inngått databehandleravtale mellom Posten og underleverandører. Samarbeidet mellom Posten og NIH er formalisert i en skriftlig avtale.

Personvernombudet legger til grunn at forsker etterfølger Norges idrettshøgskole sine interne rutiner for datasikkerhet. Dersom personopplysninger skal sendes elektronisk eller lagres på mobile enheter, bør opplysningene krypteres tilstrekkelig.

Aktimed Helse/HMSvisjon er leverandør av dataløsninger for den profesjonelle bedriftshelsetjeneste. Aktimed Helse er en bedriftshelsetjenesteleverandør som Posten har inngått avtale med tilknyttet helsescreening og datainnsamling i dette forskningsprosjektet. For råd om hva databehandleravtalen bør inneholde, se Datatilsynets veileder: <http://www.datatilsynet.no/Sikkerhet-internkontroll/Databehandleravtale/>.

PROSJEKTSLUTT

Forventet prosjektslutt er 01.11.2017. Ifølge prosjektmeldingen skal innsamlede opplysninger da anonymiseres. Anonymisering innebærer å bearbeide datamaterialet slik at ingen enkeltpersoner kan gjenkjennes. Det gjøres ved å:

- slette direkte personopplysninger (som navn/koblingsnøkkel)
- slette/omskrive indirekte personopplysninger (identifiserende sammenstilling av bakgrunnsopplysninger som f.eks. bosted/arbeidssted, alder og kjønn)

Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK sør-øst	Gjøril Bergva	22845529	17.12.2014	2014/1943 REK sør-øst D
			Deres dato:	Deres referanse:
			28.10.2014	

Vår referanse må oppgis ved alle henvendelser

Hallgeir Halvari
Høgskolen i Buskerud og Vestfold
3511 Hønefoss

2014/1943 Min trening - en intervensjonsstudie på arbeidsplassen

Forskningsansvarlig: Norges idrettshøgskole
Prosjektleder: Hallgeir Halvari

Vi viser til søknad om forhåndsgodkjenning av ovennevnte forskningsprosjekt. Søknaden ble behandlet av Regional komité for medisinsk og helsefaglig forskningsetikk (REK sør-øst) i møtet 26.11.2014. Vurderingen er gjort med hjemmel i helseforskningsloven § 10, jf. forskningsetikkloven § 4.

Prosjektomtale (original):

Prosjektet skal gi ny kunnskap om hvordan arbeidsplasser best kan hjelpe og støtte ansatte til en mer helsefremmende livsstil på en måte som ivaretar deres integritet i form av å tilfredsstille deres behov for autonomi, kompetanse og sosial støtte. Dette antas å øke indre eller selv-regulert motivasjon for mosjon som vedvarer over tid. FORSKNINGSSPØRSMÅL: Har en team-basert intervensjon som støtter behov for autonomi, kompetanse og tilhørighet, effekter på primære utfallsmål: mosjon, og på fysisk form (kondisjon, blodtrykk, livvidde, BMI, kroppssammensetning)? Sekundære utfallsmål: 1) psykologisk velvære (tilfredshet, vitalitet, positiv og negativ affekt, somatiske symptomer)? 2) arbeidsfungering (org. forpliktelse, jobbinnsett og turnover-intensjon)? 3) sykefravær? METODE: To-gruppe intervensjonsstudie med randomisering til intervensjon (n=140) og kontroll(n=100). Team-basert intervensjon (5 mnd): team-samlinger og mosjonsgrupper. Post-test etter 5 mnd., og follow-up etter 10 mnd.

Vurdering

En tidligere versjon av forskningsprosjektet (REK-referanse 2014/1517) har tidligere vært avslått av REK sør-øst A.

Komiteen vurderer at det nå innsendte prosjektet, slik det er presentert i søknad og protokoll, ikke vil frembringe ny kunnskap om helse og sykdom som sådan. I stedet er formålet med prosjektet å studere hvordan en teambasert intervensjon kan hjelpe deltagerne til å gjøre livsstilsendringer. Fysisk aktivitet og mosjon er det primære utfallsmålet studien.

Prosjektet faller utenfor REKs mandat etter helseforskningsloven, som forutsetter at formålet med prosjektet er å skaffe til veie ny kunnskap om helse og sykdom.

Det kreves ikke godkjenning fra REK for å gjennomføre prosjektet. Prosjektet kommer inn under de interne regler som gjelder ved forskningsansvarlig virksomhet. Det er institusjonens ansvar å sørge for at prosjektet følger gjeldende reguleringer for behandling av helseopplysninger. Ettersom prosjektet forutsettes gjennomført i samsvar med gjeldende reguleringer, vil dette ikke være til noe hinder for at resultatene kan publiseres.

Vedtak

Prosjektet faller utenfor helseforskningslovens virkeområde da det ikke oppfyller formålet, jf. § 2. Det kreves ikke godkjenning fra REK for å gjennomføre prosjektet.

Klageadgang

REKs vedtak kan påklages, jf. forvaltningslovens § 28 flg. Klagen sendes til REK sør-øst D. Klagefristen er tre uker fra du mottar dette brevet. Dersom vedtaket opprettholdes av REK sør-øst D, sendes klagen videre til Den nasjonale forskningsetiske komité for medisin og helsefag for endelig vurdering.

Vi ber om at alle henvendelser sendes inn med korrekt skjema via vår saksportal:

<http://helseforskning.etikkom.no>. Dersom det ikke finnes passende skjema kan henvendelsen rettes på e-post til: post@helseforskning.etikkom.no.

Vennligst oppgi vårt referansenummer i korrespondansen.

Med vennlig hilsen

Finn Wisløff
Professor em. dr. med.
Leder

Gjøril Bergva
Rådgiver

Kopi til: Høgskolen i Buskerud og Vestfold ved øverste administrative ledelse: postmottak@hbv.no
turid.sjostedt@nih.no
hallgeir.halvari@hbv.no

Appendix II

Information letter to participants

Declaration of Informed Consent

Forespørsel om deltakelse i forskningsprosjektet tilknyttet Postens helsefremmende program

Du inviteres herved til å delta på et forskningsprosjekt som en del av Postens helsefremmende program. I dette brevet gir vi deg informasjon om prosjektet, hva det går ut på og hva det innebærer å delta. Deltakelse er helt frivillig. Etter at du har lest dette vil vi invitere deg til å delta på prosjektet, og ber om at du gir oss ditt samtykke ved å skrive under en samtykkeerklæring.

1. Hva er formålet med prosjektet?

Hensikten med prosjektet og Postens helsefremmende program er å hjelpe deltakerne til å gjøre livsstilsendringer. Posten har inngått et samarbeid med Norges Idrettshøgskole for å forske på hvilke effekter et slikt program kan ha.

Det helsefremmende programmet fokuserer på livsstil generelt, mens forskningsprosjektet vil spisse seg inn mot fysisk aktivitet og trening. Hensikten med tiltakene i prosjektet er å påvirke deltakernes indre motivasjon for regelmessig fysisk aktivitet og trening. Økt fysisk aktivitet bedrer fysisk helse og trivsel, og bidrar til å forebygge livsstilssykdommer og sykefravær. Det påvirker også det overskuddet en har til innsats både på jobb og fritid.

Dette Forskningsprosjektet vil også undersøke betydningen av at dette skjer på initiativ fra arbeidsgiver og sammen med kolleger i teamet. Dette kan oppleves som en viktig støtte, og det er viktig at det ikke oppleves som et press. Forskningsprosjektet vil undersøke om deltakelse på programmet påvirker jobbfungering og holdninger til arbeidsgiver.

Dette er ikke et prosjekt der ansatte skal trene i arbeidstiden eller delta på trening organisert av arbeidsgiver. All trening foregår på fritiden og ut i fra eget initiativ og individuell treningsplan.

Team i drift er invitert til å delta, og informasjon er formidlet via HR direktør og linjeledere.

2. Når skal prosjektet gjennomføres?

Januar 2015 - juli 2015. Høsten 2015 vil alle deltakere få en kort spørreskjemaundersøkelse for å måle langtidseffekter.

3. Økonomi og organisering

Dette er et doktorgradsprosjekt i samarbeid med Norges Idrettshøgskole, og med økonomisk støtte fra Norges Forskningsråd. Samarbeidspartner er konsernstab HMS i Posten Norge.

Alle kostander tilknyttet helsecreening 1 og 2 og team-samlinger vil dekkes av arbeidsgiver. Som deltaker mottar du ingen belønning for å delta på forskningsprosjektet. Eventuelle kostander til gjennomføring av ulike treningstiltak dekkes av deg som deltaker.

4. Hva går prosjektet ut på?

Dette er en type forskningsstudie der vi skal måle effekter av tiltak. Dette skal vi gjøre ved å sammenligne resultatene i en gruppe av team som får tiltaket med en gruppe av team som ikke får det. Den siste gruppa kaller vi en kontrollgruppe. Kontrollgruppa vil få teamtiltak etter at studien er gjennomført. Fordeling av team i tiltaks- og kontrollgruppe vil skje ved trekning (tilfeldig) og først

Forskningsprosjektet

etter at alle har gjennomført helsescreening 1 (test). Du vil altså komme i én av gruppene sammen med alle de andre deltakere fra ditt team.

Begge grupper: Individuell helsescreening (test)

Du vil svare på ulike spørreskjema og ta tester som gir en status på din livsstil og helse. Helsescreeningen består av en rekke tester, og disse er beskrevet i brosjyren om Helsescreening som du skal motta sammen med dette brevet. I forskningsstudien vil vi benytte følgende informasjon som er samlet inn om deg:

- Kondisjon – oksygenopptak målt ved å ta pulsen mens du sykler på en ergometersykkel i moderat tempo. Varighet: 6 minutter. Det er ikke behov for treningstøy.
- Kroppssammensetning (fordelingen av fett-, ben- og muskelmasse) – måles ved hjelp av spesialvekt og høyde
- Kroppsmasseindeks (BMI) og livvidde – måles ved hjelp av målebånd
- Spørreskjema på livsstil og helse – fysisk aktivitet og sykefravær (egen-rapportert).
- Spørreskjema på motivasjon, trening, ulike plager, trivsel og ditt forhold til jobben.

Resultatene fra testene og spørreskjemaene på livsstil og helse vil samles i en rapport kalt en Helse- og livsstilsprofil. Helsefaglige rådgivere fra bedriftshelsetjenesten vil gjennomføre testene. De vil også gå igjennom rapporten og forklare den, svare på spørsmål og komme med råd. Screeningen gjennomføres individuelt, og rapporten er det bare rådgiver og du som får se (men informasjonen som ligger til grunn for rapporten vil inngå i forskningsprosjektet). Du får med deg et eksemplar av rapporten hjem. Tidsbruk: ca. 90 minutter per person.

Tiltaksgruppa: team-samling 1

Noen uker etter helsescreening vil teamet ha en team-samling. Denne er ledet av helsefaglige rådgivere fra bedriftshelsetjenesten. Den varer i ca. 2 timer. Her vil dere få en gjennomgang av teamets samlede helse- og livsstilsprofil. Alle deltakere vil få utdelt et arbeidshefte de skal jobbe med under samlingen og bruke aktivt gjennom hele forskningsprosjektet.

Hensikten er å gi kunnskap om trening og helse, og å hjelpe deltakere til å bli mer bevisst på egen motivasjon og hvordan de vil gjennomføre trening som passer dem.

Tiltaksgruppa: treningsgrupper

Etter team-samling 1 vil deltakere deles inn i mindre grupper. Deltakerne i gruppa er ikke forventet å trene sammen, men å støtte hverandre i å sette individuelle mål, lage treningsplaner, finne måter å takle hindringer på etc. Mellom møtene vil deltakerne lage forslag til plan og teste ut denne. Erfaringene og eventuelle endringer kan de diskutere på neste møte i treningsgruppa. Det vil være jevnlig møter i treningsgruppa før helsescreening retest i april, og det vil settes av tid til dette på de vanlige personalmøtene i teamet.

Tiltaksgruppa: team-samling 2

Noen måneder etter første team-samling vil teamet igjen samles for faglig påfyll og for å dele erfaringer med det å gjøre endringer i livsstil og delta i en treningsgruppe. Denne samlingen er også ledet av helsefaglige rådgivere fra bedriftshelsetjenesten. Denne samlingen varer ca. 1,5 time.

Begge grupper: Individuell helsescreening (re-test)

Denne er lik helsescreening 1, og hensikten er å se om deltakerne har fått fremgang. Teamene i både kontrollgruppa og tiltaksgruppa gjennomfører helsescreening re-test. Tidsbruk: ca. 90 minutter per person.

5. Mulige fordeler og ulemper ved å delta

Du vil ha fordel av å delta fordi du vil få informasjon om din nåværende helse- og livsstil, og om risikofaktorer og anbefalte livsstilsendringer. Vi gjør oppmerksom på at helsescreening er utarbeidet som et helsefremmende og forebyggende tiltak, og ikke erstatter grundigere undersøkelser tilknyttet diagnostisering og behandling av plager og sykdom som helsevesenet gjennomfører. Testene som utføres er relativt skånsomme uten særlig risiko for skade eller bivirkninger.

Det å legge om livsstil og øke fysisk aktivitet kan til tider oppleves krevende. Tiltakene er lagt opp slik at dette skjer på dine premisser og i ditt tempo. Tiltakene vil basere seg på støtte fra teamkolleger. Helsefaglige rådgivere fra bedriftshelsetjenesten vil få opplæring å lede team-samlingene på en måte som bidrar til at du som deltaker føler deg trygg og ivaretatt.

6. Hva skjer med informasjonen om deg?

All informasjon om deg som prosjektet samler inn vil kun bli brukt til det formålet vi beskrev i punkt 1. Informasjonen vil bli behandlet konfidensielt. Den vil bli oppbevart slik at ingen andre kan få tak i den. Informasjonen blir anonymisert, det vil si at all informasjon vil bli behandlet uten navn og fødselsnummer eller andre direkte gjenkjennerende opplysninger. En kode knytter deg til dine opplysninger og tester gjennom en liste over navn og fødselsdato. Det er kun autorisert personell knyttet til prosjektet som har adgang til navnelisten og som kan finne tilbake til deg.

Dette gjelder dine svar på spørreskjema og resultatet av testene du gjennomfører på helsescreening, og all annen informasjon som samles inn om deg underveis f.eks. i forhold til fremmøte på team-samlinger og i treningsgrupper eller dine tilbakemeldinger i et intervju.

Nærmeste leder vil få tilgang til teamets samlede helseprofil, men denne inneholder ingen informasjon om den enkelte.

Det vil ikke være mulig å identifisere deg i resultatene av studien når disse publiseres. Etter at forskningsprosjektet er avsluttet, vil alle personalopplysninger som kan koble informasjonen til deg som person bli slettet. Prosjektet avsluttes 01.06.2017.

7. Frivillig og informert samtykke

Selv om ditt team er invitert til å delta på det helsefremmende programmet inkludert dette forskningsprosjektet, er du ikke pålagt å delta. Det er frivillig å delta. Du kan velge å trekke deg, og uten å oppgi noen grunn, når som helst i perioden forskningsprosjektet pågår. Dette vil ikke ha noen konsekvenser for ditt arbeidsforhold til Posten og Bring. Dersom du ønsker å trekke deg fra forskningsstudien, må du kontakte følgende:

Cathrine Pedersen
Telefon: 95280687
e-post: cathrinep@nih.no

Dersom du ønsker å delta, undertegner du samtykkeerklæringen på siste side. Denne skal du putte i en konvolutt du får utdelt, og levere din teamleder, som sender den videre til forskningsprosjektet.

8. Rett til innsyn og sletting av opplysninger om deg

Hvis du sier ja til å delta i forskningsprosjektet, har du rett til å få innsyn i hvilke opplysninger som er registrert om deg. Du har videre rett til å få korrigert eventuelle feil i de opplysningene vi har registrert. Dersom du trekker deg fra forskningsprosjektet, kan du kreve å få slettet innsamlede opplysninger, med mindre opplysningene allerede er inngått i analyser eller brukt i vitenskapelige

Forskningsprosjektet

publikasjoner. Opplysningene som er samlet inn på deg vil uansett anonymiseres dersom du trekker deg.

9. Informasjon om utfallet av studien

Som deltaker har du rett til å motta informasjon om resultatet av forskningsprosjektet. Denne vil presenteres etter at prosjektet er gjennomført.

10. Godkjenning av studien

Studien er godkjent av Personvernforbundet for forskning.

11. Kontaktperson

Dersom du senere ønsker å trekke deg eller har spørsmål til forskningsprosjektet, kan du kontakte prosjektleder og doktorgradsstipendiat Cathrine Pedersen, 95 28 06 87 eller cathrinep@nih.no.

Appendix III

Booklet



KK-512-09.2014



Navn:

Min trening

Arbeidshefte



Fakta om trening

Trening er fysisk aktivitet som er planlagt, strukturert og som du gjentar. Det er mange ulike aktiviteter som gir treningseffekt, og du kan godt kombinere treningen med andre hensyn f.eks. at du reiser til jobb, gjør noe med venner og familie eller jobber i hagen. Både sport og tur er to former for trening.

Hvorfor bør jeg trene regelmessig?

1. Mindre risiko for livsstilsykdommer
2. Forebygger muskel og skjelettplager
3. Øker overskudd og bedrer humøret
4. Påvirker annen livsstil som søvn, kosthold og stress

Hva mener vi med moderat fysisk aktivitet?

- Du tar i litt ekstra, kjemmer at du bruker kroppen/musklene
- Du blir andpusten, og hjertet slår forttere
- Du blir varm og litt svett
- Du er i stand til å prate underveis

Hvor hardt, lenge og ofte bør jeg trene?

- 30 minutter moderat fysisk aktivitet hver dag (3,5 timer i uka)
- Du kan dele 30 minutter inn i kortere bolker, f.eks. 10 minutter.
- Du kan godt trene 60 minutter en dag, og lite den neste. Men du bør helst spre treningen ut over hele uka, ikke samle alt på en dag

Hva bør jeg trene?

For å ta vare på helse vår og vært i god form, er det nødvendig å trene litt variert. Dersom du f.eks. mest går turen er det viktig å sørge for trening av overkroppen i tillegg.

Kondisjon

Det er det samme som utholdenhet. Påvirker først og fremst hjerte, kretsløp og lunger. God kondisjon gjør at vi har energi til å takle hverdagens oppgaver, og overskudd til å gjøre ting vi har lyst til.

Muskelstyrke

Det er evnen musklene våre har til å utvikle kraft. Det er viktig for å kunne bevege seg uanstrengt, for god kroppsholdning og for å klare mange av dagens gjøremål. I tillegg til å bli sterkere og tåle mer, kan du med styrketrening forebygge og lindre smerter i muskler og ledd.

Hverdagsmosjon

Hverdagsmosjon er den fysiske aktiviteten vi får mens vi utfører hverdagens gjøremål, enten det er på jobb eller fritid. Denne har også en helsegevinst. Noen beveger seg mye i jobben, andre lite. Uansett bør man se på hvordan man kan øke mengden og intensiteten, f.eks. ved å sykle til jobb eller til butikken, ta trappa fremfor heisen eller gå en tur i lunsjen.



Oppgave 1: Min treningshistorie



Tidligere erfaringer med fysisk aktivitet og trening påvirker din motivasjon og dine tanker om hvorvidt trening er noe du får til og setter pris på. Tenk tilbake til oppveksten din, og de erfaringene du tok med deg derfra inn i ditt voksne liv. Noter i feltet under:

1. Var du fysisk aktiv i oppveksten, og hva slags aktiviteter drev du med i tilfelle?
2. Hva slags fysisk aktivitet likte du best og hva likte du minst?
3. Vet du hvorfor du fortsatte eller sluttet med de aktivitetene du likte best?
4. Endret dette seg da du ble voksen?
5. Hva kan du lære av din egen treningshistorie tror du?

Oppgave 2: Min treningsmotivasjon



Det å trene mer kan ha ulike konsekvenser, både positive og negative. Hva er viktig for deg? Vært ærlig med deg selv, det er hva du opplever som er viktig, ikke hva andre forventer.

Konsekvenser:	Ikke viktig			Svært viktig			
	1	2	3	4	5	6	7
Å komme i bedre fysisk form er for meg							
Å få mer overskudd er for meg							
Å få løst opp i spenninger og stress i kroppen er for meg							
Å komme i bedre humør er for meg							
Å gå ned i vekt er for meg							
Å ta vare på helsen min er for meg							
Å få mindre tid til andre ting, som følge av trening er for meg							
At trening/mosjon koster penger er for meg							
Risiko for å pådra meg skader som følge av trening er for meg							
Å treffe andre mennesker gjennom felles trening er for meg							

Fordeler for meg ved å trene mer?

Ulemper for meg ved å trene mer?

Oppgave 3: Hva passer best for meg



Det er viktig at du finner frem til aktiviteter eller treningsformer som passer deg og din livssituasjon akkurat nå. Og gjerne at de er lystbetonte, da er det lettere å motivere seg for å trene.

Liker du best å trene utendørs eller innendørs?
Svar:
Liker du å ha musikk til treningen eller at det er stille?
Svar:
Fungerer det best for kroppen din å trene på dagen eller kvelden?
Svar:
Foretrekker du å trene alene eller sammen med andre?
Svar:
Foretrekker du å delta på organisert trening med instruktør eller å trene på egenhånd?
Svar:
Foretrekker du aktiviteter som er mer varierte eller mer gjentakende?
Svar:
Liker du at aktiviteten handler om å konkurrere?
Svar:
Liker du å drive med typiske vinteraktiviteter som f.eks. ski, skøyter, aking etc.?
Svar:

Foretrekker du at treningen er et avbrett i hverdagen, eller at den kan kombineres med hverdagsaktiviteter som f.eks. reise?
Svar:
Liker du å utfordre deg selv gjennom treningen?
Svar:
Liker du at treningen også virker avslappende på deg?
Svar:
Er det viktigst at treningen er effektiv i forhold til resultater eller at den er tilfredsstillende i seg selv?
Svar:

Konklusjon

Hvilken type trening eller aktivitet kan passe deg best? Husk at treningen din bør ivareta både kondisjon, muskelstyrke og hverdagsmosjon.

Kondisjon	
Muskelstyrke	
Hverdagsmosjon	

Oppgave 4: Hvilke hindringer kan jeg møte?



Det å endre vaner kan noen ganger oppleves utfordrende. Det kan være sviktende motivasjon, dårlig tid, dårlig vær, treningskamerater som uteblir eller en opplevelse av at vi ikke behersker den treningsformen vi har valgt.

Hvilke utfordringer tenker du at du kan oppleve? List opp mulige hindringer og hva du kan gjøre for å takle dem?

Dette kan hindre meg i å trene regelmessig	Dette kan jeg gjøre for å takle hindringen

Oppgave 5: Mine treningsmål



Kan hende trener du regelmessig allerede, men ønsker å utfordre deg selv mer. Kanskje ønsker du å komme i gang med regelmessig trening, eller kanskje er du mer usikker. Dette er det bare du som kan bestemme. Men om du skulle ønske å gjøre en endring, hva er det du ønsker at denne endringen skal resultere i – kort sagt, hva er dine mål?

1. På kort sikt ønsker jeg at treningen skal:

2. På lengre sikt ønsker jeg at treningen skal:



Oppgave 6: Hvor står du akkurat nå?

Helt ærlig, hvor viktig er det for deg å endre dine treningsvaner?

Sett et kryss på tallet som markerer din opplevelse.

1 = Svært lite viktig og 10 = svært viktig

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

Hvor sikker er du på at du klarer å gjennomføre endringene du har bestemt deg for?

Sett et kryss på tallet som markerer din opplevelse.

1 = helt sikkert ikke og 10 = helt sikkert

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----



Oppgave 7: En fot i bakken

Fyll inn

1. Hva har jeg lært så langt?

2. Hva bør jeg fortsette med?

3. Hva bør jeg endre?



Min treningsplan

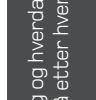
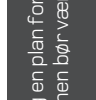


Lag en plan for en typisk uke – legg inn både trening og hverdagsmosjon. Planen bør være overkommelig, du kan heller øke på etter hvert.

UKE	Mandag	Tirsdag	Onsdag	Torsdag	Fredag	Lørdag	Søndag
Morgen							
Formiddag							
Ettermiddag							
Kveld							
Sum tid (sammenlagt)							

UKE	Mandag	Tirsdag	Onsdag	Torsdag	Fredag	Lørdag	Søndag
Morgen							
Formiddag							
Ettermiddag							
Kveld							
Sum tid (sammenlagt)							

Min treningsplan



Lag en plan for en typisk uke – legg inn både trening og hverdagsmosjon. Planen bør være overkommelig, du kan heller øke på etter hvert.

UKE.....	Mandag	Tirsdag	Onsdag	Torsdag	Fredag	Lørdag	Søndag
Morgen							
Formiddag							
Ettermiddag							
Kveld							
Sum tid (sammenlagt)							

UKE.....	Mandag	Tirsdag	Onsdag	Torsdag	Fredag	Lørdag	Søndag
Morgen							
Formiddag							
Ettermiddag							
Kveld							
Sum tid (sammenlagt)							

Min treningsplan



Lag en plan for en typisk uke – legg inn både trening og hverdagsmosjon. Planen bør være overkommelig, du kan heller øke på etter hvert.

UKE	Mandag	Tirsdag	Onsdag	Torsdag	Fredag	Lørdag	Søndag
Morgen							
Formiddag							
Ettermiddag							
Kveld							
Sum tid (sammenlagt)							

UKE	Mandag	Tirsdag	Onsdag	Torsdag	Fredag	Lørdag	Søndag
Morgen							
Formiddag							
Ettermiddag							
Kveld							
Sum tid (sammenlagt)							

Min treningsplan



Lag en plan for en typisk uke – legg inn både trening og hverdagsmosjon. Planen bør være overkommelig, du kan heller øke på etter hvert.

UKE.....	Mandag	Tirsdag	Onsdag	Torsdag	Fredag	Lørdag	Søndag
Morgen							
Formiddag							
Ettermiddag							
Kveld							
Sum tid (sammenlagt)							

UKE.....	Mandag	Tirsdag	Onsdag	Torsdag	Fredag	Lørdag	Søndag
Morgen							
Formiddag							
Ettermiddag							
Kveld							
Sum tid (sammenlagt)							

Appendix IV

Questionnaires paper I-III

MOSJON/FYSISK AKTIVITET

Med mosjon mener vi at du f.eks. går tur, går i trapper, går på ski, svømmer eller driver trening/idrett

1. Hvor ofte driver du med mosjon? (Ta et gjennomsnitt)

Kryss av for det svaret som passer best for deg (kun ett kryss):

Aldri	
Sjeldnere enn en gang i uka	
En gang i uka	
2-3 ganger i uka	
Omtrent hver dag	

2. Hvor hardt mosjonerer du i gjennomsnitt?

Kryss av for det svaret som passer best for deg (kun ett kryss):

Mosjonerer/trener ikke	
Rolig uten å bli andpusten og svett	
Blir andpusten og svett	
Tar meg nesten helt ut	

3. Hvor lenge holder du på hver gang du trener i gjennomsnitt?

Kryss av for det svaret som passer best for deg (kun ett kryss):

Mosjonerer/trener ikke	
Mindre enn 15 minutter	
15-29 minutter	
30-60 minutter	
Mer enn en time	

HVORFOR DU TRENER

Her lurer vi på hvorfor du er fysisk aktiv, i den grad du er det. Se på påstandene nedenfor, og angi i hvilken grad disse passer for deg. Benytt følgende skala:

Ikke sant for meg Delvis sant Veldig sant
 1 2 3 4 5

Jeg er fysisk aktiv fordi:

	Påstand	1	2	3	4	5
1	Jeg er fysisk aktiv og trener fordi andre sier at jeg bør					
2	Jeg får dårlig samvittighet når jeg ikke er fysisk aktiv eller trener					
3	Jeg setter pris på fordelene ved å være fysisk aktiv og trene					
4	Jeg er fysisk aktiv og trener fordi det er gøy					
5	Jeg ser ikke hvorfor jeg må være fysisk aktiv og trene					
6	Jeg deltar i fysisk aktivitet og trening fordi vennene mine/familien min sier at jeg bør					
7	Jeg skammer meg når jeg går glipp av en aktivitets- eller treningsøkt					
8	Det er viktig for meg å være i fysisk aktivitet og trene regelmessig					
9	Jeg skjønner ikke hvorfor jeg skulle gidde å være fysisk aktiv og trene					
10	Jeg liker aktivitets- og treningsøktene mine					
11	Jeg driver med fysisk aktivitet og trening fordi andre vil bli misfornøyd med meg hvis jeg ikke gjør det					
12	Jeg ser ikke poenget med å være fysisk aktiv og trene					
13	Jeg føler meg mislykket når jeg ikke har vært fysisk aktiv eller trent på en stund					
14	Jeg synes det er viktig å anstrenge seg for å være fysisk aktiv og trene regelmessig					
15	Jeg har glede av å være i aktivitet					
16	Jeg føler meg presset av vennene mine/familien min til å være fysisk aktiv og trene					
17	Jeg blir rastløs hvis jeg ikke er fysisk aktiv og trener regelmessig					
18	Jeg blir glad og fornøyd av å delta i fysisk aktivitet og trening					
19	Jeg synes fysisk aktivitet og trening er bortkastet tid					

FYSISKE PLAGER

Nedenfor listes det opp en rekke fysiske plager mennesker kan oppleve. Slike plager kan skyldes flere årsaker. Vennligst ta stilling til disse plagene i forhold til din egen situasjon. Det er viktig at du er ærlig, og svare er konfidensielle. Benytt følgende skala:

1	2	3
Ikke plaget	litt plaget	veldig plaget

I løpet av de fire siste ukene, i hvilken grad har du vært plaget med ett eller flere av følgende problemer:

		1	2	3
1	Magesmerter			
2	Ryggsmerter			
3	Smerter i armer, ben eller ledd			
4	Hodepine			
5	Brystsmerter			
6	Svimmelhet			
7	Besvimelsesanfall			
8	Følelse av at hjertet banker fort eller uregelmessig			
9	Kortpustethet			
10	Forstoppelse, løs mage eller diaré			
11	Kvalme, tarmgass eller dårlig fordøyelse			
12	Følelse av tretthet eller lite energi			
13	Søvnproblemer			

Har du oppsøkt eller har du planer om å oppsøke din fastlege på grunn av disse plagene? (sett kun ett kryss)

1	Jeg har oppsøkt fastlege	
2	Jeg har ikke oppsøkt fastlege, men jeg planlegger å gjøre det	
3	Jeg har ikke oppsøkt fastlege, og jeg planlegger heller ikke å gjøre det	

SYKEFRAVÆR

1	I løpet av de siste 6 måneder, hvor mange dager har du sammenlagt vært hjemme fra arbeid på grunn av egen sykdom?	Ingen dager	1-4 dager	5-8 dager	9-18 dager	Mer enn 18 dager

2	I løpet av de siste 6 måneder, hvor mange ganger har det hendt at du har gått på arbeid, selv om du med din helsetilstand egentlig burde holdt deg hjemme?	Ingen dager	1-4 dager	5-8 dager	9-18 dager	Mer enn 18 dager

Kommentarer eller tilbakemeldinger:



Tusen takk for at du tok deg til å svare på denne spørreundersøkelsen!

