Workplace Health Promotion: Implementing physical activity at the workplace – a change project

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Contents

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2. List of papers

I. Sjogaard, G., Justesen, J. B., Murray, M., Dalager, T. and Sogaard, K. (2014). “A conceptual model for worksite intelligent physical exercise training – IPET – intervention for decreasing life style health risk indicators among employees: a randomized controlled trial.” BMC Public Health 14: 652.

II. Justesen, J. B, Murray, M., Dalager, T., Boyle, E. and Sjogaard, G. (2014). “Implementing intelligent physical exercise training at the workplace: Health effects among office workers – a randomized controlled study.” – in revision.

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IV. Justesen, J. B, Eskerod, P., Christensen, J. R. and Sjogaard, G. (2014). “Implementing workplace health promotion – the role of middle managers in Denmark.” – submitted.

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3. List of abbreviations

CRF: Cardio respiratory fitness

CG: Control group

HR: Heart rate

IPET: Individually tailored intelligent physical exercise training

Min: Minutes

RCT: Randomised controlled trial

RPE: Rated Perceived Exertion (Borg Scale)

SD: Standard deviation

SE: Standard error of mean

TG: Training group

WHP: Workplace health promotion

VO_2max: Maximum oxygen uptake

4. Summary

Background: Workplace Health Promotion (WHP), in terms of physical activity, has proven positive effects, but there is still little knowledge of optimisation of relevant training protocols, effects on sickness presenteeism and absenteeism, or the role of change agents and middle managers in implementation. The primary aim of the thesis is to assess the effects of individually tailored intelligent physical exercise training (IPET) on office workers. The secondary aim is to discuss not only the potential for enabling employees' physical activity by appointing peers at the workplace as formal health ambassadors, but also the role and role understanding of middle managers in implementing health at the workplace and IPET´s effect on sickness presenteeism and absenteeism.

Methods: The study took the form of a two-year randomised controlled trial, RCT, among office workers allocated to either a training group (N = 194) or a control group (N = 195). The training group members were offered one-hour of high intensity exercise training every week within working hours and were also recommended to carry out 30 minutes of moderate intensity physical activity six days a week during leisure time. Before and after the intervention, employees completed a health check, including a standardised submaximal bicycle test with heart rate monitoring, to obtain an indirect estimate of maximal oxygen uptake (VO_2max), body mass, BMI, blood pressure (BP) and blood profile. They also completed a questionnaire. An exploratory study nested in the randomised controlled study was conducted, and 17 peer health ambassadors were appointed and trained at six workplaces, with 21 middle managers taking part in a half-day seminar on 'implementing physical activity as a health strategy in the workplace'. The hypothesis of this thesis is that IPET among office workers with inactive job categories will improve cardiorespiratory fitness, CRF, and/or individual health risk indicators, as well as reducing sickness absence and productivity losses (presenteeism) of office workers when implemented at the workplace through the efforts of peer health ambassadors and middle managers.

Results: At baseline, there were no differences between the two groups. An intention-to-treat analysis showed a significant 5% increase in CRF assessed as maximal oxygen uptake and data presented as VO_2max L/min as well as relative VO_2max in ml/min/kg body mass and a significant increase in workability (5%), general health (5%) and a significant decrease in HR (2.5 - steady

state) compared to the CG from baseline to one-year follow-up. Within groups a significant decrease occurred in systolic/diastolic BP of 3.4/2.8 mmHg, and blood glucose of 0.2 mmol/l for the TG. A per protocol analysis of employees in the training group with an adherence of ≥ 70% (N = 89) showed a significant 7% increase in CRF and a significant decrease in systolic BP (3.9 mmHg), a significant increase in general work ability (5%), productivity (5.5%), general health (11.5%) and a significant decrease in short-term absence (49%) compared to the CG from baseline to one-year follow-up. Overall, the adherence for the training group was 56% (29.2 training sessions). The adherence across companies ranged from an average of 36% to 62.8% and 89 (46%) employees had an adherence of ≥ 70%.

In-depth case studies on middle managers and change agents (health ambassadors) were nested in the RCT and showed that middle managers play a key role in successful implementation of WHP, but that they felt uncertain about their role, especially when it comes to engaging with their employees. Two questions that especially troubled the middle managers were identified:
(1) Is it ethically acceptable to interfere with employees' health behaviour through WHP when private borders are crossed?
(2) How should work-related activities versus health-related activities be prioritised when a scheduling conflict arises?

In the case studies, uncertainty about their role made the middle managers reluctant to take action on WHP. Instead, they were likely to leave further action to top management. Regarding the health ambassadors, proper selection of employees for the role as health ambassador was of great importance, since lack of careful identification with and respect for the appointed peers made the TG group skip the training programme even though they were initially committed. It is important to note that the health ambassadors needed different stakeholders' (e.g. middle managers and health program manager) support and skills training on how to deal with non-compliant colleagues.

Conclusion: High intensity IPET combined with recommendations of moderate intensity physical activity significantly increased CRF, general health and general work ability, and a per protocol analysis showed a significant decrease in short-term absence, systolic BP and increase in

productivity. Furthermore, formal peer health ambassadors have potential to act as facilitators of increased physical activity, however, support from different stakeholders, e.g. middle managers, is pertinent. Finally, this thesis addresses a gap in the literature on implementing and embedding WHP, linking physical activity to workplace peer facilitation and the role and role understanding of middle managers. Findings from the case study together with existing literature acknowledge a need for a model that can help middle managers execute WHP as a strategy that encompasses the engagement of their employees, the challenges of day-to-day operations and ethical issues.

5. Dansk resume

Baggrund: Sundhedsfremme og forebyggelse i form af fysisk aktivitet på arbejdspladsen har dokumenteret positiv effekt, men der er stadig mangelfuld viden om området. Blandt andet savnes viden omkring optimering af træningsinterventioner, effekt på sygefravær og medarbejdernes produktivitet. En anden vinkel, der ikke er undersøgt, er hvilken rolle forandringsagenter og mellemledere spiller i implementering og forankring af sundhedsfremme og forebyggelse. Formålet med afhandlingen var at vurdere effekten af individuelt tilpasset intelligent træning for kontoransatte. Delformålet var at undersøge forandringsagenters (sundhedsambassadørers) og mellemlederes rolle i forhold til implementering og forankring af fysisk aktivitet og sundhed på arbejdspladsen.

Metode: Studiet bestod af et to årigt randomiseret, kontrolleret forsøg (RCT). Studiets deltagere var kontoransatte, der ved lodtrækning enten deltog i en træningsgruppe (N = 194) eller i en kontrolgruppe (N = 195). Træningsgruppen blev ugentligt tilbudt en times høj intensitetstræning i arbejdstiden samt anbefalet at udføre 30 minutters fysisk aktivitet af moderat intensitet seks dage om ugen i fritiden. Før og efter interventionen gennemførte alle medarbejdere i de to grupper et sundhedstjek indbefattende måling af blodtryk, BMI udregning, blodprøve og en standardiseret submaksimal cykeltest med pulsmåling, der gav et indirekte estimat af maksimal iltoptagelse (VO2max). Både trænings- og kontrolgruppen udfyldte desuden et spørgeskema før og efter interventionen.

En eksplorativ undersøgelse indlejret i RCT studiet blev udført, og 17 sundhedsambassadører på seks forskellige arbejdspladser blev udpeget. Disse 17 gennemgik en sundhedsambassadør-uddannelse. Yderligere deltog 21 mellemledere i et halvdagsseminar om ”implementering af fysisk aktivitet som en sundhedsstrategi på arbejdspladsen”. Hypotesen med denne afhandling er, at intelligent træning blandt kontoransatte, som træner i arbejdstiden, vil forbedre deres Vo_2max, mindske individuelle risikofaktorer, reducere sygefravær og forbedre deres produktivitet. Interventionen med træning i arbejdstiden blev gennemført med støtte, accept og opbakning fra sundhedsambassadører og mellemledere.

Resultater: Der var ved baseline ingen forskel mellem trænings- og kontrolgruppen. En intention-to-treat analyse viste en signifikant stigning på 5% i kondition vurderet som maksimal iltoptagelse,

hvor data præsenteres som Vo_2max L/min samt relative VO2max i ml/min/kg kropsmasse. Desuden opnåede træningsgruppen en signifikant stigning i generel arbejdsevne (5%), generel helbredstilstand (5%) og et signifikant fald i puls (2.5 - steady state) i forhold til kontrolgruppen fra baseline til et års opfølgning. Yderligere blev der opnået et fald i systolisk/diastolisk blodtryk på henholdsvis 3,4 og 2,8 mmHg samt fald i blodsukker på 0,2 mmol/l for træningsgruppen. En per protokol analyse af medarbejdere i træningsgruppen med en deltagelse på ≥ 70 % (N = 89) viste i forhold til kontrolgruppen fra baseline til et års opfølgning en signifikant stigning på 7% i kondition, et signifikant fald i systolisk blodtryk (3.9 mmHg), et signifikant fald i korttids-sygefravær (49%) og en betydelig stigning i arbejdsevne (5%), produktivitet (5.5%) samt generel sundhed (11.5%). Den samlede deltagelsesprocent for træningsgruppen var 56 % (29,2 træningssessioner), og tilslutning på tværs af virksomheder varierede fra et gennemsnit på 36% til 62,8% .

Dybdegående casestudier om mellemledernes og sundhedsambassadørernes rolle blev indlejret i RCT´en og viste, at mellemledere spiller en central rolle i en succesrig implementering af fysisk aktivitet og sundhed på arbejdspladsen. Mellemlederne følte sig dog usikre på deres rolle, især når det drejede sig om at engagere deres medarbejdere. To spørgsmål, der især udfordrede mellemlederne, blev identificeret:

(1) Er det etisk acceptabelt at involvere sig i sine medarbejderes sundhedsadfærd via sundhedsindsatser på arbejdspladsen når privatsfæren overskrides?

(2) Hvordan skal arbejdsrelaterede aktiviteter versus sundhedsrelaterede aktiviteter prioriteres, når de tidsmæssigt kolliderer?

I casestudierne var mellemlederne usikre på deres rolle, hvilket gjorde dem tilbageholdende i forhold til at gribe ind og iværksætte andre tiltag. I stedet var de tilbøjelige til at overlade yderligere foranstaltninger til topledelsen. Udvælgelsen af sundhedsambassadører var af afgørende betydning, hvorfor træningsgruppen modtog mest mulig støtte og blev holdt fast på studiets intervention. Manglende omhyggelig udvælgelse gjorde, at træningsgruppen sprang træningen over, selvom de i starten af studiet havde sagt ja til at deltage. Det er vigtigt at bemærke, at sundhedsambassadører har brug for opbakning, løbende uddannelse og træning i, hvordan kollegaer motiveres.

Konklusion: Intelligent træning med høj intensitet i arbejdstiden kombineret med anbefalinger om fysisk aktivitet af moderat intensitet i fritiden øgede konditionen, den generelle helbredstilstand og arbejdsevnen markant og en per protokol analyse viste et signifikant fald i korttids-sygefravær og i systolisk blodtryk samt en stigning i produktivitet. Sundhedsambassadører har potentialet til at fungere som formidlere af øget fysisk aktivitet, og med støtte fra forskellige mellemledere kan de opnå succes. Endelig har forskningen i forbindelse med denne afhandling dokumenteret et hul i litteraturen omkring implementering og forankring af sundhed på arbejdspladsen, herunder sundhedsambassadørens og mellemlederens rolle og rolleforståelse. Resultaterne af casestudiet sammen med eksisterende litteratur erkender et behov for en model, der kan hjælpe mellemledere med at implementere og forankre intelligent træning og sundhed på arbejdspladsen som en sundhedsstrategi, der omfatter involvering af deres ansatte og håndterer udfordringer fra den daglige drift samt inddrager de etiske spørgsmål, der vil opstå.

6. Introduction

In today's Western World, sedentary work is the most prevalent working condition between the ages of 16 and 64 (Archer and Blair 2011). Furthermore most people in the Western World are insufficiently active (do not meet national recommendations for physical activity) and therefore do not receive the health benefits such activity would bring (Proper, Koning et al. 2003, Blair 2009, Brown, Burton et al. 2014). The workplace is an ideal setting for influencing people's health behaviour since, even in countries with high unemployment rates, the majority of the adult population is employed (Kuoppala, Lamminpaa et al. 2008). The WHO has also recommended the workplace as an ideal setting for health promotion given that physical inactivity is reported as fourth among the leading risk factors for mortality worldwide (WHO 2010). Finally, a core advantage of health promotion programmes at the workplace is that multi-level interventions can be applied, meaning that you can address organisational and environmental/policy issues in addition to factors at the individual level (Bull et al. 2003).

6.1 Implementing and embedding physical activity at the workplace – an interdisciplinary approach

The role of workplaces in workplace health promotion (WHP) is poorly understood (Waddell and Burton 2006, Jackson et al. 2014), and lack of advice on how to implement and embed the programmes has been identified as a key barrier to employer organisations' health promotion investment (Black 2008). Implementing and embedding physical activity at the workplace can be seen as a cultural change project due to the fact that both the target group members and a number of other stakeholders have to change behaviour and sustain new patterns of behaviour and prioritisation. In order to succeed with cultural change projects, the projects in question must take an interdisciplinary perspective, and it is important to understand that a universal method or theory for successful change does not exist (Burnes 2009).

Questions and problems regarding implementing and embedding physical activity as part of WHP are too complex for one research field to handle (Schultz and Edington 2007, Brown, Gilson et al. 2011, 2014, Addley, Boyd et al. 2014, Conner 2014, Noben, Evers et al. 2014).

The health effects of physical activity interventions are assessed by health science methodologies, but implementing and embedding physical activity at the workplace must work with the approaches from social science, thus taking an interdisciplinary approach using data triangulation (Cohen and Manion 2000) in order to succeed.

Research shows that strategies, structure and policies are not the prime mover in organisations; culture is (Kossek et al. 2012). For successful change to happen, change agents (health ambassadors) and middle managers must play a key role (Neubert and Cady 2001, Huy 2001 Burnes, 2009, Barton and Abrosini 2013) because they constitute the only group of employees and managers who (due to their closeness to day-to-day operations and their employees/colleagues) can execute change (Burnes 2009, Barton and Abrosini 2013). Furthermore, health ambassadors and middle managers know the informal network, abilities and emotional needs of their employees better than top managers and are therefore more suitable to serve as change movers (Huy 2001).

There appears to be inconsistent evidence of the impact of physical activity interventions on cardiorespiratory fitness (CRF), sickness presenteeism, and absenteeism, which in part may be explained by study design, implementation and the content of the intervention (Proper, Koning et al. 2003, Coury, Moreira et al. 2009, Rongen, Robroek et al. 2013, Wierenga, Engbers et al. 2013).

Given that employees spend many hours at work, a better understanding of the possible relationships between work environment factors and physical activity of office workers is needed in the development of interventions (Lin, McCullagh et al. 2014). In addition, Abraham and Michie (2008) encourage greater focus on the characteristics of those who are delivering the interventions. This is in line with Mellor and Webster (2013), who point to the need for ongoing efforts, as well as stating that site sponsors encouraging attendance at workplace health promotion events may be helpful in alleviating staff resistance. Collaboration between actors and stakeholders, inside and outside of the workplace, has been recommended by research as an important strategy in order to develop health promotion at workplaces (Dugdill et al. 2008, Eriksson et al. 2012). Furthermore, a recent review shows that workplace policies/resources for physical activity only result in a weak positive correlation with the level of physical activity actually performed (Lin et al., 2014).

Therefore the study in this thesis is not just a randomised controlled trial (RCT) study, but a study that includes the approaches from social science in order to implement and embed physical activity at the workplace.

6.2 Individually tailored intelligent physical exercise training (IPET) for office workers

The promotion of physical activity has been advocated as an important component of an organisation's business plan to improve its employees' health and productivity (Pronk and Kottke 2009). Also, from an employer's perspective, evidence of productivity outcomes is necessary to demonstrate the financial benefit and effectiveness of any WHP intervention in order to ensure management support (Collins, Baase et al. 2005, Goetzel and Ozminkowski 2008). Research has documented that physically inactive employees and employees with an unhealthy lifestyle are less productive, are more likely to be absent due to illness and have lower work ability when they are at work than employees with healthy lifestyles (Jans, Proper et al. 2007, Rongen, Robroek et al. 2013).

Recent RCT original studies of physical activity interventions at the workplace for office workers have documented some positive effects on employees' health outcomes (Proper, van der Beek et al. 2004, Sjogren, Nissinen et al. 2005, Kennedy, Boreham et al. 2007, Bernaards, Arieens et al. 2007, Kietrys, Galper et al. 2007, Block, Sternfeld et al. 2008, Andersen, Kjaer et al. 2008, Blangsted, Sogaard et al. 2008, Puig-Ribera et al. 2008, Pedersen et al. 2009, Andersen, Saervoll et al. 2011, Reijonsaari, Vehtari et al. 2012, Wolever et al. 2012, Andersen, Andersen et al. 2012, Gram, Andersen et al. 2014, Andersen, Andersen et al. 2014, Sihawong, Janwantanakul et al. 2014).

Furthermore a literature review (Proper, Koning et al. 2003) and two recent meta-analyses (Conn, Hafdahl et al. 2009, Rongen, Robroek et al. 2013) on workplace physical activity interventions in general have documented some positive effects on employees' health outcomes. Although there are positive results in some studies, the authors advocate that future research should compare interventions to confirm causal relationships and further explore heterogeneity (Proper, Koning et al. 2003, Conn, Hafdahl et al. 2009, Rongen, Robroek et al. 2013). To conclude, there is a gap in the

literature when it comes to high quality controlled trials aiming to improve physical activity at the workplace, and more high quality studies within the workplace are needed (Conn, Hafdahl et al. 2009, Rongen, Robroek et al. 2013).

Research has documented that physically inactive employees and employees with an unhealthy lifestyle are less productive, more frequently sick and have decreased workability when they are at work (Proper, van den Heuvel et al. 2006, Rongen, Robroek et al. 2013). Studies from Jans, Proper et al. (2007) furthermore show that office workers do not compensate for prolonged sitting at work by spending less time in sedentary leisure activities. Time away from work when the employee is sick (absenteeism) obviously influence productivity and workability. However, being present at work despite bad health may also impact greatly on an employee's productivity and workability (presenteeism) (Brown, Gilson et al. 2011, Mitchell, Goodman et al. 2013). Sickness presenteeism is defined as being at work while sick and therefore not delivering 100% performance in the job because of health problems (Aronsson, Gustafsson et al. 2000, Cooper and Dewe 2008, Cancelliere, Cassidy et al. 2011). Presenteeism includes time not spent on job tasks, a slower work pace and decreased quality of work, resulting in a decrease in the employee's productivity, which is often a hidden cost for employers (Loeppke, Hymel et al. 2003, Schultz and Edington 2007). It is not uncommon that presenteeism precedes or follows absenteeism, but such a connection may not always be the case (Brouwer, Meerding et al. 2005).

A systematic review of workplace physical activity interventions to reduce sickness absenteeism found preliminary evidence that physical activity interventions can have a positive effect on sickness absenteeism, while no positive effect on productivity was found (Proper, Staal et al. 2002). More recent studies supported these conclusions (Puig-Ribera, McKenna et al. 2008, Fonseca, Pedersen et al. 2009, Nobre et al. 2010, Wolever, Bobinet et al. 2012). Two meta-analyses of workplace physical activity interventions found low levels of benefit in terms of absenteeism (Kuoppala, Lamminpaa et al. 2008, Conn, Hafdahl et al. 2009) and a more recent review of workplace physical activity interventions designed to reduce sickness absenteeism found moderate evidence of no effect (Odeen, Magnussen et al. 2013). Furthermore, a recent systematic review found some effect on productivity (Cancelliere, Cassidy et al. 2011) and a meta-analysis reported little effect from WHP – including physical activity interventions – on sickness

absenteeism, productivity and work ability (Rongen, Robroek et al. 2013). There appears to be inconsistent evidence of the impact of physical activity interventions on productivity and sickness absenteeism.

A reason for the inconsistent evidence may be the study design and the implementation of the intervention (Proper, Koning et al. 2003, Coury, Moreira et al. 2009, Rongen, Robroek et al. 2013, Wierenga, Engbers et al. 2013). As recent RCT original studies clearly illustrate, the majority of physical activity interventions targeting CRF at the workplace are of moderate intensity and are not individually designed (Proper, van der Beek et al. 2004, Kennedy, Boreham et al. 2007, Block, Sternfeld et al. 2008, Blangsted, Sogaard et al. 2008, Puig-Ribera et al. 2008, Pedersen et al. 2009, Reijonsaari, Vehtari et al. 2012, Wolever et al. 2012). Regarding physical activity at moderate intensity versus high intensity, training studies have reported up to twice the effect on VO_2max (l/min)/relative VO_2max (ml/min/kg) when performing high intensity training versus physical activity at moderate level (Gibala, Little et al. 2006, Burgomaster, Howarth et al. 2008, Nybo, Sundstrup et al. 2010). Furthermore, high intensity training in particular impacts on cardiovascular risk factors (Sassen, Cornelissen et al. 2009, Sassen, Kok et al. 2010).

The following physical activity intervention in terms of intelligent physical exercise training (IPET) is particularly distinct from previous methods in terms of the content of the intervention. The concept of IPET at the workplace was: 1) to balance the physiological capacity of the employees relative to occupational exposure, 2) to tailor the exercise to individual capacities and disorders to improve employees' health, 3) to motivate employees by offering evidence of an enjoyable programme implemented with care, and support 4) to be cost-effective for the company.

7. Aim

The overall aim of this thesis was to study the effects on health and productivity of implementing and embedding IPET among office workers at the workplace in Denmark in a two-year RCT study.

The primary end-point of the RCT study was at the end of the first year of the intervention, where an increase was hypothesised in the primary outcome of CRF, and the secondary outcome of individual productivity, as well as a decrease in sickness absenteeism. In the second year of intervention, the exercise supervision was more infrequent, and it was hypothesised that the improvement obtained in the first year could be maintained after two years. This thesis reports results after one year of intervention

In addition to the evidence regarding primary and secondary outcomes obtained in the RCT study, the aim was to implement the study as a change project and discuss not only the potential for enabling employees' physical activity by appointing peers at the workplace as formal health ambassadors but also the role and role understanding of middle managers in implementing WHP. These aspects were studied in association with the RCT and contribute to the understanding of implementing and embedding physical activity at the workplace.

Papers I, II and III are part of the RCT design and registered in clinical trial. Papers IV and V are multiple-case studies (Eisenhardt and Graebner 2007), describing implementing and embedding physical activity at the workplaces as a change project. Papers IV and V use, in part, data from the questionnaire in the RCT. Paper V only uses questionnaire data from the training group (TG).

7.1 The aim of Paper I was to present a study protocol with a conceptual model for planning IPET for each office worker, optimised by the use of an individual health check, existing guidelines and state-of-the-art sports science training recommendations in the broad categories of CRF and muscle strength in specific body parts and functional training, including balance training.

7.2 The aim of Paper II was to present the effects of one weekly hour of supervised high intensity IPET at the workplace combined with recommendations of 30 minutes of

moderate intensity physical activity six days per week on CRF and physiological health risk indicator after one year of intervention among office workers.

7.3 The aim of Paper III was to investigate the effect of one weekly hour of supervised high intensity IPET at the workplace combined with recommendations of 30 minutes of moderate intensity physical activity six days per week on sickness presenteeism and sickness absenteeism (short term) among office workers.

7.4 The aim of Paper IV was to address the missing link between top management and employees when it comes to understanding how to successfully implement and embed WHP as a strategy within organisations – the role of the middle managers. How do middle managers respond to WHP? What concerns do they have about their own behaviour and prioritisation? Based on studies outside the WHP field, as well as on empirical ones, this article offers input for theory development.

7.5 The aim of Paper V was to discuss the potential for enabling employees' physical activity by appointing peers at the workplace as formal health ambassadors.

8. Method

8.1 Study design

The study design was a randomised single-blinded parallel controlled trial conducted from May 2011 to March 2014. The project was approved by the Regional Ethics Committee of Southern Denmark (S-20110051) and registered on ClinicalTrials.gov with number NCT01366950.

8.2 Workplace recruitment

In May 2010, 103 companies across Denmark were contacted by e-mail to determine their interest in this study. The project manager (author JBJ) had a previous business relationship with each of the companies. The nature of this relationship was that the author had either previously taught project management to their workers or had acted as a health promotion consultant. Seventeen companies expressed their interest, and six of these agreed to participate in the study. Ten of the remaining 11 companies that were interested in the project wanted to join later on but were not included in this study. The six companies were located across Denmark. Two were private companies (a telecommunications company and a food company), two public municipalities and two national boards (National Board of Social Services). The enrolment dates were as follows: Company A (private company 1) May 2011, Company B (municipality 1) June 2011, Company C (municipality 2) December 2011, Company D (national board 1) January 2012, Company E (national board 2) January 2012, and Company F (private company 2) March 2012. The employees at all six companies included in the study were office workers according to the inclusion criteria and none of them had jobs with a specific focus on health.

8.3 Office worker recruitment and study flow

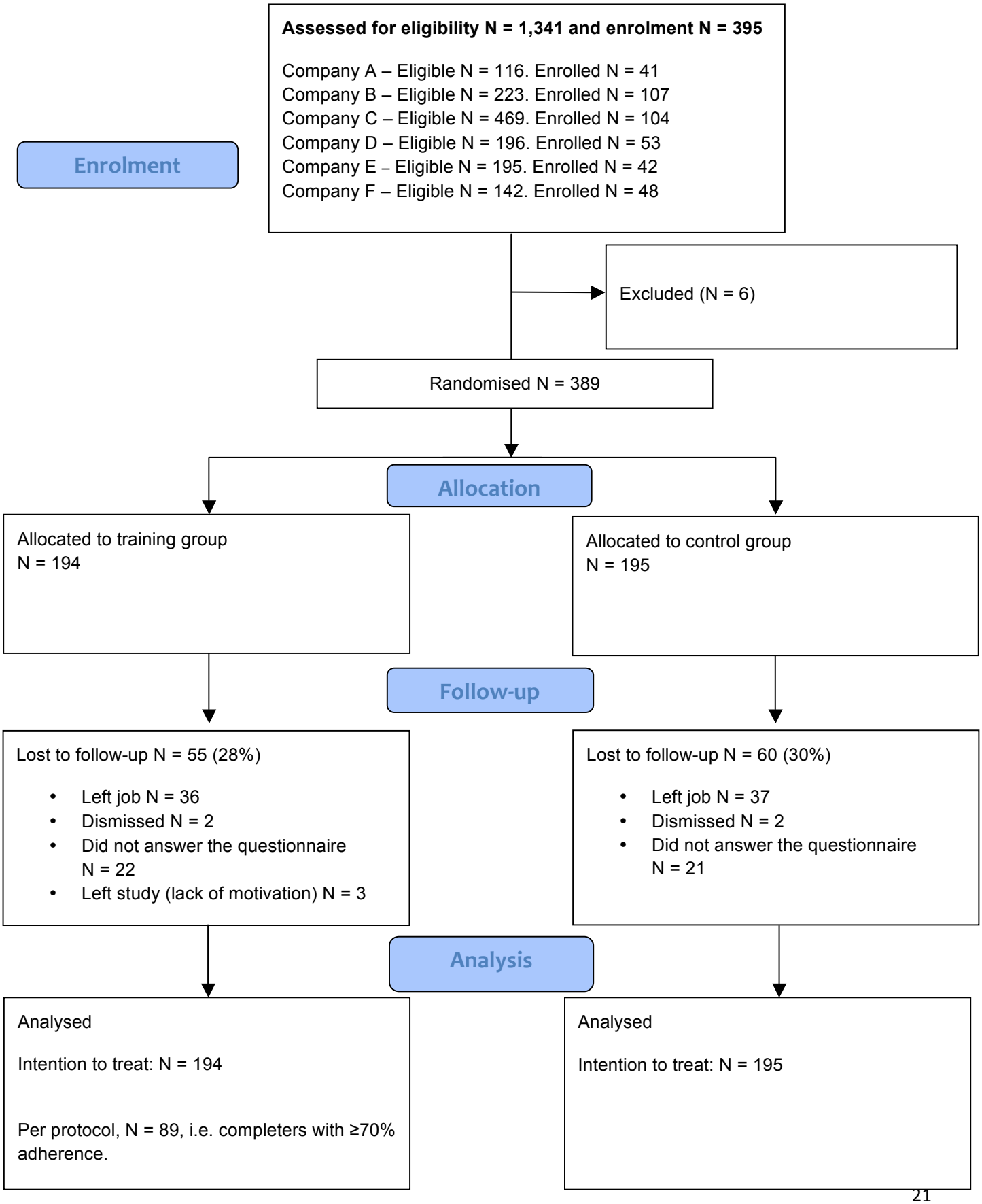
Inclusion criteria: being employed as office workers and working at least 25 hours a week. Exclusion criteria: 1) being casual workers (i.e. students or temporary workers) because they might not be employed by the company for the duration of the study; and 2) pregnant women at the time of the baseline interview were excluded because they would spend some of the year on maternity leave. Also excluded were office workers who self-reported the following conditions at their health check: cardiovascular disease, chest pain during physical exercise, myocardial

infarction (lifetime history), stroke, severe musculoskeletal disorders, symptomatic herniated disc and other severe disorders of the spine, postoperative conditions or lifetime history of severe trauma were also excluded. These exclusion criteria were chosen because employees were to train at high intensity, which would put stress on both their musculoskeletal and cardiovascular systems.

Written informed consent was obtained from all office workers at the start of the study. In total, six office workers were excluded from the study and these were all excluded because they were currently pregnant (Figure 1). As there were very few employees excluded from the study, we did not conduct an analysis to determine whether the included employees differed from the excluded employees.

All employees included at the six workplaces received an electronic questionnaire. Employees who met the inclusion criteria and filled out the questionnaire prior to a health check were part of the project. Four employees were sick or on holiday when the baseline health check was carried out at the workplaces and 84 employees left the project, were sick or on holiday during the one-year follow-up test.

Figure 1: Flowchart (baseline and one-year follow-up)



8.4 Randomisation

All enrolled employees were assigned a sequential study identification number, ID, by an authorised member of technical staff to ensure allocation concealment. After all the employees had completed their questionnaire and baseline measurements at each specific company, they were individually randomised by the supervisor of this study (Gisela Sjøgaard) to a training group, TG, or a control group, CG, using the identification number and a random number computer algorithm. Randomisation was performed within each company and, for the four companies with fewer than 100 employees enrolled, randomisation was stratified to ensure there was gender balance.

8.5 Blinding

Due to the content of the physical exercise training, employees and care providers (instructors and health ambassadors) could not be blinded to group allocation. The outcome assessors were blinded to each employee's group assignment. At follow-up testing, the employees were told not to tell the outcome assessors the group to which they were assigned. The outcome assessors were also trained not to discuss group allocation with the employees. All researchers and data analysts were blinded to group allocation.

8.6 Procedure for implementation

All six companies informed their staff about the project via their own intranet systems, and dates for information meetings were announced two months in advance. In addition to this, the contact person at each company was responsible, together with the human resources manager, for informing all top and middle managers about the present study. The project manager held three to four information meetings at each company. Information meetings addressed the overall aim of the project as well as practicalities such as the type of physical exercise programmes, where the training would take place, the health check, instructors and health ambassadors. The employees attending these meetings were able to ask questions and they all received paper copies of information about the project. This information was also available on the intranet systems of the six companies, allowing everybody at the company access to it. Shortly after the information meetings, all employees received a questionnaire and those interested in being part of the project

completed the questionnaire. IPET was prescribed for all employees in the TG after the first health check by the authors of this paper (Sjogaard, Justesen et al. 2014), and is described in detail below. All employees received the same information and same level of attention before randomisation into the two groups. After randomisation, all employees received a letter in a sealed envelope sent to them at their workplace; this letter contained information about their general health and informed them whether they were allocated to CG or TG. The CG employees were also told to maintain their usual lifestyle and that an annual health check had been scheduled for the next two years. The TG employees were also informed of the workplace training supervised by instructors and told to exercise in their leisure time (30 minutes of moderate exercise) by the health ambassadors. The training intervention is described in more detail below. Neither the TG nor the CG employees received any further information from the researchers over the course of the one-year study.

8.7 Training intervention

A conceptual model was developed for designing individually tailored programmes termed "Intelligent Physical Exercise Training" (IPET). The concept of IPET at the workplace was: 1) to balance the physiological capacity of the employees relative to occupational exposure, 2) to tailor the exercise to individual capacities and disorders to improve employees' health, 3) to motivate employees by offering evidence of an enjoyable program implemented with care, and 4) to be cost-effective for the company.

For all sessions, the training intervention and the theoretical framework of IPET were one-hour long (50-minute training sessions – allowing 10 minutes for getting to and from the training area). Each employee received an individually tailored training programme based on outcome measurements of a health check performed at baseline. The measurements included VO_2max, muscle strength, balance test, core and neck/shoulder stability, BMI, body fat %, blood pressure, blood profile and pain intensity in specified body regions. For each measurement, cut-off points were identified to allocate individual training duration and intensity within cardio-, strength- and/or functional training (see Table 1).

Table 1: Outcome measurements from the health check and questionnaire for selecting optimal individually tailored training programmes within five different training modes.

Health measurements	Cardio	Strength		Function	
	Moderate to high intensity	Neck and shoulders	Large muscle groups	Core stability	Balance
Questionnaire					
Symptoms neck/shoulder		X			
Symptoms lower back				X	
Strength test					
Strength neck/shoulder		X			
Strength back/abdominal			X		
Chiropractor check					
Core stability				X	
Neck/shoulder stability		X			
Physiological health check					
Aerobic fitness test	X				
Body mass index (BMI)	X				
Body fat %	X				
Blood pressure	X				
Blood fat (LDL + HDL)	X				
Blood glucose	X				
Balance test					X

In total, 32 principally different training programmes were identified that were then adjusted to the relative capacity of each employee in terms of training resistance or intensity – see Paper I for an exhaustive description of the 32 different training programmes (Sjogaard, Justesen et al. 2014).

Each employee started a training session with a 20-minute cardio-respiratory fitness routine that included a 10-minute warm-up in order to balance their physically inactive occupational exposure, i.e. long sitting times. After this, instructors guided the employees through their own structured purposeful exercises at the recommended exercise and training intensities for the appropriate time. High intensity exercise was defined as rowing, ball games, running, etc. (targeting 77–95% HR max corresponding to RPE 14-17). Instructors were instructed and trained to measure 1RM when training started at the six workplaces and to progress training when needed. The changes in one repetition maximum (1RM) were not recorded. The individualised intelligent exercise

programmes were composed of a mixture of aerobic exercises, strength training for major muscle groups and functional training following the guidelines from the American College of Sports Medicine (Garber, Blissmer et al. 2011), as well as specific strength training exercises for the neck and shoulder (Andersen, Kjaer et al. 2008). The choice of aerobic exercises was up to the employee with guidance from instructors and with the focus on training at a high intensity. The TG was instructed to train for one hour of IPET per week for one year at high intensity (targeting 77–95% HR max corresponding to RPE 14–17) during their working hours. Training was part of their job description, meaning they were paid to train and training took place at facilities at the workplace or in the local area.

Exercises for strength training (major muscle groups) were selected from five standardised exercises: one for shoulders, three for abdomen-back and one for the chest muscles. The intensity for strength training was 60–80% of one repetition maximum. Employees were instructed to complete three sets of eight repetitions for each exercise, but in a rotating manner between exercises. This allowed for a maximum of a 10-second break between each set. Employees who were prescribed neck and shoulder training were required to perform four different exercises for the upper extremities (Wilson and Jones 1989, Andersen, Zebis et al. 2012). The intensity for neck and shoulder training was to pain limits or as heavy as possible with proper technical execution. They were instructed to complete three sets of eight repetitions with one- to two-minute breaks between sets. Functional training exercises were selected from nine different exercises: five for balance training and four for body core training. The instructors were not given guidelines for the intensity nor for the frequency of these exercises, but were informed to focus on ensuring proper technical execution. The instructors measured training intensity at the end of every training session using the Borg scale (Rating of Perceived Exertion (RPE 6–20) (Wilson and Jones 1989). Furthermore, the employees in the TG were instructed to perform leisure time physical activity for 30 minutes at moderate intensity (64–76% HR max, RPE 12–13) six days per week in their leisure time. Recommended physical activities at a moderate intensity level were as follows: cycling organised physical activity, gardening, climbing stairs, running/jogging and strength training. The CG received no further instructions besides personal results from the two health checks, and only

the TG was motivated to do home-based training (30 minutes of moderate training) by the health ambassadors.

Throughout the first year of intervention, the one-hour training sessions during working hours were supervised by instructors, who were physical education undergraduates from the University of Southern Denmark. Prior to intervention, the instructors were informed about the project and their role in the project. The job description of the instructors was to make sure that employees in the TG completed all exercises described in their programme and trained at a high intensity and using proper techniques. They were also required to motivate the employees during workouts.

8.8 Adherence

Adherence was measured after one year of training for the "completers". After each training session, the instructors filled out the training diary for the employees. Using these diaries, we calculated adherence as the number of completed training sessions out of the total possible training sessions (34–37) within the one-year time period. The number of possible training sessions differed across companies because there were days where training was not possible for some of the companies. For the per protocol analysis, we set a cut-off point of ≥70% for adherence (Church, Blair et al. 2010). The prerequisite for the per protocol analysis for the CG was all employees in the CG.

8.9 Outcome measurements in RCT

Primary outcome (Paper II)

CRF was assessed as maximal oxygen uptake and data presented as VO_2max L/min as well as relative VO_2max in ml/min/kg body mass (Trilk, Ortaglia et al. 2013). VO_2max in L/min was assessed using the Astrand one-point sub-max test using the Astrand nomogram (Astrand and Ryhming 1954) and corrected for age (Astrand 1960). Tests were performed on a bicycle (Monark 874E, Monarch Exercise AB, Sweden) and with a polar® watch (Polar S610i Heart Rate Monitor and Polar FT2 Heart Rate Monitor) to measure heart rate (HR).

Test procedure: The start load was 60 W for women and 90 W for men, and both were instructed to cycle at a speed of 60 revolutions per minute (rpm) throughout the test. After two minutes of

warm-up, the load was adjusted based on HR. If the HR was below 120 beats per minute (bpm) the load was adjusted by 30 W every minute until a steady state (i.e. HR did not change more than four bpm in a one minute interval) was reached between 120 and 170 bpm. The test lasted a maximum of 10 minutes and employees were instructed not to talk during the test. The follow-up test followed the same routine, although if a steady state above 120 was not reached with the baseline load, additional load was added until a steady state was reached. Finally, no familiarisation session was performed prior to conducting the submaximal test, as we believe cycling to be a well-known and popular activity in Denmark. This is why we chose not to include a familiarisation session.

Secondary outcomes (Paper II)

BMI

Body mass index (BMI) was calculated to measure body weight and muscle mass. It was measured using a bio impedance device (Tanita TBF 300). Employees wearing light clothing were measured without their shoes and socks on (1 kg adjustment).

Blood pressure

Blood pressure, BP, was measured in a seated position after five to ten minutes of rest. It was measured on the right arm with an electronic blood pressure device (OMRON M7) and taken three times consecutively with no breaks. The two lowest measurements were taken to provide an average.

Blood profile

On health check day, employees had fasting blood samples drawn between 7 am and 9 am. Blood samples were handled by biomedical laboratory technicians from the University of Southern Denmark. They were analysed in a standardised fashion (enzymatic colorimetric method) for fasting blood sugar, triglycerides, total cholesterol, low density lipoprotein (LDL) and high density lipoprotein (HDL) at the hospitals in the region where the companies were located.

Secondary outcomes (Paper III)

In the Clinical Trial (NCT01366950) the measurement of productivity is defined as individual health, sickness absence and retention at the workplace. Because of the financial crisis in Denmark during the intervention period, retention at the workplace as a measurement of productivity was not appropriate. Instead sickness presenteeism was used as a measurement of productivity together with individual health and sickness absenteeism.

Sickness absence data was collected from all six companies through their human resources managers. Data was collected at baseline (one year before intervention) and after one year of intervention (one-year follow-up). We collected data from all 389 office workers. Data was accrued by years and months, and was cleansed of care days, weekends and the first and second day of child illness. Since only short-term absences (1–10 days) (Carneiro, Rasmussen et al. 2013) were in focus in this study, the periods of long-term sickness absence (≥ 11 days, which is the official cut-off point in Denmark) and part-time leave were discarded before analysis.

Questionnaire

Sickness presenteeism was a combination of general work ability (Tuomi, Ilmarinen et al. 1997), mental work ability (Ilmarinen, Tuomi et al. 1997) and productivity (Pronk, Martinson et al. 2004). Mental work ability is added as part of the study because the employees in this study primarily perform mental work. Furthermore we measured general health (Ware, Gandek et al. 1998) and the employees' contact with the health care system within the last six months. General work ability was rated on a 10-increment ordinal scale: "Imagine that your work ability is worth 10 points when it is at its best. How many points would you give your present work ability?" The rating ranged from one (not capable of working) to 10 (best work ability). Work ability regarding mental demands in the job was rated on a five-increment ordinal scale: "How would you state your present work ability regarding mental demands in your job?" The rating ranged from very good, good, OK, bad to very bad. Productivity was rated on a 10-increment ordinal scale: "How do you perceive your overall productivity in the last three months?" The rating ranged from one (the worst anyone could do) to 10 (the absolute best an employee in that job could do). Self-reported general health was rated on a five-increment nominal scale: "How do you think your health is all in

all?" The rating ranged from excellent, very good, good, less well to poor. Furthermore all office workers were asked three questions about their contact with the health care system within the last six months: "Did you contact the health care system within the last six months due to pain or discomfort in the following body regions? 1. Neck or shoulders. 2. Elbow, wrist or hand. 3. Back, hips, knees or feet." All three questions were answered "yes" or "no".

The following measurements are associated with the RCT and contribute to the understanding of implementing and embedding physical activity at the workplace. Paper IV (implementing workplace health promotion – the role of middle managers) is a sub-part of the RCT study, and includes findings from both the TG and CG. Paper V (implementing workplace health promotion – the role of peers as formal health ambassadors) is also a sub-part of the RCT study, and includes only findings from the employees randomised to the TG as well as those appointed as health ambassadors. Papers IV and V are inspired by Eisenhardt and Graebner's (2007) work on longitudinal multiple case studies.

8.10 Implementation measurements (Papers III and IV)

Middle managers (Paper IV)

Middle managers who had employees and health ambassadors participating in the study at three of the six companies, i.e. 17 people, were invited to a half-day seminar on 'implementing physical activity as a health strategy in the workplace' and an introduction to the two-year health interventions project. All the middle managers at the seminar participated in a survey. Replying to the survey was the first activity on the agenda at the seminar, i.e. the questionnaires were to be completed before the middle managers were introduced to the research project and their role in the research project. One month after completion of the survey, nine middle managers (three middle managers from each of the three companies) were interviewed – six who participated in the half-day seminar and three who did not participate. This selection was undertaken in order to identify the impacts of participating in the seminar.

Data collection

Overall (Table 2), the data presented originates from (1) the questionnaire survey with close-ended questions for all employees after one year (N=305), (2) field notes based on four meetings with health ambassadors at each workplace, (3) nine interviews with middle managers based on semi-structured interview guides at three workplaces, (4) questionnaire surveys with both open-ended and close-ended questions for middle managers as well as for health ambassadors, and (5) focus group interviews with 10 health ambassadors at three workplaces. The answers in the questionnaire containing close-ended questions for the health ambassadors were scaled from 1 to 6 where 1 = I totally disagree, 2 = I disagree, 3 = I neither agree nor disagree, 4 = I agree, 5 = I totally agree and 6 = I don't know. The data were collected from January 2012 to May 2013.

Table 2: Employees in Paper IV.

	Case A Private	**Case B Municipality**	**Case C Municipality**	**Case D National board**	**Case E National board**	**Case F Private**	**Case A – F All employees combined**
EMPLOYEES							
# Baseline	40	105	103	52	42	47	389
# After one year	26	86	88	37	37	31	305
Survey response rate *	96%	94%	99%	92%	92%	87%	93 %
HEALTH AMBASSADORS							
# Appointed	2	5	3	1	2	4	17
Meeting attendance rate**	100%	100%	100%	100%	100%	100%	100 %
Survey response rate	100%	100%	100%	100%	100%	100%	100 %
Interviewed in focus groups	-	-	100%	100%	100%	100%	100 %
MIDDLE MANAGERS							
# Formally involved	-	-	27	7	7	-	41
# In half-day seminar	-	-	13	4	4	-	21
Survey response rate***	-	-	100%	100%	100 %	-	100 %
# Interviewed	-	-	3	3	3	-	9

* Employee survey: employees after one year

** Health ambassador meetings: 4 meetings, 1 meeting every 3 months

*** Middle manager survey: employees in the half-day seminar.

After one year of training, both the TG and the CG answered three questions regarding their middle manager's role in working with WHP. The respondents received the questionnaire by e-mail (SurveyXact). The following three questions were part of the questionnaire in the study design for the overall study and therefore part of the RCT:

1. Do you feel that your middle manager prioritizes WHP at the same level as other tasks and projects in daily business?

2. To what extent do you feel that your middle manager creates room and skills for you to make the healthy choice in daily business?

3. To what extent do you feel that your middle manager creates room for WHP activities in daily business?

The responses to questions are scaled from 1 to 10, where 1 represents 'not at all' and 10 'very much'.

To "prioritise WHP at the same level as other tasks and projects in day-to-day operations" means that WHP should be a part of the middle manager's management tasks as well as all the other areas the middle managers manage.

To "create room and skills for the employees to make the healthy choice in day-to-day operations" means that middle managers must make sure that their employees have the necessary skills to make the healthy choice in day-to-day operations. By "skills" we mean the necessary knowledge about health and how to change their own health behaviour.

To "create room for WHP activities in day-to-day operations" means that middle managers must allocate time for WHP activities in their employees' weekly work schedule.

We define "not satisfied with the middle managers' health work" as when the target group gave a score of five or less for all three statements.

Health ambassadors (Paper V)

The health ambassador's job was to motivate colleagues in the TG to become physically active and sustain this during the course of the research project. The health ambassadors were part of the training group, but not part of the randomising procedure and therefore excluded from analysis because of selection bias as they were part of the implementation process. The health

ambassadors completed a four-day course before the start of intervention, dealing with the following themes: health enhancing physical activity – evidence, myth and gains; ethical issues; theories for changing behaviour; cataloguing ideas for practical facilities; and organisation, motivation and communication (Shiner 1999). They were given suggestions on how to initiate health activities within their workplace. The health ambassador's role was added to their job description and the companies allowed them to dedicate two hours per week to this role. The purpose of the health ambassador training was to educate health ambassadors to motivate and implement physical activity for their colleagues in the workplace. The training was based on evidence-based principles and built on the concepts of both 'peer delivery' and 'peer development' (Shiner, 1999). All training sessions had a practical focus in which the health ambassadors tried out the theories using the learning and training principles described by Brinkerhoff and Mooney (2008).

Table 3: Contents of training programme for the peer health ambassadors

Day 1	Day 2	Day 3	Day 4
Theoretical inputs	**Physical activity at a local gym, theoretical inputs and local development**	**Theoretical inputs**	**Physical activity at a local gym and theoretical inputs**
Definitions: health, enhancing health, prevention and treatment. *(Danish Health and Medicines Authority 2014)* Ethical issues when working with health (for example being physically active) during working hours. Evidence, myths and gains when working with physical activity. *Davis et al. 1987, Pronk et al, 2004, Galinsky et al. 2007, Dishman et al. 2009)*.	The health ambassadors tried different forms of evidence-based physical activities. *(Garber et al. 2011)* Different models and theories for changing behaviour – stages of change. *(Prochaska et al. 1995)* Self-efficacy. *(Bandura 1997)* Diffusion of innovation, whole brain. *(Hermann 1991)* Barriers to working with health in the workplace based on the trainers' experience *(Edmunds et al. 2013)* Development of a catalogue of ideas for physical activity suitable for each workplace.	How to organise and implement projects. *(Harvard Business Essentials 2004, Kraemmer and Divert 2009)* Communication. *(Kraemmer and Divert 2009)* Motivation theory. *(Pink 2009)* Appreciative enquiry. *(Cooperrider and Srivastva 1987)*.	The health ambassadors tried different forms of evidence-based physical activities. *(Andersen et al. 2008, Garber et al. 2011)* Karl Tomm's question wheel. *(Tomm 1985)*.

In order to select employees to become health ambassadors, middle managers at the six companies were asked to identify and appoint candidates in their department using the following criteria: a health ambassador should be appointed for every 10–15 employees in the department joining the intervention group by selection; they should be a team player and find it easy to motivate colleagues; they should be natural initiative-takers; they should be prepared to work on health at the workplace for two hours a week for one year; and the should have been employed at the workplace for at least five years. The prospective health ambassadors were asked by their middle manager to join the project, meaning they had the opportunity to decline. In total, 17 health ambassadors were appointed.

Follow-up meetings with health ambassadors

The purpose of the follow-up meetings was to support the health ambassadors and collect data for the study by addressing the challenges they were facing, as well as gaining insight into their experiences with and thoughts about undertaking the role as change agent. All meetings had the same agenda (everybody presented the following: 1. Good stories, 2. Challenges and 3. How to deal with the challenges until the next meeting). The meetings were facilitated by JBJ. JBJ's role was not to be an expert in the field of implementing health at the workplace but to help the health ambassadors with their job by facilitating their own reflections and problem-solving.

Data collection

One survey was aimed at the TG and concerned their views on the health ambassadors' influence on health promotion and health behaviour at the workplace.

The TG was asked two questions related to their views on the health ambassadors' influence on health promotion and health behaviour in the workplace:

1. To what extent did the health ambassadors influence the health promotion activities at the workplace during the research period?
2. To what extent did the health ambassadors influence your own health behaviour?

The two questions were scaled questions from 0–10 where 0 represented 'no influence' and 10 'strong influence'.

Another survey and all interviews were aimed at the health ambassadors. These means of data collection concerned the health ambassadors' views on the training as well as on their activities and perceived challenges in the role as health ambassador. Focus group interviews were held at four of the six companies, interviewing 10 health ambassadors, and individual semi-structured interviews were held at the last two companies, interviewing the remaining seven health ambassadors.

9. Statistics

The following H_0 hypotheses were tested: There are no differences in the changes in CRF, BMI, blood pressure and blood profile between the TG and CG after one-year intervention. Nor are there any differences in changes in sickness absenteeism, productivity, general work ability, mental work ability, general health and healthcare system contacts regarding pain and discomfort between the TG and CG from baseline to follow-up after one year of intervention.

Intention-to-treat analyses were performed on data from health checks carried forward and backwards for missing values in both baseline and follow-up measurements. Intention-to-treat analyses were performed on data from the questionnaire carried forward and backwards for missing values in both baseline and follow up measurements applying the changes as percentages within each group, respectively.

If measurements had missing values in both baseline and follow up they were replaced using all existing data in each group, respectively (VO_2max was adjusted for sex and age).

Per protocol analysis was performed using office workers in the TG who met the criteria of at least 70% adherence (≥70) as well as using all of the office workers in the CG.

Outcomes were analysed within (paired t-test) and between (ANCOVA) the TG and the CG after one year of intervention. Covariance variables were baseline results. Categorical variables were tested using chi-square and McNemar tests. Descriptive statistics were presented as mean, standard deviations (SD) and frequencies. The assumption of normality was tested using Shapiro-Wilk's test and a Q-Q plot.

Sample size calculation was based on a minimal relevant change of 5% in estimated CRF between groups with a standard deviation of 20%. Power was set to 0.8 with an alpha level of 0.05. We would need at least 128 employees in each group (O'Hara 2008). With an estimated dropout of 30%, the research project targeted the recruitment of 400 employees.

Data is shown as means and standard deviation (SD) (Tables 4–6); group mean differences are shown as means and SD, and are presented with 95% confidence intervals (95% CI). Results were considered statistically significant if the two-tailed P-value was ≤ 0.05. All analyses were performed using SPSS statistical software, version 21.

10. Results

10.1 Baseline

The employees were on average 44 ± 10.4 years old, 75% being female. The employees had an average body mass index of 25.4 ± 5.1 kg/m2, an average percentage body fat of 29.1 ± 8.8% and average steady state HR during the submaximal bicycle test for estimating VO_2max of 146 ± 12.7 bpm. The average CRF for men was 37.7 ± 11.8 ml/min/kg and 35.7 ± 10.9 ml/min/kg for women. Long-term absence periods ≥ 11 days totalled 68 periods for 44 office workers, while 148 office workers (107 women and 41 men) had 0% short- and long-term absence. At baseline, there were no statistically significant differences between TG and CG for the outcome measures (Table 4). Furthermore there were no statistically significant baseline differences for employees in the per protocol analysis compared with the rest of the employees in the TG.

Table 4: Baseline characteristics: P-values of the Independent Samples Test.

Characteristic	Training (N = 194)		Control (N = 195)		P-value	Total (N = 389)		
	Mean	SD	Mean	SD		Mean	SD	95% CI around the mean
Age (years)	44	10.6	45	10.1	**0.26**	44.3	10.4	20–68
Weight (kg)	74	16.1	74	17.1	**0.95**	74.1	16.6	44.9–138.3
VO_2max (L/min)	3.3	0.98	3.3	0.9	**0.97**	3.3	0.9	1.36–7.24
Relative VO_2max (ml/min/kg)	36	11.3	36	11.1	**0.73**	36.0	11.2	10–84
Body mass index (kg/m2)	25.3	5.0	25.5	5.2	**0.80**	25.4	5.1	16.7–49.3
Systolic BP (mm Hg)	124	17.4	124	15.8	**0.67**	124.1	16.6	87–181
Diastolic BP (mm Hg)	81	11.2	82	9.8	**0.57**	81.6	10.5	60–126
HR (steady state)	146	13.4	146	12.0	**0.60**	145.7	13.4	1.37-1.44
Total Cholesterol (mmol/l)	5.1	0.9	5.1	0.9	**0.99**	5.1	0.9	2.60–9
HDL (mmol/l)	1.7	0.5	1.6	0.4	**0.52**	1.6	0.4	0.7–3.45
LDL (mmol/l)	2.9	0.8	3.0	0.8	**0.35**	3.0	0.8	1.20–6.10
Triglyceride (mmol/l)	1.0	0.8	1.0	0.5	**0.63**	1.0	0.6	0.3–6.60
Blood glucose (mmol/l)	5.3	0.9	5.2	1.0	**0.88**	5.3	1.0	3.70–15.10
Productivity (last three months)	8.2	1.0	8.1	1.2	**0.47**	8.2	1.1	8.1–8.3
Work ability (general)	8.7	1.1	8.8	1.1	**0.50**	8.7	1.1	8.6–8.8
Work ability (mental)	4.3	0.66	4.3	0.62	**0.75**	4.4	0.64	4.2–4.3
Sickness absenteeism	4.4	6.2	3.5	4.7	**0.11**	4	5.5	0.4–4.5
General health	3.5	0.72	3.6	0.74	**0.18**	3.6	0.73	3.5–3.6

(BP = blood pressure, HDL = high-density lipoprotein, LDL = low-density lipoprotein, SD = standard deviation and 95 % CI = confidence interval).

10.2 Intervention

The adherence for the TG was 56% (29.2 training sessions) and the adherence across companies ranged from an average of 36% to 62.8%, and 89 (46%) employees had an adherence of ≥ 70%.

CRF values after one year of intervention were 37.7 ± 10.7 ml/min/kg for the TG (men = 39.5 ± 10.3 and women = 37.0 ± 10.8) and 36.0 ± 10.6 ml/min/kg for the CG.

The mean RPE for TG in this study was 15.5.

Intention-to-treat analysis between groups: Table 5 presents the absolute changes between the pre-test and post-test for the TG and the CG. TG had a significant increase in CRF, general work ability, general health and heart rate (steady state) decreased compared to the CG from baseline to one-year follow-up. Furthermore the follow-up test showed a tendency for an increase in productivity ($p = 0.054$) between groups. There were no significant changes between groups for BMI, HDL, LDL, blood glucose, total cholesterol, triglyceride, sickness absenteeism and mental work ability, nor was there a significant decrease in healthcare system contacts regarding pain and discomfort between groups.

Intention-to-treat analysis within groups: significant increase in VO2max in L/min ($p < 0.001$) as well as in ml/min/kg ($p = 0.002$) for the TG only. Significant increase in productivity for both the TG ($p = <0.001$) and CG ($p = 0.006$), a significant decrease in sickness absenteeism ($p = 0.002$) and a significant increase in mental work ability ($p = 0.003$) for the TG only. Systolic ($p = <0.001$), diastolic ($p = <0.001$) BP and heart rate at steady state ($p = 0.001$) decreased significantly in the TG, while in the CG only diastolic BP decreased ($p = 0.01$). Blood glucose decreased in the TG to 5.1 ± 0.6 mmol/l ($p = 0.03$) and in the CG to 5.1 ± 1.0 mmol/l ($p = 0.01$), while blood cholesterol decreased only in the CG to 5.0 ± 0.9 mmol/l ($p = 0.01$), and triglycerides, HDL and LDL remained unchanged in both groups. Contact with the healthcare system showed a significant decrease with regard to pain and discomfort in elbow and hand ($p = 0.049$) and a tendency in neck and shoulder (0.065) within both groups.

Table 5: Summary results of changes for each group and between groups after one year of intervention with intention-to-treat analysis. Differences are estimated as the difference between means with 95% confidence intervals (95% CI) based on Paired T-test and ANCOVA with the level at baseline applied as covariate.

Characteristic	Training (N= 194) Post-pre intervention		Control (N=195) Post-pre intervention		Difference Training – control group		P-value Between groups
	Mean	SD	Mean	SD	Mean	95% CI	
VO_2max (l/min)	0.2*	0.0	0.0	0.0	0.2	0.1–0.2	**0.016***
Relative VO_2max (ml/min/kg)	1.5*	0.5	0.1	0.5	1.4	1.7–1.7	**0.027***
Body mass index (kg/m2)	-0.1	0.2	0.0	0.1	-0.1	-0.4–0.2	**0.38**
Systolic BP (mm Hg)	-3.4*	1.2	-1.5	0.4	-1.9	-4.3–-0.3	**0.08**
Diastolic BP (mm Hg)	-2.8*	0.0	-2.3*	0.3	-0.5	-1.9–-0.7	**0.34**
HR (steady state)	-3.3*	13.7	-0.8	12.0	-2.5	-4.1–-3.4	**0.020***
Productivity (last three months)	0.4*	0.0	0.2*	0.0	0.2	0.2–0.2	**0.054**
Work ability (general)	0.3*	0.1	0.0	0.1	0.3	0.2–0.5	**<0.001***
Work ability (mental)	0.1*	0.0	0.0	0.0	0.1	0.0–0.2	**0.18**
Sickness absenteeism	- 0.7*	2.0	-0.2	0.1	-0.5	-1.1–-1.0	**0.15**
General health	0.3*	0.0	0.0	0.0	0.3	0.2–0.2	**<0.001***

*Significant change within group from pre to post ($p<0.05$). BP = blood pressure and SD = standard deviation.

Per protocol analysis between groups: Table 6 presents the absolute changes from pre-test to post-test for employees in the TG with an adherence ≥ 70%. A significant increase was found for CRF, general work ability, productivity, general health and a significant decrease was found in systolic BP, HR at steady state and sickness absenteeism compared to the CG from baseline to one-year follow-up. The chi-square test showed no significant decrease in contact with the health care system. There were no significant differences in the changes for BMI, HDL, LDL, blood glucose, total cholesterol and triglyceride.

Per protocol analyses within the TG: significant increase in VO_2max L/min (p = <0.001), relative VO_2max in ml/min/kg body mass (p = <0.001), productivity (p = <0.001), general work ability (p = <0.001), general health (p = <0.001) and a significant decrease in systolic BP (p = <0.001), diastolic BP (p = <0.001), HR at steady state (p = <0.001), blood cholesterol to 5.0 ± 0.8 mmol/l (p = 0.011) and sickness absenteeism (p = <0.001) for the group with an adherence ≥ 70%. Furthermore, health care system contact showed a tendency to decrease in the TG (adherence ≥ 70%) with regard to pain or discomfort in elbow and hand (P = 0.065) and there was a tendency for increase in mental work ability (p = 0.068).

Table 6: Summary results of changes for each group and between groups after one year of intervention for employees with an adherence ≥ 70%. 89 employees (46%) had an adherence of 70% or more. Differences are estimated as the difference between means with 95% confidence intervals (95% CI) based on Paired T-test and the ANCOVA with the level at baseline applied as covariate.

Characteristic	Training (N = 89) Pre/post intervention		Control (N = 195) Pre/post intervention		Difference Training – control group		P-value between groups
	Mean	SD	Mean	SD	Mean	95% CI	
VO_2max (L/min)	0.4*	0.6	0.0	0.0	0.4	0.2–0.1	**<0.001***
Relative VO_2max (ml/min/kg)	4.2*	6.4	0.1	0.5	4.1	2.6–1.7	**<0.001***
Body mass index (kg/m2)	- 0.1	2.4	0.0	0.1	-0.1	0.6–0.4	**0.45**
Systolic BP (mm Hg)	-5.4*	13.7	-1.5	0.4	-3.9	-5.0–-3.5	**0.043***
Diastolic BP (mm Hg)	-3.8*	9.3	-2.3*	0.3	-1.5	-3.0–-1.9	**0.12**
HR (steady state)	-6.9*	12.8	-0.8	12.0	-6.1	-5.0–-3.2	**<0.001***
Productivity (last three months)	0.5*	1.2	0.2*	0.0	0.3	0.4–0.3	**0.014***
Workability (general)	0.5*	1.1	0.0	0.1	0.5	0.3–0.3	**<0.001***
Workability (mental)	0.1	0.7	0.0	0.0	0.1	0.2–0.2	**0.24**
Sickness absenteeism	-2.2*	5.4	-0.2	0.1	-2.0	-1.5–-1.0	**<0.001***
General health	0.4*	0.0	0.0	0.0	0.4	0.3–0.2	**0.001***

*Significant change within group from pre to post (p<0.05). BP = blood pressure and SD = standard deviation.

10.3 Questionnaire surveys (middle managers)

In questionnaires prior to intervention, all middle managers in the case study (except two, who neither agreed nor disagreed) argued that employers should be engaging employees when implementing WHP. The middle managers also agreed that it was the top managers' job to engage employees before implementation. When asked about their own role in engaging employees, more than 50% of the middle managers thought that it was not down to them.

94% of all employees answered three questions (Table 7), the outcome demonstrating that middle managers did not succeed with the implementation of WHP in this research project.

Table 7: Employees' views on their middle managers' role performance. The responses to questions are scaled from 1 to 10, where 1 represents 'not at all' and 10 'very much'.

Questions	**Training (N = 144)**		**Control (N = 144)**		
	Mean	**SD**	**Mean**	**SD**	**P-value**
Do you feel that your middle manager prioritises WHP at the same level as other tasks and projects in day-to-day operations?	4.5	3.1	3.9	3.1	0.13
To what extent do you feel that your middle manager creates room and skills for you to make the healthy choice in day-to-day operations?	5	2.9	4.5	3.1	0.20
To what extent do you feel that your middle manager creates room for WHP activities in day-to-day operations?	4.5	2.9	4.1	3.0	0.25

10.4 Questionnaire surveys (health ambassadors)

The results from the survey of the 17 health ambassadors at the six workplaces clearly show that support from middle management is necessary in order to implement WHP activities (4.6 ± 0.5). Furthermore, all health ambassadors found that it was necessary to involve their middle managers when implementing WHP activities (4.8 ± 0.4), and involvement of middle managers is necessary if health ambassadors are to succeed in their work (mean of 3.9 ± 1.1). In total 137 employees participated, giving an 80% response rate.

Table 8 illustrates TG's view on the health ambassadors' influence on health promotion and health behaviour in the workplace. The answers to both questions imply that the health ambassadors have had some influence on both the health promotion activities and the individual behaviour of the TG members. However, the numbers clearly show that there is room for improvement, especially when it comes to influencing health behaviour.

Table 8: Differences are estimated as the difference between means with 95% confidence intervals (95% CI) based on an unpaired T-test). Employees (number men: 38, and women: 99) gave ratings on a 10-point scale: 1 = no influence, 10 = strong influence.

	To what extent did the health ambassadors influence the health promotion activities in the workplace during the research period?	**To what extent did the health ambassadors influence your own health behaviour?**
Mean	5.16	3.88
Standard deviation	2.92	2.84
N	137	137
Significant difference between men and women	NO	NO
Mean (men)	5.32	4.63
Mean (women)	5.11	3.60

11. Discussion

The major findings in the present PhD thesis are that one weekly hour of supervised high intensity IPET at the workplace combined with recommendations of 30 minutes of moderate intensity physical activity six days per week for one year among office workers had the following outcomes:

1) It significantly increased estimated CRF in terms of VO_2max (L/min) as well as relative VO_2max (ml/min/kg). The magnitude of increase in CRF was approximately 5% in the intention-to-treat analysis and approximately 7% in the per protocol analysis. Additionally, a number of physiological health risk indicators improved significantly.
2) It significantly increased general work ability and general health in an intention-to-treat analysis, and additionally, in a per protocol analysis, significantly increased productivity and decreased short term sickness absenteeism.
3) It shows that middle managers do not find it easy nor are they willing to fit WHP into their daily work. Middle managers would like more knowledge and skills if they are to work with WHP in daily business. Furthermore, implementing and embedding WHP as a health strategy raises ethical issues of interfering with employees' health, which by tradition has been the employee's private responsibility.
4) It showed that appointing peers as health ambassadors had great potential as an added behaviour-change technique. However, implementation of the above also adds to the knowledge of researchers and practitioners with respect to the difficulties of implementing and embedding WHP activities in the workplace.

These findings will be discussed in relation to the aim of this study with a focus on implementing physical activity successfully as WHP. The discussion is divided into the following sections: content of the IPET intervention; primary outcome of CRF and other health risk indicators; sickness presenteeism and absenteeism; implementation of WHP; strengths and weaknesses.

11.1 IPET

The present WHP intervention is very distinct from previous initiatives in terms of its content. The systematic framework of IPET was: 1) to balance the physiological capacity of the employees

relative to occupational exposure, 2) to tailor the exercise to individual capacities and disorders to improve employees' health, 3) to motivate employees by offering evidence of an enjoyable programme implemented with care, and 4) to be cost-effective for the company. In this thesis, the intervention targeted 77–95% HR max, corresponding to vigorous activity (Garber, Blissmer et al. 2011). We did not measure HR during training intervention, but the measured RPE values were 77–95% HR max = 14–17 RPE. The mean RPE for TG in this study was 15.5. Further, we did not measure HR or RPE for 30 minutes of moderate training in leisure time.

The concept developed in this thesis – and now proved to be effective among office workers – is documented in detail (Sjogaard, Justesen et al. 2014). Expenses incurred for the health check may be minimised by further optimising for essential variables; supervision may be minimised by the use of motivating ICT gadgets, simple exercises and well-explained training diaries (Gram, Andersen et al. 2014). Such efforts may eventually result in cost-effectiveness in the derived benefit for the companies and improved health for the workers and society as a whole.

11.2 CRF

The following recent RCT studies of physical activity interventions at the workplace find significant changes in CRF between groups for occupations other than office workers (Pohjonen and Ranta 2001, Eriksen, Ihlebaek et al. 2002, Christensen, Faber et al. 2011, Gram, Holtermann et al. 2012, Korshoj, Lidegaard et al. 2014). Although the RCT studies document some evidence that physical activity interventions at the workplace can be efficacious, the overall results are in alignment with a recent systematic review of workplace physical interventions from Malik, Blake et al. (2014), who state that the overall results are inconclusive. The conclusions of Malik, Blake et al. (2014) consolidate the current evidence from workplace physical activity interventions (Proper, Koning et al. 2003, Conn, Hafdahl et al. 2009, Rongen, Robroek et al. 2013). One reason why the results are inconclusive might be that the majority of physical activity interventions targeting CRF at the workplace are of moderate intensity and are not individually designed (Proper, van der Beek et al. 2004, Kennedy, Boreham et al. 2007, Block, Sternfeld et al. 2008, Blangsted, Sogaard et al. 2008, Puig-Ribera et al. 2008, Pedersen et al. 2009, Reijonsaari, Vehtari et al. 2012, Wolever et al. 2012). As Gormley et al. (2008) find in their study, high-intensity physical activities are more effective for

increasing VO_2max compared to activities comprising lower intensities, even when the lower intensity exercise is performed for a duration sufficient to accomplish the same total amount of work (Gormley, Swain et al. 2008). In order to achieve improvements in CRF, an exercise intensity of ≥ 60% of HR max is required (Davies and Knibbs 1971). Additionally, Pavey et al. (2013) in The Australian Longitudinal Study find that high intensity physical activity provides significantly higher protection against depression and cardiovascular risk than physical activity at moderate intensity. Furthermore Sassen et al. (2009, 2010) find that cardiovascular risk factors are strongly associated with the intensity of physical activity intervention. In other words, the effort to improve physical fitness (high intensity training) will improve the cardiovascular risk profile and subsequently prevent cardiovascular morbidity and mortality (Sassen, Cornelissen et al. 2009, Blair 2009, Sassen, Kok et al. 2010). Though the above studies argue for high intensity physical activity as being more effective on cardiovascular disease and mortality than physical activity at moderate intensity, studies have shown that even walking and lifting at work prevent cardiovascular disease and mortality (Moe, Mork et al. 2013).

The significant increases in CRF detailed in this thesis are considered to demonstrate a clinically relevant decrease in the risk of metabolic and cardiovascular disorders (Blair, Kohl et al. 1989, Laukkanen, Rauramaa et al. 2007, Haskell, Blair et al. 2009) and further, that hypertensive individuals are at decreased risk of future short- and long-term cardiovascular complications (Rapsomaniki, Timmis et al. 2014). A significant training-induced reduction in blood pressure is of the utmost preventive importance. Even in normotensive individuals, a reduction in blood pressure parameters is favourable for general health (Rapsomaniki, Timmis et al. 2014). In the TG, a significant decrease in systolic BP of 3.4 mmHg was found for the intention-to-treat analysis and a 5.4 mmHg significant decrease was seen in the per-protocol analysis. Furthermore there was a significant decrease in systolic BP of 3.9 mmHg between groups in the per-protocol analysis. The magnitude in reduction of systolic blood pressure is of clinical relevance (Moraes, Bacurau et al. 2012) and it has a major influence on public health. Hypertension is one of the most prevalent modifiable cardiovascular risk factors in the Western World (Ibsen et al. 2000, Rapsomaniki, Timmis et al. 2014). In comparison with our findings, earlier studies could not document significant reductions in blood pressure between groups after physical exercise training interventions at

different workplaces (Proper, Koning et al. 2003, Conn, Hafdahl et al. 2009). However, more recent RCT studies have been able to demonstrate a significant reduction in blood pressure after training interventions among other workgroups (Pedersen, Blangsted et al. 2009, Christensen, Faber et al. 2011, Zavanela, Crewther et al. 2012), providing great potential for workplace health promotion. The decrease in systolic blood pressure in the present study is an interesting finding for practitioners working with health promotion activities at the workplace, since systolic blood pressure has a greater significance than diastolic blood pressure as a cardiovascular risk factor for angina, myocardial infarction and peripheral arterial disease, particularly in later life (Basile 2002, McEachan, Lawton et al. 2011, Rapsomaniki, Timmis et al. 2014).

11.3 Sickness presenteeism and absenteeism

A review of recent RCT studies found no similar positive effects for productivity, general work ability, short term absence and general health between groups with physical activity interventions at the workplace during working hours for office workers. A similar study of Danish office workers conducted in 2005 to 2006 found positive effects between groups for CRF, but no effects on productivity, general work ability, short term absence and general health between groups were found (Blangsted, Sogaard et al. 2008, Pedersen, Blangsted et al. 2009). Importantly, the aim of that study was to reduce musculoskeletal disorders in the neck and shoulder area – which was successfully achieved – and the exercises implemented were distinct from those in this study.

The negative economic impact of sickness presenteeism has been reported to be up to seven times greater than that of absenteeism (Collins, Baase et al. 2005). Investigation of sickness presenteeism may therefore be even more important than absenteeism. It is worth noting that sickness presenteeism has been reported to be inversely related to absenteeism. For example, a societal crisis where workers lose their jobs may be a factor that reduces absenteeism but at the same time will increase sickness presenteeism (Johns 2010). The underlying mechanism is quite likely to be that workers who are afraid of losing their jobs will come to work even though they are ill, which may impair their work ability and productivity. In contrast, in the present study a per protocol analysis showed a decrease in both sickness presenteeism (significant increase in productivity and general work ability and an increase in mental work ability) and absenteeism

among office workers in the TG compared to the CG. These inter-group effects were also significant for self-reported general health, showing that the intervention in question positively affected health in TG, thereby indicating that the decrease in sickness presenteeism may be due to improved health rather than concerns about losing their jobs. Recent reviews only found very limited evidence on the effect of physical activity on presenteeism (Brown, Gilson et al. 2011, Rongen, Robroek et al. 2013) and absenteeism (Odeen, Magnussen et al. 2013, Rongen, Robroek et al. 2013). In this study we found strong evidence of the relationship between physical activity (high intensity IPET) and sickness presenteeism and absenteeism for completers. Our definition of presenteeism in this study is not an accepted standardised concept and, as Brown, Gilson et al. (2011) advocate in their recent review, there is a need for a standard definition and evaluation tool.

Overall, the positive findings in sickness presenteeism, sickness absenteeism and general health for office workers in this study underline the effectiveness and corporate incentives of implementing IPET at the workplace.

11.4 Implementing WHP

A recently published Cochrane review (Wierenga, Engbers et al. 2013) states that process evaluation is necessary to increase the acceptance rate in studies. Neither should it be forgotten that design and evaluation of health interventions are complex because they are difficult to develop, document and reproduce (Campbell, Fitzpatrick et al. 2000). Campbell et al. argue for a theoretical phase and a phase 1 (defining components of the intervention), where disciplines other than health science are studied, e.g. organisational changes. Qualitative designs such as focus group interviews or field studies can help us with implementation and can be used to show how the intervention will work and also to find potential barriers to a positive effect. Wierenga et al. (2013) state that process evaluation is lacking in most studies, resulting in a lack of systematic measures of barriers to implementing WHP. A more thorough process and effect evaluation than that used in this study, combined with a culture analysis before intervention, is necessary for the latter to succeed and demonstrate a greater effect in future studies.

The following process and effect evaluation describes what we identified after intervention:

1. The biggest barrier was management, although we worked with them prior to intervention.
2. The in-house project managers must have time in their normal duties to work on the implementation of WHP together with middle managers and health ambassadors.
3. Employees must have a say in the selection of training activities.

It seems also important to measure the work of the health ambassadors every quarter. Instructors are obvious candidates to measure effects of training at the training facilities, where the in-house project manager seems to be the right one to measure the work of health ambassadors in terms of their ability to motivate their colleagues to undertake the WHP activities. Hopkins, Glenn et al. (2012) process-evaluated their recent study: "Implementing organisational physical activity and healthy eating strategies in paid time". They found that six factors were associated with success or failure of intervention implementation. Two of the six factors focused on the organisation of the intervention. Firstly, it was suggested that peer leaders (health ambassadors) are necessary for success. This is not a question of technical aspects regarding physical activity, but of motivating their colleagues and communicating with middle managers. Secondly, the involvement of management is required: departments which tailored their own strategies and routines were the ones that succeeded in the implementation.

In reply to Hopkins, Glenn et al. (2012) findings regarding the organisation of the intervention this study worked with the organisation of the intervention through health ambassadors and middle. Findings from our work with peer leaders (health ambassadors) in this study showed that only 21% of all the employees left the study during the intervention and only 1.8% left because of lack of motivation. Further we worked with management in this study, but they did not tailor their own health strategies and routines to working with WHP.

The thesis show that the involvement of employees, health ambassadors and middle managers in the goal of getting all eligible employees to participate in WHP is essential for success and effectiveness. Involvement is not just the facilitation of information meetings and sending out materials in WHP activities. Involvement also required culture- and stakeholder-analyses where the governance of the company is studied before intervention and where departments tailor their own health strategies and routines.

When implementing WHP at the workplace, interventions should consider the difference between men and women when it comes to health. Only 25% of the employees in our study were men. The six companies in this study had a mean of 65% women and 35% men for all employees in the companies, implying that men are harder to attract than women given the design of this study. This is a general problem in workplace health interventions where study samples tend to be dominated by women (Waters, Galichet et al. 2011). A recent study reported in the American Journal of Men's Health suggests the contention that workplace physical activity interventions are not designed for men (Wong, Gilson et al. 2012). The authors conclude that in order to attract men to workplace health interventions, consultation at the pre-intervention and planning phase are necessary, and that men should have a free choice of activities with high intensity in dialogue with the instructors. This approach is not just to facilitate men's involvement in a study, but it provides a strategy that reflects men's real world physical activity needs and preferences (Wong, Gilson et al. 2012).

An Implementation Process Model for middle managers based on the experience in the present study will be described in Future Perspectives. The process model may help dealing with the challenge of inconsistent evidence of the impact of physical activity interventions on CRF, health risk indicators, sickness presenteeism and absenteeism.

11.5 Strengths and limitations

There were several strengths in this study. The mean age and gender distribution of the employees were similar to the office workers in the workforce in Denmark. The companies were from the private and public sectors and were located in different parts of Denmark. This means that the companies and the office workers were representative of the workforce in Denmark. This study also had a rigid RCT design based on the involvement of experts within occupational health as well as sports science, and the study embraces different scientific approaches ranging from RCT-based hypothesis testing to social science descriptive analysis (case studies). Another Strength was the interdisciplinary approach, the use of data triangulation and the longitudinally element in

relation to study peers as health ambassadors and middle managers. Furthermore, the study had a fairly low dropout rate of 1.8%. All six companies in the study had training facilities located close to their premises where well-educated instructors were in charge of the high intensity training. The design used in the present study can therefore be successfully implemented at workplaces with such facilities.

A limitation in the RCT study was possible contamination due to study employees being individually randomised to TG and CG, respectively, and not by cluster randomisation at a work organisational level such as department or company. Employees in the CG could have learned the exercises that were assigned to their co-workers; however, these exercises would not have been tailored to their own physical needs based on the health check and they would not have been supervised. The extensive variations in exercises prescribed to each individual in the TG were presented in Paper I (Sjogaard, Justesen et al. 2014). Another limitation of this study was the supervised training. Depending on the size of the group, the supervision may not have been sufficient, as it was not possible to follow each employee throughout their training session. Likewise, training together with one's colleagues might have generated more talk on work matters, instead of focusing on training intensity. The poor adherence (56%) is another limitation of the study and the significance of this limitation is seen from the quite large difference in the intervention's effect in the intention-to-treat and the per-protocol analyses, the latter showing twice the effect. Adherence to physical exercise interventions has already been highlighted as challenging and is often cited as a limitation to the demonstrated results (Proper et al. 2003, Blangsted et al. 2008). Often the training intervention offered has been generalised to the line of business, e.g. specific strength training for neck and shoulders for office workers (Andersen et al. 2008) and not to the individual employee. In this study, we conducted IPET on an individual basis, partly because of a more holistic approach to the employee's physical capacity, but also in an attempt to enhance adherence among participants. In our study, an adherence of 56% was found, which was not superior to that of nine RCTs recently conducted in Denmark (Sjogaard, Justesen et al. 2014), the latter showing a mean adherence of 61% (range between 31% and 86%). Our study, with individualised IPET, did not increase knowledge on how to improve adherence. Furthermore, Borg's RPE is a subjective measure, and measuring heart rate would be a more accurate

measurement of intensity. Thus, in a meta-analysis, it was emphasised that although Borg's RPE scale has been shown to be a valid measure of exercise intensity, its validity may not be as high as previously thought (Chen, Fan et al. 2002). However, in terms of practicability, Borg's RPE is feasible and cheap when implementing work health promotion interventions. Finally, no familiarisation session was performed prior to conducting the submaximal test, as we believe cycling to be a well-known activity in Denmark. For this reason, we chose not to include a familiarisation session.

A limitation of the case studies is that they do not suggest a roadmap for top management and middle managers on how to appoint and employ health ambassadors in practice. Furthermore, one limitation of this thesis is that it does not provide a detailed discussion of management support from both middle and top managers as a significant precondition for health ambassadors to be successful. Other limitations of this thesis were the relatively few interviews of middle managers, their low attendance at the half-day seminar on strategic health, where only 50% of all the middle managers participated, and the fact that there was no roadmap for middle managers on how to execute WHP in day-to-day operations.

12. Future Perspectives

12.1 Building a new model for implementing and embedding WHP

Findings from the present case studies and adherence in the RCT, together with existing literature, acknowledge a need for a model that can help middle managers execute WHP as a strategy comprising the engagement of their employees, the challenges of day-to-day operations and ethical issues. The following WHP implementation process model shows how the incorporation of the defined propositions (interviews and questionnaires from health ambassadors and middle managers) and existing literature to support the propositions (Table 9) can enable middle managers to implement and embed WHP at the workplace successfully. The model can be used as a benchmark for implementation effectiveness in future studies.

Model 1: WHP Implementation Process Model for middle managers. The model refers to the propositions presented below in Table 9

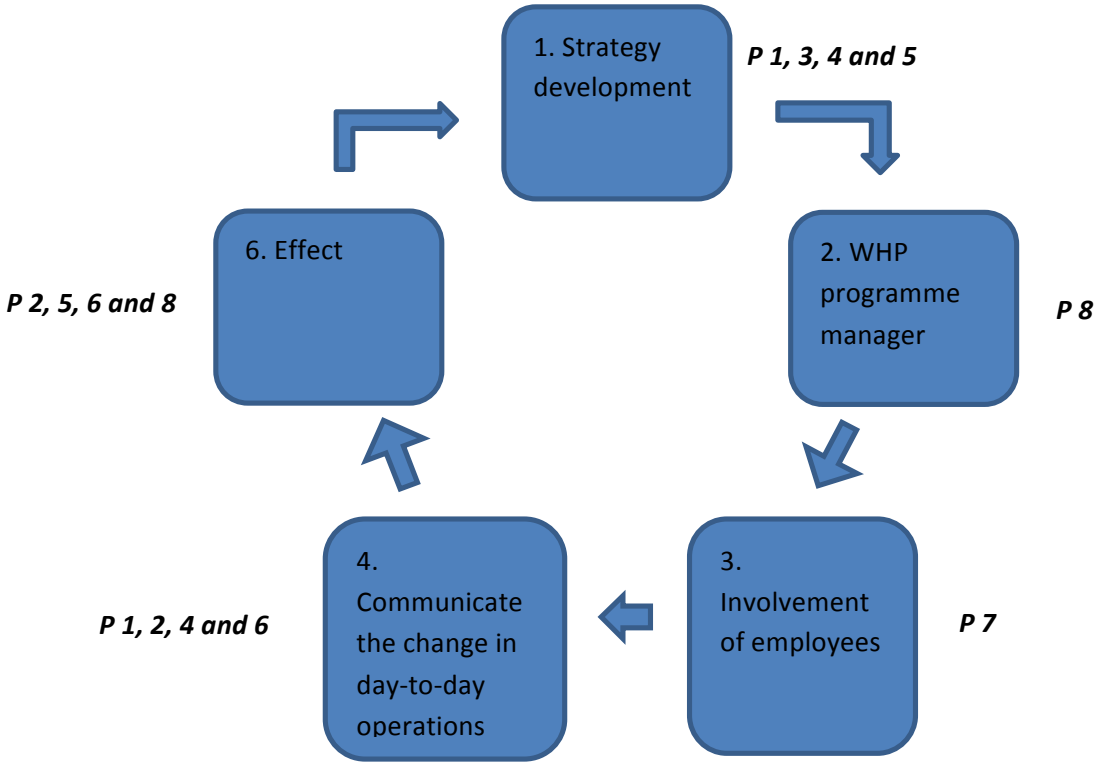


Table 9: Propositions for building an implementation process model for middle managers

Proposition 1	*In order to make employees change health-related behaviour, middle managers must through their own behaviour and attitudes communicate the importance of suitable health-related behaviour*	'Setting the scene' in terms of not only using the normal channels of communication in the company (like posters and intranet), but personally communicating the WHP project is a key tool for communicating change and part of the middle managers' role (Rouleau and Balogun 2011).
Proposition 2	*In order to make middle managers clear about their role in WHP implementation, training, including theory inputs on WHP and health management, is necessary*	
Proposition 3	*In order for middle managers to feel confident about ethical issues regarding interfering with employees' 'private life', an engagement process must take place before they can fulfil their role in implementing WHP in the workplace*	Our findings relate to Grant (2008), who states that for successful alignment to happen it is necessary to study the culture of middle managers within organisations, because over time people working together will think and act in a similar fashion and become self-protective and resistant when 'outsiders' attempt to change them. Furthermore, the literature supports the notion that alignment between the value systems of the change intervention and the existing culture is necessary for change to happen (Burnes and Jackson 2011).
Proposition 4	*In order for WHP to become part of day-to-day operations, top managers and middle managers must work together to align WHP in the governance structure of the company*	
Proposition 5	*In order for middle managers to succeed, they must work together with top managers*	As the current literature states, middle managers have a key role as drivers of change (Huy 2001, Neubert and Cady, 2001, Barton and Abrosin, 2013). Furthermore, to implement change projects with success it is important to define roles for various parties involved in the change, and it is essential for all organisations to identify the resources and competencies needed for successful change (Grant 2008, Sassen, Kok et al. 2010, Michel et al. 2013). Middle managers must work together with their employees instead of directing change from the top, and to succeed they must work as facilitators and coaches (Kanter 2008). Berry et al. (2010) state that middle managers must work together with a health programme manager in order to succeed.
Proposition 6	*In order for middle managers to succeed, they must set goals for their health ambassadors and follow up on their work*	
Proposition 7	*Engaging employees is crucial for successful implementation of WHP, and middle managers must be in charge of the engagement process*	
Proposition 8	*A health programme manager is necessary in order to succeed in implementation of WHP, and the programme manager must adjust and evaluate activities and assist middle managers in measuring effect*.	

Testing the model was outside the scope of the research reported in this thesis. Future studies will investigate the effect of the WHP implementation process model on middle managers role and performance when it comes to implementing and embedding WHP with success.

13. Conclusion

This study demonstrated that one hour of supervised IPET during working hours every week and recommendations of 30 minutes of exercise at moderate intensity six days a week had several positive effects. The intervention increased CRF significantly by approximately 5%, and also improved general work ability and general health for the TG compared to CG. Furthermore, employees with an adherence of ≥ 70% had a significant increase in sickness presenteeism, a significant decrease in sickness absenteeism and systolic BP and an even higher improvement in CRF and general health. This thesis also increases the understanding of researchers and practitioners as to the difficulties of implementing WHP activities as well as new means to solve these, as both these professions must be aware of the resistance to change and not take for granted that middle managers who work with change on a daily basis find it easy to fit the execution of WHP into their implementation models. In addition to this, our findings show that appointing the 'wrong' health ambassadors, as well as insufficient instruction for the ambassadors, can severely jeopardise a WHP initiative, even when the initiative is supported by top management and the target group members are highly motivated to change their health behaviour at the starting point. Overall, these results underline the effectiveness and corporate incentives of implementing IPET at the workplace.

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15. Papers

Paper I (pdf file – published article).

Paper II.

Implementing intelligent physical exercise training at the workplace: Health effects among office workers - a randomized controlled trial

Abstract

Background: Introducing physical exercise training for preventing lifestyle diseases at the workplace can be an effective tool for health promotion. The aim of this study was to assess the cardiovascular effects of individually tailored intelligent physical exercise training, IPET, for office workers.

Methods: The study was a two-year randomized controlled trial among office workers allocated to a training, TG, (N = 194) or a control group, CG, (N = 195). The TG received one-hour high intensity IPET every week within working hours and was further recommended to perform 30 minutes of moderate intensity physical activity six days a week during leisure time. Before and after the intervention, the office workers received a health check including an indirect estimate of maximal oxygen uptake (VO_{2max}), BMI, blood pressure (BP), and blood profile. The health check served as input for tailoring IPET, using cut-points for each health risk indicator. Further, occupational exposure in terms of physical inactivity impacted on the IPET schedule for all participants.

Results: At baseline, there were no differences between groups. The overall mean values (mean ±SD) were: VO_{2max} 3.2±0.9 l/min or 36±11 ml/min/kg body weight, systolic/diastolic BP 124±16/81±10mmHg, blood glucose 5.2±1mmol/l, and total blood cholesterol 5.1±0.9mmol/l. An intention-to-treat analysis showed after the first year a significant 5% increase in VO_{2max} in TG group compared with the CG. Furthermore, within the TG a significant decrease occurred in systolic/diastolic BP of 3.4/2.8mmHg, and blood glucose of 0.2mmol/l. A per protocol analysis,

among employees in the TG with an adherence of ≥ 70% (N = 89) showed a significant 7% increase in VO_{2max} and significant decrease in systolic BP (3.9 mmHg) compared with the CG. Further, within the high adherence TG a decrease in systolic/diastolic BP of 5.4/3.3mmHg, and blood cholesterol of 0.2mmol/l was seen.

Conclusion: High intensity IPET combined with recommendations of moderate intensity physical activity significantly increased VO_{2max} in absolute values and relative to body weight. The magnitude of increase implied decrease in cardiovascular health risks factors. Within the TG decreases in BP and blood glucose/cholesterol additionally indicated a decreased health risk. In all, this study was effective in decreasing health risk indicators among office workers.

Trial registrations: NCT01366950.

Key terms physical activity intervention, risk factor for cardiovascular disease; work health promotion.

Background

The workplace is an ideal setting for implementing health promotion programs that may have an impact on employees' health [1]. The World Health Organization (WHO) has emphasized the workplace as an important arena for public health campaigns [2]. Previous health promotion studies in the workplace have shown to be useful for the prevention of musculoskeletal disorders [3], prevention of the uptake of smoking [4], reduction of overweight workers [5, 6], reduction of alcohol consumption [7], and increase in the level of physical activity [8].

Research has shown that physical activity prevents a wide range of diseases such as psychological diseases, musculoskeletal diseases and cardiovascular diseases [9, 10]. RCT studies have shown an increase in physical activity [11] was associated with an increase in quality of work and a decrease in sick leave when physical activity was implemented at the workplace [12, 13]. In addition, a (type of study cohort, RCT) study found that physically active employees had higher energy surplus and were in general, less stressed than physical inactive employees [14]. Though workplace interventions designed to promote physical activity have shown positive results, in some studies

these results were controversial [8, 15]. Therefore, more high quality studies within the workplace are needed.

A recent meta-analysis of effectiveness of workplace health promotion (WHP) concluded that effectiveness is partly determined by intervention characteristics [19]. In line with this we have in previous studies started to design a physical activity concept where individualized tailored practical training sessions are developed for employees at the workplace [16, 17]. It combines all forms of physical activity in order to improve everybody´s cardiorespiratory fitness, muscular strength and endurance, body composition, flexibility and/or neuromotor fitness.

In summary, the workplace is a place where health promotion strategies can be implemented and have been shown to improve the worker's health [3, 16 and 17]. However, there exists a gap in literature when it comes to high quality controlled trials aiming to improve physical activity for office workers at the workplace [18, 19]. To improve the effectiveness of WHP physical activity interventions may need to be tailored individually and implemented in working hours [20]. Therefore, the aim of the present study was to investigate the effects of implementing individually tailored intelligent physical exercise training, IPET, for office workers over a two-year period [20].

Objective

The present paper presents health effects of one weekly hour of supervised high intensity intelligent physical exercise training at the workplace combined with recommendations of 30 minutes of moderate intensity physical activity six days per week The primary end-point was cardio-respiratory fitness (CRF) after one-year. During the first year, the training at the workplace was supervised every week and in addition self-training 30 minutes every day was recommended, therefore, CRF was hypothesized to increase in the first year. During the second year, the aim was to maintain the increase in CRF. Training supervision was given once a month at the workplace and data will be presented in a subsequent paper.

Method

Study design

The study design was a randomized single-blinded parallel controlled trial conducted from May 2011 to March 2014. Further details have been extended below and described previously [20].

The project was approved by the local Ethics Committee of Southern Denmark (S-20110051) and registered in ClinicalTrials.gov, number: NCT01366950.

Workplace recruitment

In May 2010, 103 companies across Denmark were contacted by an e-mail to determine their interest in this study. The project manager (author JBJ) had a previous business relationship with each of the companies. The nature of this relationship was either previously teaching project management to their workers or a health promotion consultant. Seventeen companies expressed their interest and six of these agreed to be involved with the study [20]. The six companies were located across Denmark. Two were private companies (a telecommunications company and a food company), two public municipalities, and two national boards (department of social services). The enrollment dates were: Company A (private company 1) May 2011, Company B (municipality 1) June 2011, Company C (municipality 2) December 2011, Company D (national board 1) January 2012, Company E (national board 2) January 2012, and Company F (private company 2) March 2012. The job roles of the participant's at all six included companies were office workers according to the inclusion criteria and none of them had a specific focus on health.

Office Worker Recruitment and Study Flow

Inclusion: All participants were employed as an office worker and working for at least 25 hours a week.

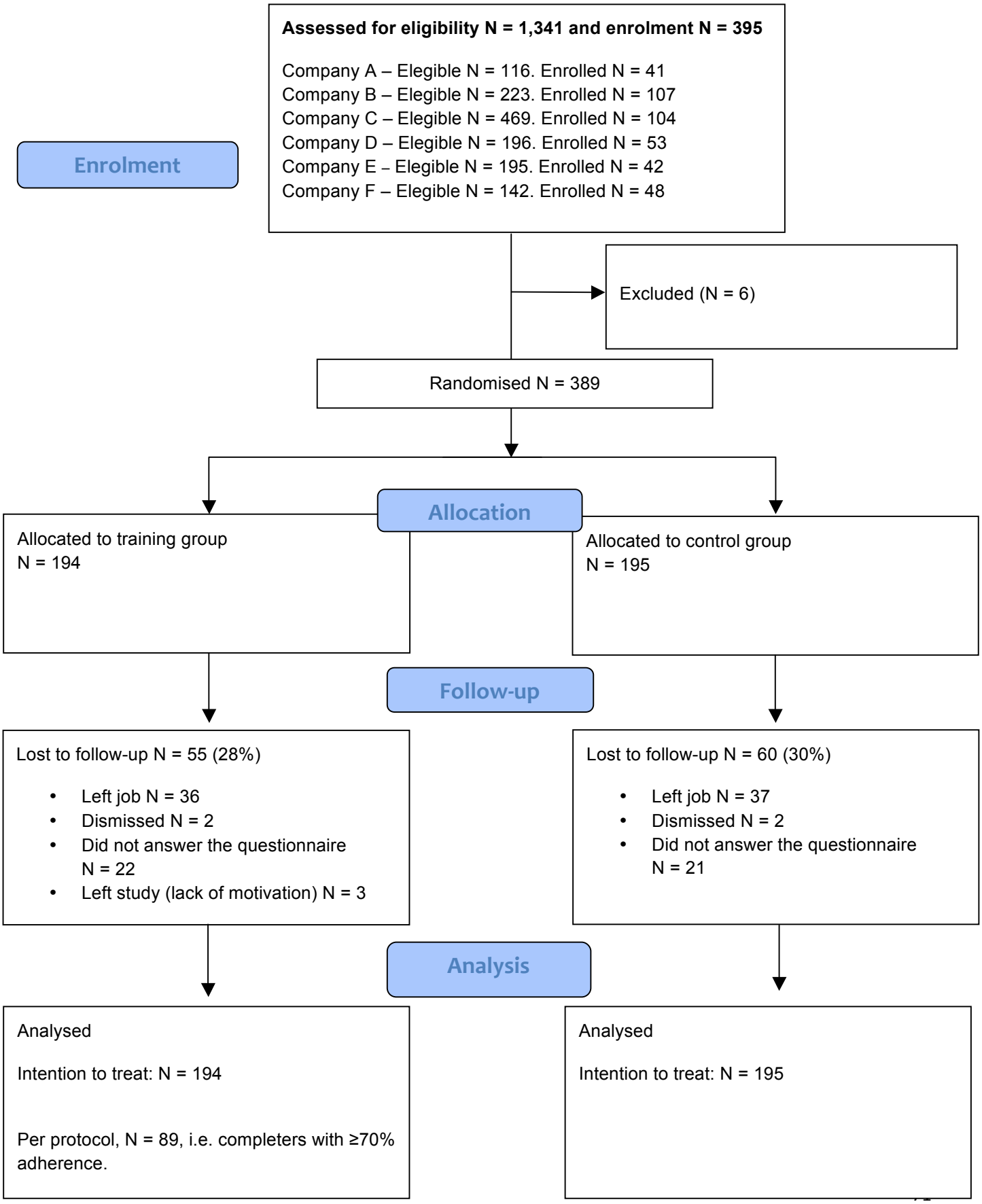
Exclusion: Causal workers (i.e. students or temporary workers) were excluded from the study because they may not be employed by the company for the duration of the study. Women who

were pregnant at the time of the baseline interview were excluded because they would spend some portion of the year on maternity leave. We further excluded office workers who self-reported the following conditions at their health check: cardiovascular diseases, chest pain during physical exercise, myocardial infarction (life time history), stroke, severe musculoskeletal disorders, symptomatic herniated disc, and other severe disorders of the spine, postoperative conditions or life time history of severe trauma. These exclusion criteria were chosen because employees were to train at high intensity which would put stress on both the musculoskeletal and cardiovascular systems.

Written informed consent was obtained from all office workers at the start of the study. In total, six office workers were excluded from the study and these were all excluded because they were currently were pregnant (Figure 1). As there were very few employees excluded from the study, we did not conduct an analysis to determine if the included employees differed from the excluded employees [20].

All employees (assessed) at the six workplaces received an electronic questionnaire. Participants who made inclusion criteria and filled out the questionnaire prior to health check where part of the project. Four participants were sick or at vacation doing baseline health check at the workplaces and 84 employees left the project, were sick or at vacation doing one-year follow-up test.

Figure 1: Flowchart (baseline and one-year follow-up)



Randomization

All enrolled employees were assigned a sequential study identification number, ID, by an authorized technical staff person ensuring allocation concealment. After all employees completed their questionnaire and baseline measures at each specific company, the employees were individually randomized by the supervisor of this study (author GS) to a training group, TG, or a control group, CG, using the identification number and a random number computer algorithm. Randomization was performed within each company and for the four companies with less than 100 employees enrolled randomization was stratified to ensure balance regarding sex.

Blinding

Due to the content of the physical exercise training, participants and care providers (instructors and health ambassadors) could not be blinded to group allocation. The outcome assessors were blinded to the employee's group assignment. At follow-up testing, the employees were informed not to tell the outcome assessors what group they were assigned. The outcome assessors were also trained to not discuss with the participants their group allocation. All researchers and data analysts were blinded to group allocation.

Procedure for implementation

All six companies were informed about the project via intranet and dates for information meetings were announced two months in advance. Further, the contact person at each company was responsible, together with the director/manager for Human Resources, for informing all top and middle managers regarding the present study. The project manager held three to four information meetings at each company. Information meetings addressed the overall aim as well as practicalities such as: type of physical exercise programs, site of training, health check, instructors, and health ambassadors [20]. The attending employees were able to ask questions and they all received information about the project in hard copy. In addition, the information was available on the intranet of the six companies allowing everybody at the company to see. Shortly after the information meetings, all employees received a questionnaire and those interested to be part of the project completed the questionnaire. Individual tailored intelligent exercise was prescribed for all employees in the training group after the first health check by the authors of this article, and is

described in details below. All participants received the same information and same level of attention before randomization into the two groups. After the randomization, all participants received a letter in closed envelope send to the workplace containing information about their level of health and were informed they were allocated to CG or TG, respectively. The CG was further informed to maintain their usual lifestyle and that a yearly health check had been scheduled for the coming two years. The TG was further informed about the worksite training supervised by instructors and to perform leisure training (30 minutes of moderate training) by the health ambassadors. The training intervention is described in more detail below. During the one-year study, both the TG and CG did not receive any further information from the researchers. Written informed consent was obtained from all employees at the start of the study.

Primary outcomes

CRF was assessed as maximal oxygen uptake and data presented as VO2max L/min as well as relative VO2max in ml/min/kg body mass [21]. VO_2max in liter/min were assessed with Åstrand one-point sub-max test using the Åstrand nomogram [22] and corrected for age [23]. Tests were performed on a bicycle (Monark 874E, Monarch Exercise AB, Sweden) and with a polar® watch (Polar S610i Heart Rate Monitor and Polar FT2 Heart Rate Monitor) to measure heart rate (HR).

Test procedure: Start load was 60 W for women and 90 W for men and both were instructed to bike with a cadence of 60 repetitions per minute (rpm) throughout the test. After two minutes warm-up, the load was adjusted based on HR. If the HR was below 120 beats per minute (bpm) the load was adjusted by 30 W every minute until a steady state (i.e. HR did not change more than four bpm in a one minute interval) was reached between 120 – 170 bpm. Test length was a maximum of 10 minutes and employees were instructed not to talk during the test. Follow-up test followed the same routine, though if a steady state above 120 was not reached with baseline load, additional load was added until steady state was reached. Finally, a familiarization session was not performed prior to conducting the submaximal test as we believe cycling to be a well-known activity form in Denmark. Based on this, we chose not to include a familiarization session.

For individually tailoring the extent of CRF training the VO_2max in liter/min/kg for each participant in the TG was evaluated relative to established fitness norms in Denmark, e.g. for men between 40 – 49: Low = <36, middle = 36 – 43 and high = >43, and for women between 40 – 49: Low = <31, middle = 32 – 40 and high = >41 [24].

Secondary outcomes

BMI

Body mass index (BMI) was calculated to measure body weight and muscle mass. It was measured using a bio impedance device (Tanita TBF 300). Employees while wearing light clothing were measured without shoes and socks (one kg adjustment).

Blood profile

On health check day, employees had fasting blood samples drawn between 07:00 – 09:00 am. Blood samples were handled by biomedical laboratory technicians from The University of Southern Denmark. They were analyzed in a standardized fashion (enzymatic colorimetric method) at the hospitals in the region where the companies were located for: fasting blood sugar, triglycerides, total cholesterol, low density lipoprotein (LDL), and high density lipoprotein (HDL).

Blood pressure

Blood pressure, BP, was measured in seated position after five to ten minutes of rest. It was measured on the right arm with an electronic blood pressure device (OMRON M7) and taken three consecutively times with no breaks. The two lowest measurements were averaged together [20].

Training intervention

The training intervention and the theoretical framework of "Intelligent Physical Exercise Training" (IPET) has been described in detail previously [20]. In short, all sessions were one-hour long (50 min training sessions – allowing 10 min for getting to and from the training area). Each employee received an individually tailored training program based on outcome measures of a health check performed at baseline. The measures included VO_{2max}, muscle strength, balance test, core and

neck/shoulder stability, BMI, body fat %, blood pressure, blood profile, and pain intensity in specified body regions. For each measure cut-points were identified to allocate individual training duration and intensity within cardio-, strength- and/or functional training. In total 32 principally different training programs were identified that further were adjusted to the relative capacity of each participant in terms of training resistance or intensity [20]. Each employee started a training session with a 20 min cardio-respiratory fitness routine that included a 10 min warm up in order to balance their physically inactive occupational exposure, i.e. long sitting times. After this, instructors guided the employees through their own structured purposeful exercises at the recommended exercises and training intensities for the appropriate time.

High intensity exercise was defined as rowing, ballgames, running etc. (targeting 77 – 95 % HR max corresponding to RPE 14-17). Instructors were instructed and trained to measure 1RM when training started at the six workplaces and to progress training when needed. The changes in 1RM were not recorded. The individualized intelligent exercise programs were composed of a mixture of aerobic exercises, strength training for major muscle groups and functional training following the guidelines from the American College of Sports Medicine [25] as well as specific strength training exercises for the neck and shoulder [26]. The choice of aerobic exercises was up to the employee with guidance from instructors and with the focus of training at a high intensity.

The TG was instructed to train for one-hour of IPET per week for one-year including high intensity (targeting 77 – 95 % HR max corresponding to RPE 14-17) during their working hours. Training was part of their job description meaning they were paid to train and training took place at facilities on the workplace or at facilities in the local area.

Exercises for strength training (major muscle groups) were selected from five standardized exercises: one for shoulders, three for abdomen-back and one for the chest muscles. The intensity for strength training was 60 – 80% of one repetition maximum. Participants were instructed to complete three sets of eight repetitions for each exercise, but in a rotating manner between exercises. This allowed for a maximum of ten seconds break between each set.

Employees who were prescribed neck and shoulder training were required to perform four different exercises for the upper extremities [27, 28]. The intensity for neck and shoulder training was to pain limits or as heavy as possible while using proper technical execution. They were

instructed to complete three sets of eight repetitions with one to two minutes breaks between sets.

Functional training exercises were selected from nine different exercises: five for balance training and four for body core training. The instructors were not given guidelines for the intensity nor for the frequency of these exercises, but were informed to focus on ensuring proper technical execution was done. The instructors measured training intensity at the end of every training session using the Borg scale (Rating of Perceived Exertion (RPE 6-20) [28]. Furthermore the employees in the TG were instructed to perform home based physical active 30 minutes at moderate intensity (64-76 % HR max, RPE 12-13) for six days per week in their leisure time. Recommended physical activity at a moderate intensity level were as follows: Bicycling, organized physical activity, gardening, climbing stairs, running/jogging and strength training. The CG received no further instructions besides personal results from the two health checks and only the TG was motivated to do home-based training (30 minutes of moderate training) by the health ambassadors.

Adherence

Adherence was measured after one-year of training for the "completers" (i.e. employees who took part in health checks after one-year of intervention). After each training session, the instructors filled out the training diary for the participants. Using these diaries, we calculated adherence as the number of completed training sessions out of the total possible training sessions (34 - 37) within the one-year time-period. The number of possible training sessions differed across companies because there were days where training was not possible for some of the companies. For the per protocol analysis, we set a cut-point of ≥70 % for adherence [29]. The conditions of per protocol for the CG were employees who took part in the follow-up health check after one-year of intervention.

Instructors

The one-hour training sessions during working hours was supervised by instructors, who were physical kinesiology bachelor students from the University of Southern Denmark. Prior to intervention, the instructors were informed about the project and their role in the project. The instructors had the following job description: Making sure that employee in the training groups completed all exercises described in their program and trained at a high intensity, and with proper techniques. Further they were required to motivate the employees during workouts.

Health ambassadors

The health ambassador's job was to motivate colleagues in the TG to become physically active and sustain during the course of the research project. The health ambassadors were part of the training group, but not part of the randomizing procedure and therefore excluded from analysis because of selection bias as they were a part of the implementation process. The health ambassadors completed a four-day course before the start of intervention dealing with the following themes: Health enhancing physical activity – evidence, myth and gains; ethical issues; theories for changing behavior; cataloguing ideas for practical facilities; organization, motivation and communication [30, 31]. They were given suggestions on how to initiate health activities within their workplace. The health ambassador´s role was added to their job description and the companies allowed them to dedicate two hours per week to this role. In order to select employees to become health ambassadors middle managers in the six companies were asked to identify and appoint candidates in their department using the following criteria: A health ambassador should be appointed for every 10 – 15 employees in the department joining the intervention group by selection, a team worker, find it easy to motivate colleagues, initiative at nature, work with health at the workplace for two hours a week for one year and had been employed at the workplace for at least five years. The possible health ambassadors were asked by their middle manager to join the project meaning they had the possibility to decline.

Statistical analysis

The following hypothesis was tested: There is no difference in the changes of cardiorespiratory fitness level between the TG and CG after the one-year intervention.

Intention-to-treat analysis was performed on data carried forward and backwards for missing values in both baseline and follow-up measurements. If measurements had missing values in both baseline and follow up they were replaced by means of all existing data (adjusted for sex and age).

Per-protocol analysis was performed using office workers in the TG who met the criteria of at least 70% adherence (≥70) as well as all of the office workers in the CG. Primary and secondary outcomes were analyzed within (paired t-test) and between (ANCOVA) the TG and the CG after one-year of intervention. Covariance variables were baseline results (table 1). Descriptive statistics were presented as mean, standard deviations (SD) and frequencies. The assumption of normality was tested using Shapiro-Wilk´s test and construction qq.

Sample size calculation was based a minimal relevant change of 5 percent in estimated cardiorespiratory fitness between groups with a standard deviation of 0.2. Power was set to 0.8 with an alpha level of 0.05. We would need at least 128 employees in each group [32]. With an estimated dropout of 30%, the research project targeted to recruit 400 employees.

Data are shown as means and SD (table 1 and absolute values in table 2 and 3); group mean differences are shown as means and standard error (SE) and presented with 95 % confidence intervals (95 % CI). Results were considered statistically significant if the 2-tailed p-value was <0.05. All analyses were performed using SPSS statistical software, version 21.

Results

Baseline

The participants in the study were on average 44 years old, 75% were female, had an average body mass index of 25.4 kg/m2, average percentage body fat of 29.1 %, and average steady state HR during the submaximal bicycle test for estimating bicycle test for estimating VO_2max of 146 ± 12.7 bpm. The average CRF for men was 37.7 ± 11.8 ml/min/kg and 35.7 ± 10.9 ml/min/kg for women. At baseline, there were no statistically significant differences between training and control group for the outcome measures (Table 1).

Table 1: baseline characteristics: P-values of the Independent Samples Test.

Characteristic	Training (N = 194)		Control (N = 195)		P-value	Total (N = 389)		
	Mean	SD	Mean	SD		Mean	SD	95% CI around the mean
Age (years)	44	10.6	45	10.1	**0.26**	44.3	10.4	20–68
Weight (kg)	74	16.1	74	17.1	**0.95**	74.1	16.6	44.9–138.3
VO_2max (L/min)	3.3	0.98	3.3	0.9	**0.97**	3.3	0.9	1.36–7.24
Relative VO_2max (ml/min/kg)	36	11.3	36	11.1	**0.73**	36.0	11.2	10–84
Body mass index (kg/m2)	25.3	5.0	25.5	5.2	**0.80**	25.4	5.1	16.7–49.3
Systolic BP (mm Hg)	124	17.4	124	15.8	**0.67**	124.1	16.6	87–181
Diastolic BP (mm Hg)	81	11.2	82	9.8	**0.57**	81.6	10.5	60–126
HR (stady state)	146	13.4	146	12.0	**0.60**	145.7	13.4	1.37-1.44
Total Choles-terol (mmol/l)	5.1	0.9	5.1	0.9	**0.99**	5.1	0.9	2.60–9
HDL (mmol/l)	1.7	0.5	1.6	0.4	**0.52**	1.6	0.4	0.7–3.45
LDL (mmol/l)	2.9	0.8	3.0	0.8	**0.35**	3.0	0.8	1.20–6.10
Triglyceride (mmol/l)	1.0	0.8	1.0	0.5	**0.63**	1.0	0.6	0.3–6.60
Blood glucose (mmol/l)	5.3	0.9	5.2	1.0	**0.88**	5.3	1.0	3.70–15.10

(BP = blood pressure, HDL = High-density lipoprotein, LDL = low-density lipoprotein, SD = Standard deviation and 95 % CI = confidence interval).

Intervention

Overall, the adherence for the TG was 56% (29.2 training sessions). The adherence across companies ranged from an average of 36% to 62.8%, and 89 (46%) employees had an adherence of ≥ 70%.

The mean RPE for TG was 15.5 (Minimum= 10, Maximum= 20 and SD = 1.3) and 1.8 % left the study because of lack of motivation.

CRF after one year of intervention were 37.7 ± 10.7 ml/min/kg for the TG (men = 39.5 ± 10.3 and women = 37.0 ± 10.8) and 36.0 ± 10.6 ml/min/kg for the CG. For TG with an adherence of >70 %, the CRF was 38.1 ± 10.5 ml/min/kg (men = 39.6 ± 8.9 and women = 37.5 ± 11.1). Average steady state HR for the TG = significantly decreased to 142 ± 13.7 bpm and which was significantly lower compared to 146 ± 13.3bpm for the CG.

Within group analysis showed a significant increase in VO2max in L/min ($p < 0.001$) as well as in ml/min/kg ($p = 0.002$) for the TG only (table 2). Furthermore, systolic and diastolic BP decreased significantly in the TG, while in the CG only diastolic BP decreased ($p < 0.01$). Blood glucose decreased in the TG to 5.1 ± 0.6 mmol/l ($p < 0.03$) and in the CG to 5.1 ± 1.0 mmol/l ($p < 0.01$), while blood cholesterol decreased only in the CG to 5.0 ± 0.9 mmol/l ($p < 0.01$), and triglycerides, HDL and LDL remained unchanged in both groups.

Table 2: summary results of changes for each group and between groups after one year of intervention with intention-to-treat analysis. Differences are estimated as the difference between means with 95% confidence intervals (95% CI) based on Paired T-test and ANCOVA with the level at baseline applied as covariate.

Characteristic	Training (N= 194) Post-pre intervention		Control (N=195) Post-pre intervention		Difference Training – control group		P-value Between groups
	Mean	SD	Mean	SD	Mean	95% CI	
VO_2max (l/min)	0.2*	0.0	0.0	0.0	0.2	0.1–0.2	**0.016***
Relative VO_2max (ml/min/kg)	1.5*	0.5	0.1	0.5	1.4	1.7–1.7	**0.027***
Body mass index (kg/m2)	-0.1	0.2	0.0	0.1	-0.1	-0.4–0.2	**0.38**
Systolic BP (mm Hg)	-3.4*	1.2	-1.5	0.4	-1.9	-4.3–-0.3	**0.08**
Diastolic BP (mm Hg)	-2.8*	0.0	-2.3*	0.3	-0.5	-1.9–-0.7	**0.34**
HR (steady state)	-3.3*	13.7	-0.8	12.0	-2.5	-4.1–-3.4	**0.020***

*Significant change within group from pre to post ($p<0.05$). BP = blood pressure and SD = standard deviation.

Per protocol analysis: Table 3 presents the absolute changes from pre-test to posttest for employees in the TG with an adherence ≥ 70%. A significant increase was found for CRF ($p = <0.001$) and HR at steady state ($p <0.001$) and a significant decrease was found in systolic BP ($p = 0.043$) for the TG compared with the CG. There were no significant differences in the changes for BMI, HDL, LDL, blood glucose, total cholesterol and triglyceride and there was no significant difference between employees in the TG with a level of adherence less than 70% compared to employees with an adherence ≥70%.

Within the TG analysis showed a significant increase in Vo2max L/min ($p = <0.001$), relative Vo2max in ml/min/kg body mass ($p = <0.001$) and a significant decrease in systolic BP ($p = <0.001$), diastolic BP ($p = <0.001$) and HR at stady state ($p = <0.001$). Total blood cholesterol decreased to 5.0 ± 0.8 mmol/l ($p < 0.011$).

Table 3: summary results of changes for each group and between groups after one year of intervention for employees with an adherence ≥ 70%. 89 employees (46%) had an adherence of 70% or more. Differences are estimated as the difference between means with 95% confidence intervals (95% CI) based on Paired T-test and the ANCOVA with the level at baseline applied as covariate.

Characteristic	Training (N = 89) Pre/post intervention		Control (N = 195) Pre/post intervention		Difference Training – control group		P-value between groups
	Mean	SD	Mean	SD	Mean	95% CI	
VO_2max (L/min)	0.4*	0.6	0.0	0.0	0.4	0.2–0.1	**<0.001***
Relative VO_2max (ml/min/kg)	4.2*	6.4	0.1	0.5	4.1	2.6–1.7	**<0.001***
Body mass index (kg/m2)	- 0.1	2.4	0.0	0.1	-0.1	0.6–0.4	**0.45**
Systolic BP (mm Hg)	-5.4*	13.7	-1.5	0.4	-3.9	-5.0–-3.5	**0.043***
Diastolic BP (mm Hg)	-3.8*	9.3	-2.3*	0.3	-1.5	-3.0–-1.9	**0.12**
HR (steady state)	-6.9*	12.8	-0.8	12.0	-6.1	-5.0–-3.2	**<0.001***

*Significant change within group from pre to post ($p<0.05$). BP = blood pressure and SD = standard deviation.

Discussion

The following discussion will discuss if IPET is feasible for companies and if the outcome of this article are clinically relevant and relevant for future work health promotion (WHP) interventions.

The major findings of this randomized controlled trial were the significant increases in estimated CRF for office workers doing IPET for one hour per week at high intensity during working hours for one-year. The magnitude of increase in CRF was approximately 5% in the intention to treat analysis and approximately 7% in the per protocol analysis. Furthermore the per protocol analyses showed a significant decrease in systolic BP between groups. This increase in estimated cardiorespiratory fitness is considered to be able to provide a clinically relevant decrease in the risk for metabolic and cardiovascular disorders [33]. Similar finding of increased CRF was found in a study of Danish office workers conducted in 2005 to 2006 [34]. Also, in a study by Kennedy, Boreham et al [35] who investigated the effect of stair climbing on health-related fitness in sedentary office workers, found a significant increase of 9.4 % in predicted VO_{2max}. These results, combined with the present study add new knowledge to the conclusion of Properet al´s [8] paper, who found inconclusive evidence regarding the effects of a worksite physical activity intervention on physical fitness.

Studies among other occupations have demonstrated that IPET has a positive effect on CRF Gram et al [16] demonstrated a significant increase in CRF among construction workers, who trained three times per week for 20 minutes in 12 weeks. However, as indicated in the review by Proper et al [8] only a small number of high-quality trials exist and more evidence is needed within this area.

This study showed an effect on high intensity physical activity intervention in working hours, but is high intensity physical activity in working hours feasible for companies? Physical activity in working hours will only be feasible for the company, if the activities are cost-effective for the company. We have conducted nine RCT studies where exercise during working hours was negotiated. Data has shown that this did not impact negatively on productivity [36]. For this study, the workplace bought into reserving time in the work-day for exercises.

Hypertensive individuals are at increased risk for future short- and long-term cardiovascular complications [37]. A significant training-induced reduction in blood pressure is of outermost preventive importance. Also in normotensive individuals, a reduction in blood pressure parameters is favorable for general health [37]. In the TG, a significant decrease in systolic blood pressure of 3.4 mmHg was found for the intention to treat analysis and a 5.4 mmHg significant decrease was seen in the per protocol analysis. Furthermore there was a significant decrease in systolic BP of 3.9 mmHg between groups in the per-protocol analysis. The magnitude in reduction of systolic blood pressure is of clinical relevance [38] and it has major influence on public health. Hypertension is one of the most prevalent modifiable cardiovascular risk factors in the Western World [39, 37]. In comparison with our findings, earlier studies could not document significant reductions in blood pressure between groups after physical exercise training interventions at different worksites [8, 16]. However, more recent randomized controlled trials have been able to demonstrate a significant reduction in blood pressure after training interventions among other workgroups [40, 41], providing a great potential for workplace health promotion. The decrease in systolic blood pressure in the present study is an interesting finding for practitioners working with health promotion activities at the workplace since systolic blood pressure has a greater significance than diastolic blood pressure as a cardiovascular risk factor for angina, myocardial infarction and peripheral arterial disease, particularly in later life [42, 43 and 37].

Blood glucose level and total blood cholesterol (adherence ≥ 70%) reduced significantly within the TG. Elevated levels of fasting blood glucose are a known risk factor for metabolic diseases maybe associated with dysfunction and failure of different organs [44]. Epidemiologic studies have found various manifestations of atherosclerotic vascular disease to be associated with elevated levels of cholesterol [45]. A significant reduction may therefore be highly beneficial for the participants in the TG, especially participants with levels of total blood cholesterol and blood glucose above recommended guidelines.

Strengths and limitations

There were several strengths in this study. The mean age and gender distribution of the participants were similar to the office workers in the workforce in Denmark. The companies were

from the private and public sectors and were located in different parts of Denmark. Therefore, the companies and the office workers were representative of the workforce in Denmark. Further, this study had a rigid RCT design with the involvement of experts within occupational health as well as sports science [20]. Furthermore, the study had a fairly low dropout rate 1.8%. All six companies in the study had training facilities located close to their work where well educated instructors were in charge of the high intensity training. The design used in the present study can therefore be successfully implemented at workplaces with such facilities.

A limitation in our study was possible contamination due to study participants being individually randomized to TG and CG, respectively, and not by cluster randomization at a work organizational level such as, department or company. Employees in the CG could have learned the exercises that were assigned to their co-workers in the TG; however, these exercises would not have been tailored to their own physical needs based on the health check and they would not be supervised. The extensive variations of exercises prescribed to each individual in the intervention group were presented previously [20]. Another limitation of this study was the supervised training. Depending on the size of the group, the supervision may not have been sufficient as it was not possible to follow each participant during their whole training session. Likewise, training together with one's colleagues might have caused more talk regarding work instead of focusing on training intensity. The poor adherence (56%) is another limitation of the study and the significance of this limitation is seen from the quite large difference in effect of the intervention in the intention to treat and the per protocol analysis, the latter showing twice the effect. Future studies of the role the middle managers in implementing WHP could determine the feasibility of IPET in working hours. Furthermore, Borg's RPE is a subjectively measure and measuring heart rate would be a more accurate measurement of intensity. Thus, in a meta-analysis it was emphasized that although Borg´s RPE scale has been shown to be valid measure of exercise intensity, its validity may not be as high as previously thought [46]. Though for practicability, Borg's RPE is feasible and cheap when implementing work health promotion interventions. Finally, a familiarization session was not performed prior to conducting the submaximal test as we believe cycling to be a well-known activity form in Denmark. Based on this, we chose not to include a familiarization session.

Conclusions

This study demonstrated that one-hour of supervised individually tailored high intensity training program during working hours every week and recommendations of 30 minutes of exercise at moderate intensity for six days a week had several health enhancing effects. The intervention increased CRF significantly by approximately 5% for the TG compared against CG and within groups, TG demonstrated reduced blood pressure. Furthermore, participants with an adherence of ≥70% reached an even higher increase in CRF and a decrease in systolic BP. Together; this underlines the effectiveness of implementing IPET at the workplace.

Competing interests

The authors declare that they have no competing interests.

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Authors' Contributions

JBJ and GS have made substantial contributions to conception and design. MM and TD have given contributions to data acquisition and EB has carried out data analysis together with JBJ and GS. All authors have been involved in drafting the manuscript and revising it critically for important intellectual content; and have given final approval of the version to be published.

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Paper III.

The effect of intelligent physical exercise training on sickness presenteeism and absenteeism among office workers: a randomized controlled trial

Abstract

Background: The aim of this paper was to investigate the effect of individually tailored intelligent physical exercise training (IPET) on sickness presenteeism (SP) and absenteeism among office workers.

Methods: In a randomized controlled trial employees were allocated to a training, TG, (N = 194) or a control group, CG, (N = 195). The TG received one-hour high intensity IPET every week within working hours, and was recommended to perform 30 minutes of moderate intensity physical activity six days a week during leisure time. Before and after the one-year intervention the office workers answered a questionnaire on SP.

Results: At baseline, there were no differences between groups. After one year an intention-to-treat analysis showed a significant 5% increase in general work ability, general health and no change in absenteeism in TG group compared with the CG. A per protocol analysis, including employees in the TG with an adherence of ≥ 70% (N = 89) showed a significant 6% improvement in SP and 49% decrease in sickness absenteeism.

Conclusion: High intensity IPET in working hours combined with recommendations of leisure time moderate intensity physical activity improved productivity by an effect on SP and a decrease in sickness absenteeism if following the intervention protocol.

Key terms physical activity intervention, individualized training, productivity, work health promotion.

Background

The importance and benefits of leisure time physical activity have for many years been well established in relation to the cardiovascular system[1, 2] and all-cause mortality [3 - 5] and recently, also been emphasized for a maintained musculoskeletal health.[6, 7] In today´s Western World sedentary work is the most widely used working condition between the ages of 16-64.[2] Furthermore the majority in the Western World are insufficiently active (not meeting national recommendations of physical activity) and are therefore not receiving the health benefits of it.[8 - 10]

The workplace has been recommended as an ideal setting for health promotion and physical inactivity reported as fourth among the leading risk factors for mortality worldwide.[11] Research has documented that physically inactive employees and employees with an unhealthy lifestyle are less productive more sick and have decreased workability when they are at work.[12, 13] Studies from Jans, Proper et al.[14] furthermore show that office workers do not compensate for prolonged sitting at work by spending less time in sedentary leisure activities. Time away from work when the employee is sick (absenteeism) obviously influence productivity and workability. However, also being present at work in spite of bad health may highly impact an employee's productivity and workability (presenteeism).[15, 16] Sickness presenteeism (SP) is defined as being at work while sick and therefore not delivering 100 % performance at the job because of health problems.[17, 18] Presenteeism includes time not spend on job task, slower work pace and decreased quality of work meaning a decrease in the employees productivity which often is a hidden cost for employers.[19, 20] It is not uncommon that presenteeism precedes or follows absenteeism, but such connection may not always be the case.[21]

Only few high quality physical exercise training (PET) studies have shown preliminary positive effect on SP[22,10, 18] and absenteeism at the workplace.[23 - 25] To our knowledge it´s unknown whether a workplace high intensity training intervention successfully improving health-related measures also provides improvements in sickness absenteeism and presenteeism. Furthermore, no studies have thoroughly described the PET that decreased sickness absenteeism and presenteeism.

The aim of the present paper was to present a secondary data analysis of a RCT to investigate the effect of individually tailored intelligent physical exercise training (IPET) on SP and absenteeism among office workers over a one-year period.

Method

Study design

A randomized single-blinded parallel controlled trial was conducted from May 2011 to March 2014 with primary outcome presented separately.[26] Details have been described previously[27] but are presented in short.

The project was approved by the local Ethics Committee of Southern Denmark (S-20110051) and registered in ClinicalTrials.gov, number: NCT01366950.

Workplace recruitment

In May 2010, 103 companies across Denmark were contacted by an e-mail to determine their interest in this study. The project manager (author JBJ) had a previous business relationship with each of the companies. The nature of this relationship was either previously to teach project management to their workers or to act as a health promotion consultant. Seventeen companies expressed their interest and six of these agreed to be involved in the study.[27] The six companies were located. Two were private companies (a telecommunications and a food company), two public municipalities, and two national boards (department of social services).

Office Worker Recruitment and Study Flow

Inclusion: All participants who were employed as office workers and working for at least 25 hours a week. Only workers with job roles as office workers at the six included companies were offered participation and none of the job roles had a specific focus on health.

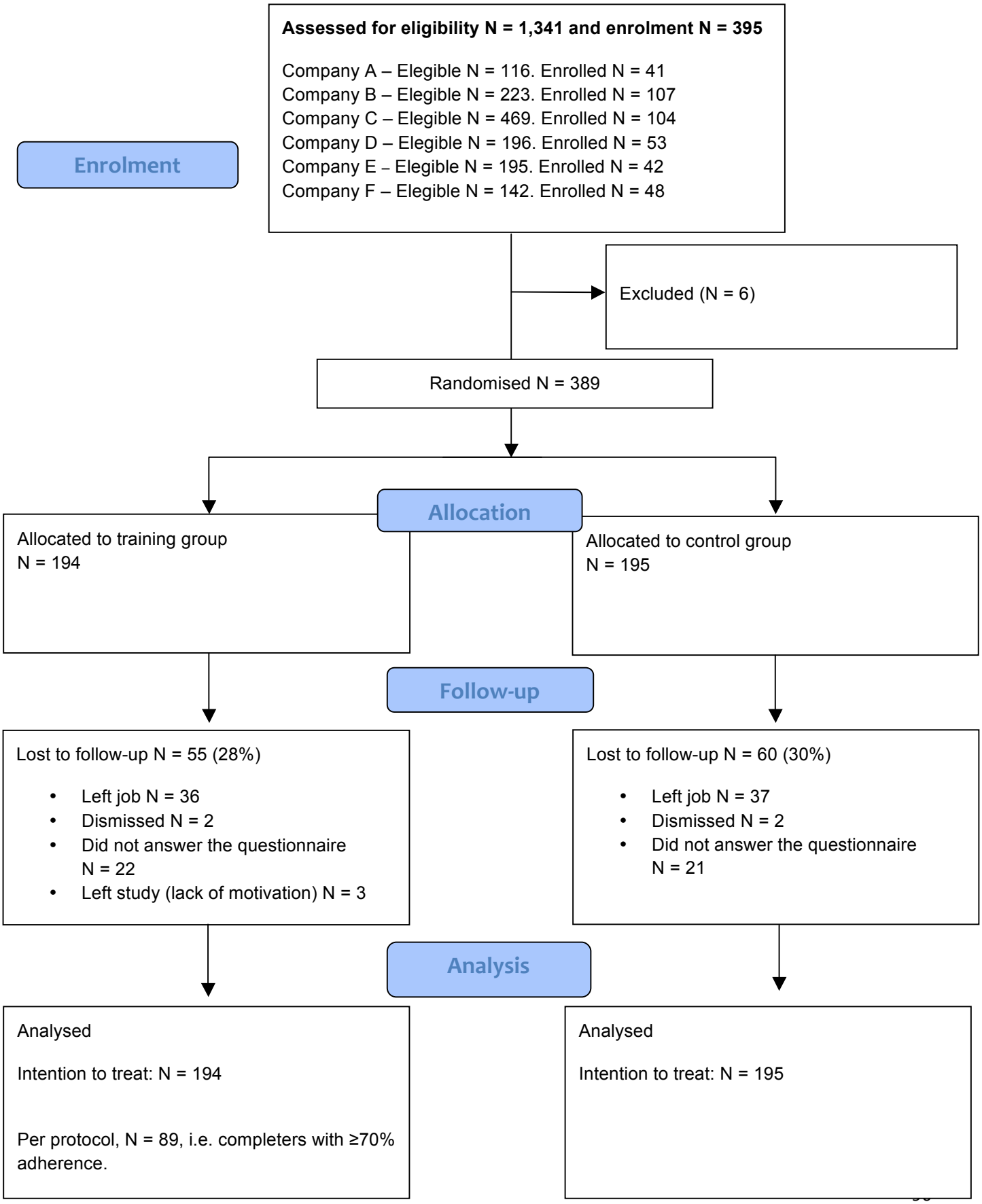
Exclusion: Causal workers (i.e. students or temporary workers) were excluded. Women who were pregnant at baseline were excluded because they would spend some portion of the year on maternity leave. We further excluded office workers who self-reported the following conditions at their health check: cardiovascular diseases, chest pain during physical exercise, myocardial infarction, stroke, severe musculoskeletal disorders, symptomatic herniated disc, and other severe

disorders of the spine, postoperative conditions or life time history of severe trauma. These exclusion criteria were chosen because employees were to train at high intensity which would put stress on both the musculoskeletal and cardiovascular systems.

Written informed consent was obtained from all office workers at the start of the study. In total, six office workers were excluded from the study and these were all excluded because of pregnancy (Figure 1). As there were very few excluded from the study, we did not conduct an analysis to determine if the included employees differed from the excluded employees.[27]

Participants who fulfilled the inclusion criteria and answered the questionnaire prior to health check where included. Four participants were sick or on vacation during baseline health check and 84 employees left the project, were sick or on vacation during one-year follow-up test.

Figure 1: Flowchart (baseline and one-year follow-up)



Randomization

All enrolled employees were assigned a sequential study identification number by an authorized technical staff person ensuring allocation concealment. After all employees had completed their questionnaire and the baseline measures at each company were completed, the employees were individually randomized by the supervisor of this study (author GS) to a training group, TG, or a control group, CG, using the identification number and a random number computer algorithm. Randomization was performed within each company and for the four companies with less than 100 employees enrolled randomization was stratified to ensure balance regarding sex.

Blinding

Due to the content of the physical exercise training, participants and care providers (instructors and health ambassadors) could not be blinded to group allocation. The outcome assessors were blinded to the employee's group assignment. At follow-up testing, the employees were informed not to tell the outcome assessors what group they were assigned. The outcome assessors were also trained to not discuss with the participants their group allocation. All researchers and data analysts were blinded to group allocation.

Procedure for implementation

The employees in the companies were informed about the project via intranet and dates for information meetings were announced two months in advance, for details see.[27] The contact person at each company was responsible, together with the manager for Human Resources, for informing all top and middle managers regarding the present study. The project manager held three to four information meetings at each company. Information meetings addressed the overall aim as well as practicalities such as: type of physical exercise programs, site of training, health check, instructors and health ambassadors.

Outcome measures

A previous paper has presented the primary outcome data in term of cardio-respiratory fitness after one-year. The present paper presents the subset of secondary outcomes: general

workability, mental workability and productivity (together reflecting SP), sickness absenteeism, self-reported general health and healthcare system contacts regarding musculoskeletal pain and discomfort.[27]

Sickness absence

Sickness absence data were collected from all six companies through the manager for Human Resources. Data were collected at baseline (one year before intervention) and after one year. We collected data from all 389 office workers. Data were accrued by years and months, and were cleansed of care days, weekends and child first and second day of illness. Since only short term absence (1 – 10 days)[28] were in focus in this study, the periods of long term sickness absence (≥ 11 days, which is the official cut point in Denmark) and part-time leave were discarded before analysis.

Questionnaire

From questionnaire, the study reports the effects on SP, here represented as, mental workability and productivity.[30] Mental workability is part of the study because the employees in this study primarily do mental work. Workability was rated on a ten-step ordinal scale: Imagine that your workability is worth ten points when it is best. How many points would you give your present workability? The rating ranged from one (not capable of working) to ten (best workability). Workability regarding mental demands in your job was rated on a five step nominal scale: How would you state your present workability regarding mental demands in your job? The rating ranged from very good, good, ok, bad to very bad. Productivity was rated on a ten-step ordinal scale: How do you perceive your overall productivity the last three months? The rating ranged from one (the worst anyone could do) to ten (the absolute best an employee in your job could do). Self-reported general health was rated on a five step nominal scale: How to you think your health is all in all? The rating ranged from excellent, very good, good, less well and poor. All office workers were asked three questions about their contact with the health care system within the last six months: Did you contact the health care system within the last six months due to pain or discomfort in the following body regions? 1. Neck or shoulders. 2. Elbow, wrist or hand. 3. Back, hips, knees or feet. All three questions were answered yes or no.

Training intervention

The training intervention and the theoretical framework of IPET have been described previously.[27] In short, all sessions were one-hour long (50 min training sessions – allowing 10 min for getting to and from the training area). Each employee received an individually tailored training program based on outcome measures of a health check performed at baseline. The measures included VO_{2max}, muscle strength, balance test, core and neck/shoulder stability, BMI, body fat %, blood pressure, blood profile, and pain intensity in specified body regions. For each measure cut-points were identified to allocate individual training duration and intensity within cardio-, strength- and/or functional training. In total 32 principally different training programs were identified that further were adjusted to the relative capacity of each participant in terms of training resistance or intensity.[27] Each employee started a training session with a 20 min cardio-respiratory fitness routine that included a 10 min warm up in order to balance their physically inactive occupational exposure, i.e. long sitting times. After this, instructors guided the employees through IPET.

Adherence

Adherence was evaluated after one-year of training for the "completers" (employees who took part in health checks after one-year). After each training session, the instructors filled out the training diary for the participants. We calculated adherence as the number of completed training sessions out of the total possible training sessions, which ranged from 34 - 37 between the six companies within the one-year time-period. The number of possible training sessions differed across companies because there were days when training was not possible for the companies. For the per-protocol analysis, we set a cut-point of ≥70 % for adherence.[31] The conditions of per-protocol for the CG were employees who took part in the follow-up health check after one-year.

Statistical analysis

The following hypothesis were tested: There is no difference in changes of sickness absenteeism, productivity, workability, workability regarding mental demands, general health and healthcare system contacts regarding pain and discomfort between the TG and CG from baseline to follow-up after one year of intervention.

Intention-to-treat analyses were performed on data carried forward and backwards for missing values in both baseline and follow up measurements applying the changes in percentage within each group, respectively. If measurements had missing values in both baseline and follow up they were replaced by means of all existing data in each group, respectively.

Per-protocol analysis was performed using office workers in the TG who met the criteria of at least 70% adherence (≥70) as well as the office workers in the CG. Secondary outcomes were analyzed within (paired t-test) and between (ANCOVA) the TG and the CG after one year of intervention. Covariance variables were baseline data. Categorical variables were tested using chi-square- and McNemar tests. Descriptive statistics are presented as mean and standard deviations (SD). The assumption of normality was tested using Shapiro-Wilk´s test and construction qq.

Data are shown as means and SD (table 1 and absolute values in table 2 and 3); group mean differences are shown as means and standard error (SE) and presented with 95 % confidence intervals (95 % CI). Results were considered statistically significant if the 2-tailed p-value was =<0.05. All analyses were performed using SPSS statistical software, version 21.

Results

Baseline

The participants were on average 44 ± 10.4 years old, 75% were female, had an average body mass index of 25.4 ± 5.1 kg/m2 and an average percentage body fat of 29.1 ± 8.8%. Long term absence periods ≥ 11 days were in total 68 periods for 44 office workers and 148 office workers (107 women and 41 men) had 0 % short and long term absence. There were no significant differences regarding these variables between TG and CG. Also, there were no statistically significant differences between TG and CG for the outcome measures (Table 1).

Table 1. Baseline characteristics: P-values of the Independent Samples Test and one-way ANOVA.

Characteristic	Training (N = 194)		Control (N = 195)		P-value	Total (N = 389)		
	Mean	SD	Mean	SD		Mean	SD	95% CI around the mean
Productivity (last three months)	8.2	1.0	8.1	1.2	**0.47**	8.2	1.1	8.1–8.3
Work ability (general)	8.7	1.1	8.8	1.1	**0.50**	8.7	1.1	8.6–8.8
Work ability (mental)	4.3	0.66	4.3	0.6	**0.75**	4.4	0.64	4.2–4.3
Sickness absenteeism	4.4	6.2	3.5	4.7	**0.11**	4	5.5	0.4–4.5
General health	3.5	0.72	3.6	0.7	**0.18**	3.6	0.73	3.5–3.6

(SD = Standard deviation and 95 % CI = confidence interval).

Intervention

The adherence for the training group was 56% (29.2 training sessions). The adherence across companies ranged from an average of 36.0% to 62.8%, and 89 (46%) employees had an adherence of ≥ 70%.

Intention to treat analysis: table 2 presents the absolute changes from pre- to post-test. The TG had a significant increase in general workability ($p = <0.001$), a tendency in increase for productivity ($p = 0.054$) and a significant increase in general health ($p = <0.001$) compared to the CG from baseline to one-year follow-up. There were no significant changes between groups for sickness absenteeism, mental workability and no significant decrease in healthcare system contacts regarding pain and discomfort between groups.

Within groups analysis (table 2) showed for the TG a significant increase in general work ability (p = <0.001), mental workability (p = 0.003), productivity (p = <0.001) and general health (p = <0.001) as well as a significant decrease in sickness absenteeism (p = 0.002). For the CG a significant increase in productivity (p = 0.006) was found. Further, contact to the healthcare system showed a significant decrease regarding pain and discomfort in elbow and hand (P = 0.049) and a tendency in neck and shoulder (P = 0.065) within both groups.

Table 2. Summary results of changes for each group and between groups after one year of intervention with intention-to-treat analysis. Differences are estimated as the difference between means with 95% confidence intervals (95% CI) based on Paired T-test and ANCOVA with the level at baseline applied as covariate.

Characteristic	Training (N= 194) Post-pre intervention		Control (N=195) Post-pre intervention		Difference Training – control group		P-value Between groups
	Mean	SD	Mean	SD	Mean	95% CI	
Productivity (last three months)	0.4*	0.0	0.2*	0.0	0.2	0.2–0.2	**0.054**
Work ability (general)	0.3*	0.1	0.0	0.1	0.3	0.2–0.5	**<0.001***
Work ability (mental)	0.1*	0.0	0.0	0.0	0.1	0.0–0.2	**0.18**
Sickness absenteeism	- 0.7*	2.0	-0.2	0.1	-0.5	-1.1–-1.0	**0.15**
General health	0.3*	0.0	0.0	0.0	0.3	0.2–0.2	**<0.001***

*Significant changes from pre to post (p<0.05). (SD = Standard deviation and SE = Standard error).

Per protocol analysis: Table 3 presents the absolute changes from pre- to post-test for employees in the TG with an adherence ≥ 70%. TG had a significant increase in workability (p = <0.001), productivity (p = 0.014) and general health (p = <0.001) and a significant decrease in sickness absenteeism (p = <0.001) compared to the CG from baseline to one-year follow-up. The Chi-square test showed no significant decrease in contact with the health care system.

Within the TG analysis showed an increase in general workability (p = <0.001), productivity (p = <0.001) and general health (p = <0.001) and a significant decrease in sickness absenteeism (p =

<0.001). Further, health care system contact showed a tendency to a decrease in the TG regarding pain or discomforts in elbow and hand (P = 0.06).

Table 3. Summary results of changes for each group and between groups after one year of intervention for employees with an adherence ≥ 70%. 89 employees (46%) had an adherence of 70% or more. Differences are estimated as the difference between means with 95% confidence intervals (95% CI) based on Paired T-test and the ANCOVA with the level at baseline applied as covariate.

Characteristic	Training (N = 89) Pre/post intervention		Control (N = 195) Pre/post intervention		Difference Training – control group		P-value between groups
	Mean	SD	Mean	SD	Mean	95% CI	
Productivity (last three months)	0.5*	1.2	0.2*	0.0	0.3	0.4–0.3	**0.014***
Workability (general)	0.5*	1.1	0.0	0.1	0.5	0.3–0.3	**<0.001***
Workability (mental)	0.1	0.7	0.0	0.0	0.1	0.2–0.2	**0.24**
Sickness absenteeism	-2.2*	5.4	-0.2	0.1	-2.0	-1.5–-1.0	**<0.001***
General health	0.4*	0.0	0.0	0.0	0.4	0.3–0.2	**0.001***

*Significant change within group from pre to post (p<0.05). BP = blood pressure and SD = standard deviation.

Discussion

The major findings of this study implementing IPET during working hours for one-year among office workers were the significant decrease in general work ability, productivity, tendency for mental workability as well as the decrease in sickness absenteeism for office workers with an adherence of more than 70%. Additionally, self-reported general health improved significantly during this year.

The negative economic impact of SP has been reported to be up to seven times larger than that of absenteeism.[32] Therefore, investigation of SP may be even more important than absenteeism. Of note is that SP has been reported to be inversely related to absenteeism. For example, a societal crisis where workers lose their jobs may be a factor that reduces absenteeism but at the same time will increase presenteeism.[33] The underlying mechanism is quite likely that workers afraid of losing their jobs will be on the job even though they are sick, which may impair their job workability and productivity.

In contrast, in the present study a decrease in both SP and absenteeism was found among those in the TG compared to the CG. These effects were significant among participants with adherence ≥ 70% who decreased in short time sickness absenteeism while increasing both productivity and work ability. These between group effects were also significant for self-reported general health, showing that the present intervention positively affected health in TG, and hereby indicating that the decrease in SP rather may be due to improved health than concerns about losing their jobs.

A systematic review of workplace PA interventions to reduce sickness absenteeism found preliminary evidence that PA interventions can positive effect sickness absenteeism while no positive effect was found on productivity.[23] More recent studies supported these conclusions.[24, 25] Two meta-analysis of workplace PA interventions found low levels of benefit on absenteeism[34, 35], and a more recent review of workplace PA interventions aiming at a reduction in sickness absenteeism, found moderate evidence for no effect.[36] Furthermore, a recent meta-analysis reported small effect sizes of WHP– including PA interventions – regarding sickness absenteeism, productivity and workability.[13] Thus, there appears to be inconsistent evidence of the impact of PA interventions on SP and absenteeism, which in part may be explained by study design, implementation, and content of the intervention.[8, 37, 13, 38] The present WHP intervention was in

particular distinct from previous regarding the content of the intervention. The IPET was 1) individually tailored based on a health check screening for all three major life style diseases: cardiovascular, metabolic, and musculoskeletal disorders, 2) evidence based physical exercises specific for counteracting each of these lifestyle diseases were implemented relying on sports science training principles using high intensities by expert trainees, and 3) supervision of on the job exercise training 1 hour per week combined with health ambassadors support of leisure time moderate training 30 min each day.[27] The concept developed in this project – and now proved to be effective among office workers – is documented in details and therefore for free available for future studies. Expenses for health check may be minimized by further optimizing for essential variable and supervision may be minimized by the use of motivating ICT gadgets, simple exercises, and well explained training diaries.[39] Such efforts may eventually result in cost-effectiveness in the benefit for the companies and improved health for the workers and the society.

The baseline levels of sickness absenteeism, workability, productivity, and general health were similar to those in a study of Danish office workers conducted in 2005 to 2006, in which no effects on these outcomes were found with workplace PA interventions.[40, 41] Importantly, the aim of that study was to reduce musculoskeletal disorders in the neck and shoulder area - which was successfully achieved, and the exercises implemented were distinct from those in the present study. The same exercises were performed by all workers in the same intervention group – i.e. they were not individualized, some exercises involved mainly small muscle groups not taxing the cardiovascular system others were of more moderate intensity.

Strengths and limitations

Strength and limitations have been described in detail previously.[26] In short, the mean age and gender distribution of the participants were similar to the office workers in the workforce in Denmark. The companies were from the private and public sectors and were located in different parts of Denmark.

A limitation in our study was possible contamination due to study participants being individually randomized to TG and CG, respectively, and not by cluster randomization at a work organizational

level such as, department or company. Employees in the CG could have learned the exercises that were assigned to their co-workers in the TG; however, these exercises would not have been tailored to their own physical needs based on the health check and they would not be supervised. The extensive variations of exercises prescribed to each individual in the intervention group were presented previously.[27] The poor adherence (56%) is another limitation of the study and the significance of this limitation is seen from the difference in effect of the intervention in the intention to treat and the per protocol analysis. Future studies of the role the middle managers in implementing WHP could determine the feasibility of IPET in working hours.

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Authors' Contributions

JBJ and GS have made substantial contributions to conception, design and analysis. JBJ have made statistics analysis. All authors have been involved in drafting the manuscript and revising it critically for important intellectual content and have given final approval of the version to be published.

Conclusion

This study demonstrated that one-hour of supervised IPET during working hours every week and recommendations of 30 minutes of exercise at moderate intensity for six days a week had several effects. The intervention improved general workability and general health by approximately 5% for the TG compared to CG. Furthermore, participants with an adherence of ≥70% had a significantly improvement in SP and general health and additionally decreased sickness absenteeism by 49%. Overall, these results underline the effectiveness and corporate incentives of implementing IPET at the workplace if following the intervention protocol.

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Paper IV.

Implementing workplace health promotion – the role of middle managers in Denmark

ABSTRACT

Many workplace health promotion (WHP) articles claim there is a need for top management to support WHP. This article addresses a missing link between top management and employees when it comes to understanding how to successfully implement and embed WHP as a strategy within organizations: the role of the middle managers. How do middle managers respond to WHP? What concerns do they have about their own behavior and prioritization? Based on studies outside the WHP field, as well as on empirical ones, this article offers input to theory development.

Findings from in-depth case studies on middle managers and change agents (health ambassadors) from a two-year RCT intervention on increased physical activities among office workers in Denmark show that middle managers play a key role in successful implementation of WHP, but that they feel uncertain about their role, especially when it comes to engaging with their employees. Two questions that especially trouble the middle managers were identified: (1) Is it ethically acceptable to interfere with employees' health behavior through WHP when non-work-related health behavior borders on the private sphere are crossed? (2) How should work-related activities versus health-related activities be prioritized when a scheduling conflict arises? In the case studies, uncertainty about their role made the middle managers reluctant to take action on WHP. Instead they were likely to leave further action to top management.

All participants gave their written informed consent to participate. The local Ethics Committee approved the protocol, which qualified for registration in ClinicalTrials.gov [ref. after review].

Key words: Work health promotion, implementing health as a strategy, middle manager, physical activity.

INTRODUCTION

The workplace is an ideal setting for influencing people's health behavior since, even in countries with high unemployment rates, the majority of the adult population is employed (Kuoppala *et al.*, 2008). Furthermore, most people spend many hours in the workplace, where they can motivate and encourage each other towards a healthier lifestyle. Finally, companies usually have effective communication channels where target groups can be reached with more success than through traditional public health campaigns, such as national obesity and smoking prevention campaigns (Danish Prevention Committee, 2009).

Interventions to increase physical activity (PA) may be suitable for workplace health promotion (WHP) due to health effects that are valued by organizations (Proper *et al.*, 2003). Danish, Dutch and American studies have documented an increase in activity (Proper *et al.*, 2006), efficiency and quality of work and a decrease in sick leave (Pronk, 2004, Galinsky *et al.*, 2007) as well as a decrease in musculoskeletal complaints (Blangsted *et al.*, 2008) when implementing PA in the workplace. Furthermore, Danish studies have shown that active employees have a higher energy surplus and are less stressed (Hansen *et al.*, 2010). In addition, it is generally accepted in literature and practice that WHP activities are worthwhile and profitable, and that employees and employers alike are highly motivated to work with WHP (Kuoppala *et al.*, 2008).

Despite all the advantages of WHP and the positive support in implementing and embedding WHP, maintaining the activity remains a major challenge (Berry *et al.*, 2010). A review shows that workplace policies/resources for PA only result in a weak positive relationship with the level of actually performed PA (Lin *et al.*, 2014). At the same time, research shows that strategies, structure and policies are not the prime mover in organizations; culture is (Kossek *et al.*, 2012). Thus, implementing WHP can be perceived as a cultural change effort, as both the target group members as well as a number of other stakeholders have to change behavior and sustain new patterns of behavior and prioritization. However, evidence-based research shows that 70% of all change projects in the workplace fail (Burnes and Jackson, 2011; Charles and Dawson, 2011).

For successful change to happen middle managers must play a key role (Neubert and Cady, 2001; Huy, 2001; Burnes, 2009; Barton and Abrosini, 2013), but in the WHP literature there is a knowledge gap as to the contents and concerns regarding the middle managers' role in implementation and embedding of WHP as a health strategy.

THEORETICAL FRAMEWORK

Top and middle management can be seen as two complementary systems that need to work together in search of success (Kotter, 2001). Top managers define strategies and have responsibility for the overall direction of the organization (mission/vision), whereas middle managers must commit to strategies laid down by top management and execute strategies throughout the organization by relating the strategies to their own departments (Huy, 2001; Neubert and Cady, 2001). In terms of WHP, a health strategy within an organization can be seen as *an effort related to the employees' health behavior that can help the company attain its overall company vision*. The health strategy is pursued by explicit health measures as well as health initiatives e.g. WHP projects.

For successful change to happen, middle management has to play a key role, as it is the only group of managers who (due to their closeness to daily business and their employees) can execute change (Burnes, 2009; Barton and Abrosini, 2013). Middle managers have access to top management, and their job is to bring order and consistency to the organization (Kotter, 2001; Balogun, 2006; Bryant and Stensaker, 2011). Middle managers know the informal network, modes and emotional needs of their employees better than the top managers and are therefore more suitable as change movers (Huy, 2001).

When middle managers' commitment to WHP as a health strategy is lacking, they often fail to engage in the behavior that supports change (Barton and Abrosini, 2013). Inappropriate culture in the form of lack of alignment between the value system of the change intervention and employees undergoing the change (Burnes and Jackson, 2011) and weak managers (Kotter, 1996) are other sources of non-successful WHP. In addition, individual changes will not be effective over time if group values, norms, and artifacts are not changed (Schein, 1996).

Research shows that it is possible to change culture, but it is a long haul which involves the whole organization (Kanter *et al.*, 1992). Change is a group activity, and the management of change is a cultural and cognitive process rather than a rational and analytical exercise (De Witt and van Muijen, 1999). Company artifacts and formal norms can be changed but when it comes to the deepest levels of company culture, i.e. values and basic assumptions, which typically are invisible and even unconscious (Schein, 1992), it is more difficult (Brubak and Wilkenson, 1996).

An ‘emergent approach’ to change is the most suitable method when dealing with cultural change, as attempts to change culture through top-down management alone will not work (Stacey, 2010). A core element of the emergent approach is that change managers work together with the organization instead of directing change from the top (Stacey, 1995), and for change to happen managers must work on themselves, change their own behavior and challenge their own assumptions and values in order to understand what they ask of their co-workers (Kotter, 1999; Balogun, 2003).

Resistance to change is inevitable, and the more a given change effort challenges people’s existing norms of behavior and assumptions, the more resistance there will be (Kotter, 1996). Middle management can be resistant to new strategies if they feel they are losing control or influence (Kotter, 2007; Randall and Nielsen, 2009). Perhaps some middle managers are satisfied with the status quo or feel lack of empowerment, and that they cannot identify themselves with the burning platform, i.e. a sense of urgency for the change (Kotter, 1996; Harley *et al.*, 2006; Michel *et al.*, 2013). This is in line with research showing that more than 50% of all change projects fail because middle managers fail to establish a sense of urgency (Kotter, 2007).

From this argumentation it follows that middle managers must develop skills to deal with resistance from their employees, and top managers must develop skills to deal with resistance from their middle managers. In particular, resistance from middle managers themselves is not dealt with in the literature. Competence development (education and involvement) of the middle managers seems to be a core element when it comes to successful implementation of change and sustaining momentum (Michel *et al.*, 2013). Furthermore, it is important to define the contents of the roles of various forms of change agents (Gareis, 2010).

In sum, middle managers play a key role in implementing successful change. However, a gap in the literature exists when it comes to describing how the middle managers themselves understand and buy into their role, and how their role performance influences employees.

The aim of this paper is to address this gap by investigating middle managers’ own understanding of their role as well as the employees’ assessment of their middle managers’ fulfillment of the role in a two-year randomized controlled trial intervention study.

METHOD

Study design for the overall intervention study

The empirical study which was part of a health intervention research project [ref. after review] consisted of a multiple-case study involving six Danish organizations. The study was a prospective two-year parallel group, examiner-blinded, randomized controlled trial with a physical exercise training intervention group and a control group. The enrollment was sequential in six strata from May 2011 to March 2013, with baseline as well as one-year and two-year follow-up measures. Employees (office workers) were individually randomized within each stratum using computerized random numbers and balanced for gender in strata with less than 100 employees. As part of the research project one employee for every 10–15 employees was appointed as health ambassador (HA). The HA's job was to motivate their colleagues in the training group to become and remain physically active and to coordinate and implement health promotion activities in general.

The HAs were selected by middle management and trained to support the target group. The intervention for the target group (incl. the appointed HAs) consisted of individually tailored training programs termed "Intelligent Physical Exercise Training", IPET. The organizations allowed each participant to allocate one hour of weekly working hours to IPET. The IPET concept was: 1) to balance the physiological capacity of the employees relative to occupational exposure, 2) to tailor the exercise to individual capacities and disorders to improve employees' health, 3) to motivate participants by offering evidenced and enjoyable programs implemented with care, and 4) to be cost-effective for the organization. All researchers were blinded to the randomization. The main aim of the overall study was to measure if IPET had a positive effect on office workers' individual health (fitness level, BMI, blood profile and blood pressure), productivity, short term absence, workability, general health and pain or discomfort which required contact with the healthcare system.

Recruitment of workplaces and participants

In total, 103 Danish private and public companies were contacted by mail in May 2010. The companies were selected due to presumed interest in health issues. Seventeen of the 103 companies agreed to receive more information. One of the researchers visited all seventeen companies and presented the research project to the contact person and a top manager. After the seventeen

meetings, six companies agreed to participate. In sum, 389 employees, seventeen HAs and 41 middle managers agreed to participate in the study.

Interactions with HAs

During the first year of intervention, all appointed HAs, i.e. seventeen persons, held four one-hour meetings with one of the researchers. Meetings were held at the six companies. The purpose of the meetings was to gain insight into the HAs´ experience of undertaking their role as change agents. After one year of intervention, the HAs answered a questionnaire by mail (SurveyExact). In addition, focus group interviews were held at three companies where ten HAs participated.

Interactions with middle managers

Middle managers who had employees and HAs participating in three of the companies, i.e. seventeen persons, were invited to a half-day seminar on 'implementing PA as a health strategy in the workplace' and an introduction to the two year health interventions project. All invited middle managers attended the seminar and participated in a survey. Replying to the survey was the first activity on the agenda at the seminar, i.e. the questionnaires were to be completed before the middle managers were introduced to the research project and their role in the research project. One month after completion of the survey, nine middle managers (three middle managers from each of the three companies) were interviewed – six who participated in the half-day seminar and three who did not participate. This selection was undertaken in order to identify the impacts of participating in the seminar.

Data collection

Overall (Table 1), the data presented in this article stem from (1) questionnaire survey with close-ended questions for all employees after one year (N=305), (2) field notes based on four meetings with HAs at each workplace, (3) nine interviews with middle managers based on semi-structured interview guides at three workplaces, (4) questionnaires surveys with both open-ended and close-ended questions for middle managers as well as for HAs, and (5) focus group interviews with ten HAs at three workplaces. Questionnaire with close-ended questions to the HAs were scaled from 1

– 6: 1: I totally disagree, 2. I disagree, 3. I neither agree nor disagree, 4. I agree, 5. I totally agree and 6. I don't know. The data was collected from January 2012 to May 2013.

Table 1: employees in paper IV.

	Case A Private	Case B Municipality	Case C Municipality	Case D National board	Case E National board	Case F Private	Case A – F Employees all together
EMPLOYEES							
# Baseline	40	105	103	52	42	47	389
# after one year	26	86	88	37	37	31	305
Survey response rate *	96%	94%	99%	92%	92%	87%	93 %
HEALTH AMBASSADORS							
# appointed	2	5	3	1	2	4	17
Meeting attendance rate**	100%	100%	100%	100%	100%	100%	100 %
Survey response rate	100%	100%	100%	100%	100%	100%	100 %
Interviewed in focus groups	-	-	100%	100%	100%	100%	100 %
MIDDLE MANAGERS							
# formally involved	-	-	27	7	7	-	41
# in half-day seminar	-	-	13	4	4	-	21
Survey response rate***	-	-	100%	100%	100 %	-	100 %
# interviewed	-	-	3	3	3	-	9

* Employee survey: employees after one year

** Health ambassador meetings: 4 meetings, 1 meeting every 3 months

*** Middle manager survey: employees in the half-day seminar.

After one year of training both the exercise group and the control group answered three questions regarding their middle manager's role on working with WHP. The respondents received the questionnaire by mail (SurveyExact).

In order to dutifully undertake the middle manager role related to WHP, the middle manager has to:

1. prioritize WHP at the same level as other tasks and projects in daily business
2. create room and skills for the employees to make the healthy choice in daily business
3. create room for WHP activities in daily business.

To “prioritize WHP at the same level as other tasks and projects in daily business”, means that WHP should be a part of the middle manager’s managing job as well as all the other areas the middle managers manage.

To “create room and skills for the employees to make the healthy choice in daily business”, means that middle managers must make sure their employees have the necessary skills to make the healthy choice in daily business. By “skills” we mean the necessary knowledge about health and how to change their own health behavior.

To “create room for WHP activities in daily business”, means that middle managers must allocate time for WHP activities in their employees’ weekly work program.

The three issues (1–3) mentioned above form our construct of ‘role performance’.

We define “not satisfied with the middle managers health work” when the target group gave a score of five or less in all three questions.

RESULTS AND DISCUSSION

Questionnaire surveys

In questionnaires prior to intervention all middle managers in the case study - except two, who neither agreed nor disagreed, argued that employees should be engaging employees when implementing WHP. Furthermore the middle managers agreed that it was the top managers' job to engage employees before implementation. When asked about their own role in engaging employees, more than 50% of the middle managers thought that it was not their role.

Ninety-four percent of all employees answered the three questions (Table 2), the outcome demonstrating that middle managers did not succeed with the implementation of WHP in this research project. Employees found that middle managers only to some degree (total mean ± SD: 4.2 ± 3.1) prioritized WHP at the same level as other projects in daily business, and their ability to create room and skills for the healthy choice in daily business was rated as: 4.8 ± 3.0. Furthermore, the rating of middle manager's prioritization of WHP in daily business was at a similar level: 4.3 ± 3.0, with no significant differences between the training- and control group for any of the three questions.

Table 2: employees' view on their middle managers' role performance. The responses to questions are scaled from 1 to 10, where 1 represents 'not at all' and 10 'very much'.

Questions	Training (N = 144)		Control (N = 144)		
	Mean	SD	Mean	SD	P-value
Do you feel that your middle manager prioritises WHP at the same level as other tasks and projects in day-to-day operations?	4.5	3.1	3.9	3.1	0.13
To what extent do you feel that your middle manager creates room and skills for you to make the healthy choice in day-to-day operations?	5	2.9	4.5	3.1	0.20
To what extent do you feel that your middle manager creates room for WHP activities in day-to-day operations?	4.5	2.9	4.1	3.0	0.25

Results from the survey with the seventeen (HAs) at the six workplaces clearly show that support from middle management is necessary in order to implement WHP activities (4.6 ± 0.5). Furthermore, all HAs found that it was necessary to involve their middle managers when

implementing WHP activities (4.8 ± 0.4), and involvement of middle managers is necessary if HAs are to succeed in their work (mean of 3.9 ± 1.1).

Interviews

Based on findings from the interviews, we present and discuss themes that relate to middle management's role when implementing and embedding WHP as a strategy.

Middle managers' role

Middle managers agreed prior to the training intervention (i.e. on the questionnaire before the research project presentation at the half-day seminar) that they should play an active role during the intervention. However, our findings show that they found it difficult in practice. As the following quotations from interviews of middle managers show, implementing WHP as a health strategy was a new discipline for all the middle managers in the study.

Two middle managers replied to the question about their former experiences with WHP in the workplace:

"*We have had some activities like a running club, yoga and training in a local fitness center [offered] for all employees to use in our free time.*"

"*WHP has not been part of our role. Instead the tacit message from the company has been that it is our own personal responsibility to work on health in our free time.*"

Five out of six middle managers agreed that their role in the WHP project was clearly described, but it was still a new discipline for them and they needed more knowledge and tools to fulfill their role in implementing WHP:

"*It is unclear for me how to practice my new role – it is a new discipline for me.*"

"*Health management is a new discipline we haven't worked with before and we need to know what is expected from us in practice.*"

"*It is a challenge to practice leadership in health, which is an unknown discipline compared with the professional fields I work with in daily business.*"

"*I need more knowledge and skills to work with WHP in practice as a middle manager.*"

The findings relate to the work of Gareis (2010) and Michel *et al.* (2013), who point out that education is a core element when it comes to successful implementation of change and sustaining momentum.

Findings from the empirical study show that when middle managers were asked about their understanding of their role in implementing WHP, all middle managers but one agreed that a very important part of their job (i.e. role in the research project) was to show through their attitude that working with WHP was important. When middle managers were asked about the importance of their own behavior (signaling the importance of being healthy and taking part in intervention activities) the majority (75%) still agreed that it was important. The following statements from the interviews of both the HAs and the middle managers support this.

Middle managers:

"*It is our job to communicate the change and to exemplify the change ourselves.*"

"*Middle managers must take an active part in WHP activities and in that way signal that it [WHP] is not only allowed but is highly prioritized.*"

"*There must be full focus on and acceptance of health and well-being in all links in the chain – only then will we succeed.*"

HAs:

"*Middle managers must encourage employees to engage in WHP activities during working hours.*"

"*If middle managers don't take an active part in the WHP activities then we (employees) are not sure whether it is ok for us to [take part]*."

An interesting finding is that all middle managers in the survey prior to intervention stated that they should be role models. A month after, all but two no longer saw themselves as role models. This conflicts with both the questionnaires and the literature. 'Setting the scene' in terms of not only using the normal channels of communication in the company (like posters, departmental meetings and intranet), but personally communicating the WHP project is a key tool for communicating change and part of the middle managers' role (Rouleau and Balogun, 2011). Research (McKay *et al.*, 2013) indicates that uncertainty due to lack of communication in change projects can be stressful.

Based on these insights, we propose:

Proposition 1: In order to make employees change health-related behavior, middle managers must through their own behavior and attitudes communicate the importance of suitable health-related behavior.

Proposition 2: In order to make middle managers clear about their role in WHP implementation, training including theory inputs on WHP and health management is necessary.

Role-related challenges

Our empirical study shows that middle managers found ethical issues related to the WHP difficult to work with as well as the interference in daily business. Middle managers joining the half-day seminar stated that WHP is a joint responsibility between the company and their employees. However, the two middle managers who did not take part in the workshop found it problematic to interfere with employees' health-related behavior:

"*I find it problematic that companies and society in general interfere with how people want to live their lives.*"

"*It can be problematic to interfere in employees' health, and I see a tendency for companies to interfere with how you live your private life, which worries me.*"
"*I think that this goes beyond traditional management. This is not about management but about influencing employees to make the right decision concerning health, which is very different from my normal job dealing with daily business.*"

All middle managers agreed that finding time for WHP in daily business was the biggest challenge, together with ethical issues of management interfering in employees' health and wellbeing:

"*Do we have time for this in daily business? Daily business is my top priority.*"

"*I can't see myself as the manager with raised finger telling my colleagues how to live a healthy life – it is not my job to do that.*"

"*Can we as middle managers interfere in employees' health?*"

Furthermore the middle managers were concerned about the time used for WHP activities. As their primary job is to take care of operational aspects and, with constant pressure from top management to reduce costs, undertake re-organization and implement other new structures and systems, WHP was hard to prioritize:

"*My job as a manager is to find the right balance between work and health activities in working hours.*"

"*Do we have time for this in hard times? What I mean is that I have to take time out from my professional work to use on WHP activities*."

Competition from daily business within the given organization is a big challenge when working with WHP. Our findings relate to Grant (2008), who states that it is necessary to study the dissonance between the existing culture and the envisioned organizational change in order to succeed in the latter. Furthermore, the literature supports the notion that alignment between the value systems of the change intervention and the existing culture is necessary for change to happen (Burnes and Jackson, 2011). The findings show a specific need for middle managers to work

together with top-management on their understanding of their own role regarding ethical issues in WHP, e.g. how to deal with non-work-related health behavior bordering on the private sphere. HAs were trained for this engagement process with employees in the study, but findings show that they believe that they will not succeed without the middle managers' support (ref. comes after review). Our findings relate to Grant (2008), who states that for successful alignment to happen it is necessary to study the culture of middle managers within organizations, because over time people working together will think and act in similar fashion and become self-protective and resistant when "outsiders" attempt to change them.

Based on these insights, we propose:

Proposition 3: In order for middle managers to feel confident about ethical issues regarding interfering with employees "*private life*", *an engagement process must take place before they can fulfill their role in implementing WHP in the workplace*.

Proposition 4: In order for WHP to become daily business, top managers and middle managers must work together to align WHP in the governance structure of the company.

Top management's role

For successful implementation of WHP, middle managers have a key role as executers of change. Furthermore, middle managers will not succeed if they are not supported by top managers at all times. As middle managers state in interviews:

"*Together with middle managers, top managers must work out the change throughout the organization.*"

"*Top managers must back us up at all times.*"

"*Top managers must at all times prioritize the intervention.*"

"*It must become a natural part of our job – a new culture.*"

"*The challenge is that we feel the pressure for budget cuts every day and we have to run even faster every day – top managers must show us how much WHP must be prioritized.*"

HA's state:

"*Middle managers must set up goals for our work together with us and follow up on results if we are to succeed in our job.*"

"*In all change processes, including WHP, management must show us the importance of the change and back it up at all times.*"

Findings from interviews of middle managers and focus group interviews of HAs support the conclusion that engagement of employees is necessary in if implementation of WHP is to succeed, but, at the same time, the interviews and survey show that middle managers were not sure about the engagement process and took no action in the engagement process in the research project:

HA: "*The whole organization must work on the implementation of WHP together, including middle managers, and both employees and management must agree that this is important for us.*"

Middle managers:

"*Co-work between middle managers and employees is necessary for success and there must be employee engagement at all times.*"

"*Engagement is necessary so that we don't lose our colleagues in the process.*"

"*I think that you need to know* '*your people*' *in order to know what to do to motivate them*".

"*I think the employees have been engaged in information meetings but I'm not sure.*"

Both middle managers and HAs argue for the need of a project manager in order to succeed in implementing WHP as a health strategy:

Middle managers:

"*Like all other new change projects – somebody must take responsibility for WHP interventions.*"

"*Interventions should be adjusted and evaluated regularly at all times if we really want to succeed.*"

HAs:

"*For WHP to be a success somebody must be responsible for evaluating the activities.*"

"*Somebody must run the project and help us with health-related challenges in daily business.*"

All 24 one-hour meetings with HAs in the six workplaces raised the challenge of getting middle managers to take action in WHP activities. This included getting support from their middle managers as well as making middle managers set goals for the HAs' work and to follow up on the goals.

The findings demonstrate that it is important for middle managers to be supported by top managers and engage their employees at all times if they are to succeed in implementation of WHP. As the current literature states, middle managers have a key role as drivers of change (Huy, 2001; Neubert and Cady, 2001; Barton and Abrosini, 2013). Furthermore, to implement change projects with success it is important to define roles for various parties involved in the change, and it is essential for all organizations to identify the resources and competencies needed for successful change (Grant, 2008; Michel *et al.*, 2013). Middle managers must work together with their employees instead of directing change from the top, and to succeed they must work as facilitators and coaches (Kanter, 2008). Berry *et al*. (2010) state that middle managers must work together with a health program manager in order to succeed. Furthermore Berry *et al.* (2010) argue for the necessity of a WHP program manager in order for change to happen. The program manager must have knowledge

of health aspects as well as organizational skills; and when working strategically with WHP all activities must be measured and adjusted to ensure they have an effect (Berry *et al.*, 2010).

Based on these insights, we propose:

Proposition 5: In order for middle managers to succeed, they must work together with top managers.

Proposition 6: In order for middle managers to succeed, they must set goals for their HAs and follow up on their work.

Proposition 7: Engaging employees is crucial for successful implementation of WHP, and middle managers must be in charge of the engagement process.

Proposition 8: *A health program manager is necessary in order to succeed in implementation of WHP, and the program manager must adjust and evaluate activities and assist middle managers in measuring effect*.

Strengths and limitations

Major strengths of this study were the high numbers of workplaces and participants from both the private and public sector which were geographically representative in a two-year study and the rigid RCT design with the involvement of experts within occupational health as well as sports science [ref. after review]. Furthermore, data was obtained from middle managers, HAs and employees using data triangulation (Eisenhardt, 1989).

A limitation of this study was middle managers' low attendance at the half-day seminar on strategic health where only 50% of all the middle managers participated. Another limitation is that all participants were office workers. It might be interesting to involve more employee groups in future study. The same holds true for the national origins of the study. As it was conducted in Denmark, it might be interesting to investigate the impact of national culture by doing future studies in more countries. With its very explicit and detailed research design, it would be easy to undertake similar studies in the future.

CONCLUSION

This study adds to the knowledge of researchers and practitioners with respect to the difficulties of implementing and embedding WHP activities in the workplace. Middle managers do not find it easy nor are they willing to fit WHP into their daily work. Middle managers ask for more knowledge and skills if they are to work with WHP in daily business. Furthermore, implementing and embedding WHP as a health strategy raises ethical issues of interfering with employees' health, which by tradition has been the employee's private responsibility.

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Paper V.

Implementing workplace health promotion – the role of peers as formal health ambassadors

Abstract

Purpose – The purpose of this paper is to discuss the potential for enabling employees' physical activity (PA) by appointing peers at the workplace as formal HAs.

Design/methodology/approach – An exploratory study nested in a representative randomized controlled study was conducted. Peer HAs were appointed and trained in PA programs at six workplaces.

Findings – Formal peer HAs have a potential as facilitators of increased PA. However, proper selection of ambassadors is of great importance. Lack of careful identification with and respect for the appointed peers made target group members skip the PA promotion program even though they were initially committed. Importantly, the HAs need skills training on how to deal with non-compliant colleagues. Finally, support from different stakeholders, e.g. middle managers is pertinent.

Research limitations/implications – The study was exploratory. Explanatory research that integrates peers as formal HAs and PA performance is needed. The target group's willingness to accept the HAs as role models or respectable spokespersons imply that inclusion of informal power and status is necessary in theory building of peers as change agents. Further, educational aspects are important.

Practical implications – Selection of peers as HAs must include an assessment of their informal power and role model potential. HA education should include theory, practice tools and skills training for dealing with target group members as well as other stakeholders. Furthermore HAs must receive ongoing support from middle managers.

Originality/value – The paper addresses a gap in the literature linking PA to workplace peer facilitation.

Key words: Workplace health promotion, workplace health education, peers in workplace health promotion, physical activity.

Background

Workplace programs aimed at encouraging employees to more physical activity (PA) are gaining popularity these years (see e.g. Dishman *et al.*, 1998; WHO, 2010; Edmunds *et al.*, 2013). However, the health promotion role of workplaces is poorly understood (Waddell and Burton, 2006; Jackson *et al.*, 2014), and lack of advice on how to implement the programs has been identified as a key barrier for employer organizations' health promotion investment (Black, 2008).
In this paper, we discuss the potential for enabling employees' PA by a structural intervention, i.e. appointing peers at the workplace as formal HAs (HA). Research shows that interventions in which employees are appointed as interventionists are more effective than interventions with other actors as interventionists (Conn *et al.*, 2009). Further, a core advantage of health promotion programs at the workplace is that multi-level interventions can be applied, meaning that you can address organizational and environmental/policy issues in addition to factors at the individual level (Bull *et al.*, 2003). Edmunds *et al.* (2013) emphasize that the PA culture of the workplace should be considered. They present findings from a program in which the culture within teams was a barrier to the team members' participation. Despite personal awareness and interest of the program, lack of interest and attention to the PA by the team leaders inhibited the team members in participating.

In addition, Abraham and Michie (2008) encourage an increased focus on the characteristics of those who are delivering the interventions. This is in line with Mellor and Webster (2013) who point to the need of ongoing efforts as well as they state that site sponsors encouraging attendance at workplace health promotion events may be helpful in alleviating staff resistance. Collaboration between actors and stakeholders, inside and outside of the workplace, has been recommended by research as an important strategy in order to develop health promotion at workplaces (Dugdill *et al.*, 2008; Eriksson *et al.*, 2012). However, only limited research on the barriers and facilitating factors related to this kind of collaboration is carried out (Goetzel *et al.*, 2008; Lang *et al.*, 2009). A peer formally appointed as HA and collaborating with external consultants and various management levels inside the company is an example of such an actor. The present research therefore contributes to this research gab, acknowledging that peers are a significant part of any workplace culture.

Since Albert Bandura's well-received article on health promotion by social cognitive means (Bandura, 2004), an ongoing debate on health education practice has taken place (e.g. Golden and

Earp, 2012; Fielding, 2013; Lieberman *et al.*, 2013). A core theme in the debate concerns how to integrate various levels of interventions. In their classic work on promoting an ecological perspective, McLeroy *et al.* (1988) suggested that influences on health behavior can take place at five different levels: intrapersonal, interpersonal, institutional, community and policy. Further, they argue that interventions that address at least two of these levels are expected to be the most effective. In addition, Golden and Earp (2012) point to the fact that "ecological models assume not only that multiple layers of influence exist but also that these levels are interactive and reinforcing" (p. 364).

However, many of the theories and intervention techniques observed in the literature focus on individual and interpersonal change even though it is widely acknowledged that structural changes are needed (Lieberman et al., 2013), and that interventions which incorporate multilevel strategies (e.g. employee attitudes towards PA, social support, onsite PA facilities, marketing and management support) result in an increase in PA program participation levels (Crump *et al.*, 1996; Campbell and MacPhail, 2002; Warren *et al.*, 2010; Edmunds *et al.*, 2013)

Another theme in the current debate is how to better include new stakeholders in the interventions to increase effectiveness. Fielding (2013) states that "to truly change the conditions for health, contributions would have to be made by many sectors and stakeholders including employers and businesses" (p. 514) and, further, that "it will be critically important to learn and understand the goals of nontraditional partners as new relationships are developed" (p. 517). Auvinen *et al.* (2012) add that "research into stakeholders in work health promotion (WHP) has been scarce" (p. 177).

In the present article, we investigate the structural factor of appointing peers at the workplace as formal HAs in a representative randomized controlled study at six workplaces. Except for the formal appointment, this structural intervention on the institutional level consists of educating HA within health promotion and behavior as well as allocating some of their weekly work time for health promotion. The underlying idea is that efforts on the individual and interpersonal levels are supported by workplace peers as non-traditional partners when it comes to changed health behavior.

The workplace is an ideal setting for health promotion interventions due to the fact that even in countries with high unemployment rates the majority of the adult population works (Kuoppala *et*

al., 2008). Furthermore, adults spend many hours at the workplace, during which they can motivate and encourage each other, and companies have effective communication channels through which target groups can be reached with more success than through traditional public health campaigns (Danish Prevention Committee, 2009).

However, the literature is vague when it comes to describing what is believed to constitute 'peerness' (Shiner, 1999), and "the transformative power of the peer principle is not yet widely understood and systematically applied" (Gartner and Riessman, 1999, p. 6). In addition, reference to theory in peer education literature is very limited (Turner and Shepherd, 1999).

Theoretical frame of reference

Peer education can be defined as "sharing our experiences and learning from others like us" (Robins, 1994, p. 2). This type of education has been popular within schools and youth services since the 1960s, starting out within drug prevention efforts and gaining especially intense attention in practice and in the literature of the 1990s (Milburn, 1995; Norman, 1998). The use of peers is also well-known in the academic world, where peer reviewing is a common phenomenon.

A rationale for using peers is tied to the notion of identity (Turner and Shepherd, 1999). The peer status can in health promotion be seen as an alternative to the 'expert' status of a health education professional (Shiner, 1999). According to the rationale of identity, which builds on social learning theory, the peers are consciously or unconsciously perceived as role models by the target group members (Bandura, 1977). A role model should be seen as attractive by the target group member, and attractiveness should be understood in broad terms (Eskerod and Jepsen, 2013). It may be that the target group member and the role model share certain characteristics which the target group member can identify with, or that the role model has characteristics which the target group member aspires to. "People are more likely to hear and personalize messages resulting in changing attitudes and behaviors if they believe the messenger is similar to themselves and faces the same concerns and pressures" (Gartner and Riessman, 1999, p. 5-6).

Another argument for the potential of peer HAs is that peers can act as influential spokespersons for a change initiative if they are seen as trustworthy and as someone the target group members would like to be at good terms with (Eskerod and Jepsen, 2013).

Peer HAs can both be seen as a structural supplement to the health program manager and as an alternative to internal or external consultants (Grima and Trépo, 2011). The peer HAs become the link between those who want the change (e.g. top management) and the adopters of the change (employees) (McMaster *et al.*, 2005). Competence development (education and involvement) of change agents, i.e. HAs in our case, is a core element when it comes to successful implementation of change (Burnes, 2009; Gareis, 2010).

Shiner (1999) claims that the nature of peer involvement in particular needs to be scrutinized, investigated and defined more clearly than it currently is in the literature. He contributes to this himself by offering a distinction between 'peer delivery' and 'peer development'. According to Shiner (1999), peer delivery is the most common way of understanding the peer education concept. Peer delivery is about providing knowledge, facts, practical pieces of advice as well as formal sessions to the target group members, whereas peer development is about the peer change agents developing their own situation in a positive way by identifying their own training needs, negotiating these with trainers, and advancing their own interests concerning the peer activities. Peer delivery calls for project management and communication skills, whereas peer development relates to the potentials of being a role model who also changes health behavior and develops him- or herself based on the WHP initiative.

In Abraham and Michie's taxonomy (2008) on behavior change techniques, three of their 26 techniques relate particular well when using formal peer HAs. These three are:

(a) The usage of follow-up prompts, i.e. the target group member is contacted by the HA during the course of a PA program.
(b) Provision of opportunities for social comparison, i.e. the target group member can observe a non-expert's, i.e. the HA's performance on PA.
(c) Provision of social support, i.e. prompting consideration of how the target group member can change his/her behavior by the HA offering the member help or social support.

Methods

The research involved a representative randomized controlled study registered in [ref. after blind review] and performed in Denmark in 2011-2014. The aim was to study whether individually tailored worksite-based physical training among workers with inactive job categories will: 1) Improve cardiorespiratory fitness and/or individual health risk indicators, 2) Improve muscle strength and decrease musculoskeletal disorders, 3) Succeed in regular adherence to worksite and leisure physical activity training, and 3) Reduce sickness absence and productivity losses (presenteeism) in office workers [ref. after review].

Recruiting participants

In all, 103 Danish organizations were contacted and 17 of these showed interest in participating. Eventually, six organizations (two private and four public) committed themselves to participate. The target group members were all office workers who worked at least 25 hours a week, who were not pregnant, and did not suffer from certain specified serious diseases. Following baseline measurement, participants were randomized to either a PA training group (TG) (n=194) and a control group (n=195). The present study on the peers as formal HAs is a sub-part of the randomized study, and includes only findings from the participants randomized to the PA TG as well as those appointed as HAs. This part is inspired by Eisenhardt and Graebner's (2007) work on longitudinal multiple case studies. The HAs' task was to motivate colleagues to become and remain physically active during the research project, and to coordinate and implement health promotion activities in the workplace in general.

Among the eligible employees, middle managers appointed peers to act as HAs. Middle managers were asked to select and appoint HAs among employees with at least five years of seniority within the organization. As criteria for selection, the middle managers were asked to choose employees they believed would be able to motivate their colleagues and have the drive to take initiatives, such as motivating colleagues in the TG to become and sustain physically active 30 minutes of moderate intensity six days a week during the course of the research project. Further, the appointed had to be able and allowed to allocate two hours a week during work time for two years for the HA role. In addition, the middle managers were instructed not to appoint so-called sports freaks. The HAs were supposed to represent the 'average' employee when it came to PA, thus providing a better basis for role modeling. The HAs trained together with the PA training group but were not part of the

randomized TG. In total, 17 HAs were appointed, each covering 10-15 of the target group members, i.e. office colleagues.

All participants gave their written informed consent and the local ethics committee of [ref. after blind review] approved the study protocol.

Interventions

The training intervention and the theoretical framework of "Intelligent Physical Exercise Training" (IPET) has been described in detail previously [ref. after blind review]. In short, all sessions were one-hour long (50 min training sessions – allowing 10 min for getting to and from the training area). Each employee received an individually tailored training program based on outcome measures of a health check and a questionnaire performed at baseline.

The purpose of the HA training was to educate HAs to motivate and implement PA for their colleagues in the workplace. The training was based on evidence-based principles and built on the concepts of both 'peer delivery' and 'peer development' (Shiner, 1999) (see theoretical framework). All training sessions had a practical focus in which the HAs tried out the theories in practice using the learning and training principles described by Brinkerhoff and Mooney (2008).

Table 1: contents of training programme for the peer health ambassadors

Day 1	Day 2	Day 3	Day 4
Theoretical inputs	**Physical activity at a local gym, theoretical inputs and local development**	**Theoretical inputs**	**Physical activity at a local gym and theoretical inputs**
Definitions: health, enhancing health, prevention and treatment. *(Danish Health and Medicines Authority 2014)* Ethical issues when working with health (for example being physically active) during working hours. Evidence, myths and gains when working with physical activity. *Davis et al., 1987, Pronk et al, 2004, Galinsky et al. 2007, Dishman et al. 2009)*.	The health ambassadors tried different forms of evidence-based physical activities. *(Garber et al. 2011)* Different models and theories for changing behaviour – stages of change. *(Prochaska et al. 1995)* Self-efficacy. *(Bandura 1997)* Diffusion of innovation, whole brain. *(Hermann 1991)* Barriers toworking with health in the workplace based on the trainers' experience *(Edmunds et al. 2013)* Development of a catalogue of ideas for physical activity suitable for each workplace.	How to organise and implement projects. *(Harvard Business Essentials 2004, Kraemmer and Divert 2009)* Communication. *(Kraemmer and Divert 2009)* Motivation theory. *(Pink 2009)* Appreciative enquiry. *(Cooperrider and Srivastva 1987)*.	The health ambassadors tried different forms of evidence-based physical activities. *(Andersen et al. 2008, Garber et al. 2011)* Karl Tomm's question wheel. *(Tomm 1985)*.

follow-up meetings

The purpose of the follow-up meetings was to support the HAs and collect data for the study by addressing the challenges they were facing as well as getting insight into their experiences with and thoughts about undertaking the role as change agent. All meetings had the same agenda (everybody presented: 1. Good stories. 2. Challenges. 3. How to deal with the challenges until next meeting). The meetings were facilitated by one of the researchers. The researchers' role was not to be an expert in the field of implementing health on the workplace but to help the HAs with their job by facilitating their own reflections and problem solving.

Data collection

More means of data collection were applied in order to increase credibility and validity of the results by data triangulation (Cohen and Manion, 2000), and both quantitative and qualitative data were collected. Surveys (using SurveyExact), individual semi-structured interviews and focus groups interviews were conducted.

One survey was aimed at the target group, i.e. the employees in the TG, and concerned their views on the HAs' influence on health promotion and health behavior in the workplace. In total 137 employees participated, giving an 80% response rate.

Another survey and all interviews were aimed at the HAs. These means of data collection concerned the HAs' views on the training as well as on their activities and perceived challenges in the role as HAs. All 17 HAs participated in the survey, giving a 100% response rate. Focus group interviews were held at four of the six companies, interviewing ten HAs, and individual semi-structured interviews were held in the last two companies, interviewing the remaining seven HAs.

Results and discussion

The 137 employees in the TG, were asked two questions in the survey related to their views on the HAs' influence on health promotion and health behavior in the workplace:

1. *To what extent did the HAs influence the health promotion activities at the workplace during the research period?*
2. *To what extent did the HAs influence your own health behavior?*

The two questions were scale questions from 0-10 were 0 represented 'no influence' and 10 'strong influence'. The results from the employee survey can be seen in Table 2.

Table 2: differences are estimated as the difference between means with 95% confidence intervals (95% CI) based on an unpaired T-test). Employees (number men: 38, and women: 99) gave ratings on a 10-point scale: 1 = no influence, 10 = strong influence.

	To what extent did the health ambassadors influence the health promotion activities in the workplace during the research period?	**To what extent did the health ambassadors influence your own health behaviour?**
Mean	5.16	3.88
Standard deviation	2.92	2.84
N	137	137
Significant difference between men and women	NO	NO
Mean (men)	5.32	4.63
Mean (women)	5.11	3.60

For Question 1, the mean answer was 5.2 (SD = 2.9). For Question 2, the mean answer was 3.9 (SD = 2.8). For neither of the questions significant differences between men and women or across organizations were identified.

The answers to both questions imply that the HAs have had some influence on both the health promotion activities and the individual behavior of the TG members. However, the numbers clearly show that there is room for improvement, especially when it comes to influencing health behavior.

Based on the qualitative data collection, we discuss issues related to selecting and educating HAs at the workplace.

Selecting HAs

Tension and conflict between some of the HAs and some of the TG members was present due to lack of respect of the HAs as well as envy. Some office workers thought that middle management had appointed wrong people for the role and felt they could be better HAs themselves. In order to promote identification between the HAs and the TG members, the middle managers were asked to select the ambassadors on the basis of their lifestyle, in terms of their being interested in health but not 'fanatic'. Some of the TG members responded positively to this selection criteria, while others responded negatively. Those with negative responses could not identify with the appointed ambassadors and would not seek or take any of their advice; see the statements in table 3.

Table 3: Statements on selection by the health ambassadors

"The most important [condition] for obtaining success is [in my opinion as health ambassador] that you are fully accepted by the colleagues and management."
"There was a lot of criticism in the beginning because I had been selected [by middle management] for the role and not been elected [by the employees]. A lot of colleagues thought that they would be better suited [for the role as health ambassador]. They couldn't understand why it was me [who had been selected]."
"Some active [colleagues] thought that I, as an ambassador, should be a frontrunner. So the fact that I had difficulties when it came to meeting at 8 AM [the time at which a health activity started] resulted in many negative [comments]. I was supposed to be 'the holy' and 'the good' who worked hard – and preferably did better than the others."
"[In my role as peer health ambassador] I wanted to be the way [the colleagues] wanted me to be, but that was difficult as they didn't all want the same thing."
"I'm a bit afraid of the comments [about me not being the right person to be health ambassador]… If too many of these [comments] pop up it pains me, and therefore I chose not to [take on a certain health promotion activity]."

The findings relate to Walker and Avis' (1999) statement that being involved in peer education does not automatically make the person participating empowered. To be successful the person must be perceived as a role model, be a spokesperson and be thought of as resembling the target group (Eskerod and Jepsen, 2013). Further, the findings relate to the work of Nikolaou *et al.* (2007), who point to the importance of a relationship based on trust between the peer change agent and the target group, as well as to Buchanan and Boddy (1992), who point to the importance of legitimacy, and Bandura (1977), who states that to be a credible role model the selected peer must have a high status within the peer group. Finally, it relates to Ryan and Kossek (2008), who discuss the need for considering whether the implementation of the change initiative breaks down or creates barriers when it comes to inclusion of all the employees (and e.g. their different health conditions and lifestyles).

Based on these insights, we propose:

Proposition 1: In order for a formal peer HA to be influential on health behavior, the target group must be able to identify with the peer, i.e. see the peer as a role model, or at least respect the peer as a spokesperson of the WHP initiative.

Educating HAs

The aim of the four-day training program was to give the HAs knowledge of and tools for how to motivate their colleagues and initiate health activities at the workplace.
Out findings show that the HAs found the education helpful. One states:

> "*I can't remember the name of the model, but the wheel with the different processes* [i.e. stages of change] *a person has to go through in order to change behavior has worked for me. In the beginning it was hard to use the models and theories in practice, but I looked at the material from the training program, and that helped me getting started.*"

However, the ambassadors would like to have more theory, practice tools and skills training on two issues: (1) how to give feedback concerning observed changed health behavior as well as observed non-compliance; and (2) dealing with other stakeholders within the organization, e.g. middle management.

Concerning (1), i.e. how to give feedback concerning negatively changed behavior and non-compliance, the degree of 'pushiness' towards the target group members, i.e. the usage of personal follow-up prompts, was an issue more ambassadors were struggling with, as can be seen from these statements:

> *"I could have [intervened more directly with the individual participants]. I expect this will come [during the project]. It's not natural for me [to do personal prompting], it's something I have to learn."*

> *"Probably I could be more 'pushy' towards people. But I don't feel comfortable in the role as one with a whip or a bitch who constantly has to remind grown-ups about doing this or that."*

> *"I only do something if my colleagues come to me with problems."*

Concerning (2), i.e. dealing with other stakeholders within the organization, the ambassadors expressed that they needed skills on how to negotiate and influence management levels within the organization to create time for PA during work hours:

> *"Sometimes I have had to take a hard line because [middle managers pointed to] their schedules etc. I'm not willing to accept that, when the managing director has said that it is possible [to include training during the workdays]."*

Based on the findings, we claim that it is important that the HA education include theory, practice tools and skills training on how to deal with resistance in form of non-compliance from target group members as well as from middle managers. This relates to the work of Parkin and Mc.Keagany (2000), who point to the importance of differentiating between initiatives aimed at changing community norms (such as making managers and employees stop scheduling meetings at the time where the PA is scheduled) and initiatives targeted at the level of the individuals (such as making peers change health behavior). It further relates to literature on change management, e.g. Rogers (1995), who points to the need to be able to diagnose problems as well as to create an intent to

change and translate that intent into action, and Buchanan and Boddy (1992), who emphasize the importance of problem-solving skills.

We propose:

Proposition 2: In order to be influential, the HA needs theory, practice tools and skills training on how to give feedback on changed health behavior as well as non-compliance.

Proposition 3: In order to create room for WHP, the HA needs skills training on how to negotiate with management.

Finally, the ambassadors pointed to the need for follow-up on their training, e.g.

> "*We need a follow-up every six months in order to stay focused. [Such a follow-up will] at the same time [...] motivate us to do more.*"

This relates to the work of Gareis (2010) and Michel *et al.* (2013), who point out that education is a core element when it comes to successful implementation of change and sustaining momentum. It also relates to the work of Walker and Avis (1999), who state that many projects involving peers underestimate the training required.

We propose:

Proposition 4: Follow-up training including continuous theory inputs on motivation and feedback is necessary in order to sustain HAs' influence on peers' changed health behavior.

Implications and concluding remarks

Our research contributes to the understanding of PA at the workplace by investigating the use of a structural intervention at the institutional level, i.e. using peers as formal HAs at the workplace. Abraham and Michie (2008) propose a taxonomy of behavior change techniques used in interventions. Our research shows that appointing peers as HAs has great potential as an additional behavior change technique.

Based on an empirical study on promoting PA among the employees at six Danish workplaces, our findings show that appointing the 'wrong' HAs as well as insufficient education of the ambassadors can heavily jeopardize a WHP initiative, even when the initiative is supported by top management and the target group members at the starting point are highly motivated to change their health behavior.

The findings suggest that the TG's willingness to accept the HA as a role model or at least as a respectable spokesperson for the WHP are of great importance. This points to the relevance of including concepts on informal power and status in the theory of successful HAs.

A limitation to the study is that it does not suggest a roadmap for top management and middle managers on how in praxis to appoint an employee as HA. Future research could investigate the consequences on PA by letting the TG select the HA, as suggested by one of the employees in the present study.

When it comes to HA education, the findings show that there is a need to include theory, practice tools and skills training on giving feedback to target group members, not least in the case of non-compliance, as well as skills training on how to deal with other stakeholders in the workplace, e.g. middle managers, so that they are not only able to work on the peer-to-peer level but also on the management level.

A limitation of this paper is that it does not in detail discuss management support from both middle and top managers as a significant condition for the HAs to be successful. Further, we have not in detail touched upon goal setting and follow-up activities at the department or company level. However, this would be a subject for further research activities. In addition, we suggest an empirical study where findings from this research are applied in the selection process as well as in the training of HA.

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Authors' Contributions

JBJ, PE and GS have made substantial contributions to conception, design and data analysis. All authors have been involved in drafting the manuscript and revising it critically for important intellectual content; and have given final approval of the version to be published.

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