Worksite Physical Activity Intervention and Somatic Symptoms Burden: The Role of Coworker Support for Basic Psychological Needs and Autonomous Motivation

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Suffering from somatic symptoms can seriously hamper one’s quality of life and ability to function, causing lost work productivity, sickness absence, and extensive medical utilization. Physical activity (PA) has demonstrated promising results related to mild to moderate cases of somatic symptoms. The present study explored whether a worksite health promotion intervention was able to increase PA and cardiorespiratory fitness, and to reduce somatic symptoms and sickness absence. The intervention was designed based on the tenets of Self-determination theory. A pre–post cluster randomized controlled trial was conducted with 202 industrial workers in a Norwegian logistics company. Results from repeated measures, multivariate analysis of variance, revealed an overall intervention effect and significant change between groups related to somatic symptoms in favor of the intervention group, albeit no significant change in sickness absence. We applied structural equations modeling to test a model of health behavioral change, which posited that increased support for PA from coworkers and autonomous motivation for PA predicted changes in PA, cardiorespiratory fitness, and somatic symptoms. The results underline the effectiveness of including coworker social support in health promotion programs aimed to increase PA and reduce somatic symptoms.

Keywords: worksite health promotion programs, physical activity, somatic symptoms, sickness absence, self-determination theory

The beneficial effects of physical activity (PA) related to health problems like cardiovascular diseases, musculoskeletal complaints, and depression is thoroughly documented (American College of Sports Medicine [ACSM], 2014). Moreover, a review of cross-sectional and longitudinal studies indicates that PA is associated with lower levels of sickness absence (Amlani & Munir, 2014). In Norway, the most common cause of sickness absence is musculoskeletal complaints, accounting for 39% of lost workdays, followed by mental complaints with 20%, whereas cardiovascular diseases account for only 3% (Nygård, 2015). Moreover, findings indicate that up to 50% of primary care consultations are due to somatic symptoms where no underlying organic condition is found, and the diagnosis is based solely on the patients’ subjective reports (Ihlebæk, Brage, & Eriksen, 2007). In other words, the majority of Norwegian employees are absent due to a state of ill-being, presumably incorporating socioeconomic, worksite contextual, and biopsychosocial processes, including lifestyle (Tveito, Halvorsen, Lauvålien, & Eriksen, 2002).

Worksite health promotion programs designed to increase PA can possibly prevent negative consequences of poor physical and mental health, such as reduced productivity and less work satisfaction and engagement, in addition to increased sickness absence and occupational disability pension (Conn, Hafdahl, Cooper, Brown, & Lusk, 2009; Rongen, Robroek, van Lenthe, & Burdorf, 2013). However, we argue that programs must address the complex interaction between worksite contextual and biopsychosocial factors to reduce the employees’ burden of somatic symptoms and prevent future sickness absence.

Worksite factors related to social support have been found to provide a buffer against ill-being and sickness absence (Demouy, Bakker, Nachreiner, & Schaufeli, 2001; Karasek et al., 1998). Self-determination theory (SDT) has contributed to the field by introducing the concepts of basic psychological needs satisfaction,
and autonomous self-regulation, consistently found to affect the effort, performance, and well-being of human beings (Deci, Olafsen, & Ryan, 2017; Ryan & Deci, 2017). For instance, perceived worksite support for basic psychological needs (autonomy, competence, and relatedness) has been found to mediate the relationship of socioeconomic status with physical health (e.g., somatic symptoms and sickness absence) and mental health (e.g., emotional exhaustion and psychological vitality; González, Swanson, Lynch, & Williams, 2016). Likewise, a longitudinal study demonstrated that the experience of basic needs frustration at work was associated with higher levels of work stress, which predicted higher levels of somatic symptoms, emotional exhaustion, and sickness absence (Olafsen, Niemiec, Halvari, Deci, & Williams, 2017). Williams and colleagues emphasize the importance of developing worksite interventions capable of providing support for basic psychological needs (Williams et al., 2014). In the field of health care and health promotion, an autonomy supportive health care climate has consistently demonstrated positive (small-to-moderate) relations to lifestyle changes, in addition to mental and physical health (Ng et al., 2012). The present study in the non-treatment context contributes to these findings by incorporating worksite support for making health behavior changes. We aimed to explore whether a PA promotion intervention, designed to support the employees’ basic psychological needs satisfaction related specifically to PA, was capable of affecting one of the strongest predictors of ill health, somatic symptoms.

**Somatic Symptoms**

Somatic symptoms incorporate a number of physical complaints related to various bodily functions such as stomach or bowel problems, headache, chest pain, dizziness, shortness of breath, fatigue, and insomnia, in addition to musculoskeletal complaints related to the back, arms, legs, and joints (Kroenke, 2003). According to Kroenke and colleagues, somatization is the “association of medically unexplained somatic symptoms with psychological distress and health seeking behavior” (Kroenke, Spitzer, & Williams, 2002, p. 258). Somatic symptoms have demonstrated a consistent and significant overlap with mental ill-being. For instance, Gierk and colleagues found a moderately high correlation with anxiety ($r = .55$) and depression ($r = .57$; Gierk et al., 2014). Patients with a substantial burden of somatic symptoms have been found to respond positively to psychosocial treatment methods, especially cognitive-behavioral therapy (Allen, Escobar, Lehrer, Gara, & Woolfolk, 2002; Kroenke, 2007). However, studies have indicated that mild cases of somatic symptoms are prevalent among the Norwegian population in general (Ihlebek, Eriksen, & Ursin, 2002). In the latter study, 80% reported some musculoskeletal pain and 65% some pseudoneurological complaints (e.g., dizziness and tiredness), but the prevalence of substantial complaints was relatively low (13% and 5%, respectively).

**Somatic Symptoms and Physical Activity**

In cases of mild or uncomplicated patterns of somatic symptoms, physicians are advised to recommend their patients nonpharmacological treatments like graded activity and exercise (HenningSEN, Zipfel, & Herzog, 2007). Leisure-time moderate-to-vigorous PA is associated with fewer musculoskeletal complaints among worker populations (Hildebrandt, Bongers, Dul, van Dijk, & Kemper, 2000), even over a period of 11 years (Holth, Werpen, Zwart, & Hagen, 2008), specifically related to neck pain (Andersen et al., 2010), lower back pain (Tveito, Hysing, & Eriksen, 2004), and pain threshold in general (Allen et al., 2002). Moreover, review studies have demonstrated a consistent positive effect of PA on the management of mild-to-moderate depression (Paluska & Schwenk, 2000; Teychenne, Ball, & Salmon, 2008). There is also partial research support for the hypothesis that high PA levels function as a buffer, resulting in fewer stress-induced health problems (Gerber & Pühse, 2009).

The question is whether worksite health promotion programs, targeting PA, are effective in reducing the participants’ burden of somatic symptoms and the risk of prolonged sickness absence. Reviews of worksite PA interventions found strong evidence for their effects on musculoskeletal disorders, more varied effects on fatigue and general health complaints (Proper, Koning, van der Beek, Hildebrandt, Bosscher, & van Mechelen, 2003), and significant albeit limited evidence for the effect of PA on lower back pain and sickness absence (Tveito et al., 2004). Meta-analyses have found significant but small effects of worksite PA interventions on sickness absence for two-group posttest studies (Cohen’s $d = .19$), albeit no significant effects in two-group pre–post studies (Conn et al., 2009) and small effects in good quality studies ($d = .11$) compared with poor/fair quality studies ($d = .37$; Rongen et al., 2013). Findings are equivocal. We argue that there is a need for more studies exploring the psychosocial mechanisms that can help us understand how the interventions affect both the employees’ motivation and the ability to make lifestyle changes, as well as their well-being. Health promotion intervention studies based on the framework of SDT have obtained promising results in the context of health care (Ng et al., 2012).

**Self-Determination Theory**

“SDT is a macro-theory that has received empirical confirmation for understanding the roots of human motivation, emotion, and behavior in social contexts” (González et al., 2016, p. 973). According to SDT, we as human beings are characterized by an innate propensity to engage in activities that enhance our skills, sense of mastery, and enjoyment (Deci & Ryan, 2000). When we experience the presence of opportunities and social support, this natural tendency will unfold. During everyday life, we engage in numerous activities, some of which we will find intrinsically motivating. Others we identify with because they are of true personal meaning and importance, like exercising to stay healthy. On a motivational continuum, this would be defined as autonomous motivation. Autonomous motivation has proven to be important both for the maintenance of the behavior in question and for general well-being and performance, and it is thus related to both work and health (Ryan & Deci, 2017). On the contrary, when motivation is controlled by external pressure (e.g., demands or punishment) or by internal pressure (e.g., a sense of obligation or conflicting feelings of guilt and shame), this hampers well-being and reduces effort.

According to SDT, three basic psychological needs have proven to be of special importance to our motivational quality and general well-being: the need for autonomy (i.e., feeling volitional and self-endorsed), competence (i.e., feeling mastery and effective),
and relatedness (i.e., feeling we belong and are cared for; Deci & Ryan, 2000; Ryan & Deci, 2002). Environmental conditions and “significant others” (e.g., managers, physicians, teachers, parents, coaches, coworkers, and team-mates) can be perceived as supportive, neglectful, or even thwarting of these needs, either facilitating or hampering a process whereby the values of a specific behavior is internalized. The SDT model of health behavior change posits that support from health care practitioners will move patients toward a stronger sense of competence and motivation for the health behavior in question (Williams, Gagné, Ryan, & Deci, 2002). The model has received empirical support in numerous studies on physical health (e.g., tobacco abstinence and weight control) and mental health (e.g., increased vitality and decreased symptoms of depression; Ng et al., 2012). However, to our knowledge, this is the first worksite PA intervention designed specifically to incorporate support for PA from peers, in this case coworkers, and not just exercise instructors or health care practitioners.

**Peer Support From Coworkers**

A number of studies have contributed to our knowledge about the health-related effects of a supportive work climate. However, with a few exceptions, studies tend to focus on perceptions of a supervisor as the provider of social support. A unique contribution from co-workers’ support of basic psychological needs has been found to be related to psychological health (Moreau & Mageau, 2012), emotional exhaustion, and turnover intentions (Richer, Blanchard, & Vallerand, 2002). Moreover, high-quality relationships with coworkers were found to function as a buffer against burnout, especially for employees with less autonomous work motivation (Fernet, Gagné, & Austin, 2010). In the context of a worksite health promotion intervention, we questioned whether the supervisors could be perceived as an efficient source of support related to PA. In general, it is not within their formal job description to counsel their subordinates on health and lifestyle choices, nor do they possess the required capacity or competence.

Thus, we hypothesized that peers could be incorporated as an efficient provider of support for basic psychological needs related to PA and lifestyle changes, both during and after the intervention period. Intervention studies incorporating peers commonly train nonprofessionals to offer ongoing peer support (informational, emotional, motivational, and practical), commonly defined as the peer educator approach (Fisher et al., 2017; Linnan, Fisher, & Hood, 2013). A review reported predominantly positive effects of this approach on health practice and clinical outcomes in treatment settings related to diabetes prevention and management (Fisher et al., 2017). Studies incorporating social support from groupings already established or naturally occurring, like coworkers, are rather common in the context of worksite health promotion. However, peers are seldom evaluated separately from the intervention as a whole (Linnan et al., 2013). To be effective, we hypothesized that the intervention should build on the established bonds between coworkers, offer them simple training in need-supportive behavior, and provide them with a structure that facilitates reciprocal support for basic psychological needs and a mutual process of internalization toward autonomous motivation for PA. Hence, the current study explored the effects of a supportive climate created by a health and exercise advisor (HEA) and coworkers embedded in a structure of talks, plenary discussions, a booklet with self-reflection tasks, and dialog in small groups of peers.

**Research Hypotheses**

In the present study, we tested the following hypotheses:

1. The intervention group would demonstrate increased levels of perceived support for PA, autonomous motivation for PA, and cardiorespiratory fitness (CRF), and in addition reduced levels of somatic symptoms and sickness absence, compared with a nonintervention control group.

2. The data would support the SDT-based model of health behavior change, which postulates that increases in perceived support for PA from coworkers would be associated with increases in autonomous motivation for PA, resulting in increases in PA levels.

3. In line with the model, we hypothesized that increases in PA would be positively associated with changes in CRF and negatively associated with changes in somatic symptoms, which in turn would affect sickness absence. Increased CRF was hypothesized to be negatively associated with somatic symptoms.

**Method**

**Study Design and Participants**

The present study is based on a pre–post cluster randomized controlled trial consisting of an intervention and a control condition. Following baseline assessments in January, three worksite locations were randomly allocated to the intervention group, and three to the control group. Cluster randomization was applied due to the group-based intervention design and in order to reduce the risk of contamination and crossover between the two conditions. The practical and financial scale of the study did not allow for more than six worksite locations. The intervention group was offered group-based sessions during a period of 16 weeks, followed by posttest assessments in June (5 months). Findings related to the effects of the intervention on biomedical health markers (e.g., blood pressure, cholesterol, and waist circumference) and additional details on the intervention design have previously been published (Pedersen, Halvari, & Williams, 2018).

The study recruited participants employed in the logistics industry working in sorting, transport, or distribution of parcels and mail. In Norway, the logistics sector is the second largest when it comes to prevalence of sickness absence, only surpassed by the health and social services sector (Nygård, 2015). Participants employed at six different geographical worksite locations were presented with the study during information meetings, and written consent was obtained prior to baseline assessments. All procedures were approved by the Data Protection Official for Research in Norway.

In short, a total of 202 employees were recruited among 320 eligible employees (68%). The study sample consisted of 76% men, mean age was 42.5 years, and 14.3% had a college degree (Table 1). The sample did not differ significantly from eligible
employees who declined to participate in terms of gender, $t = 0.70, p = .482$, or age, $t = 0.98, p = .328$. The sample size was within the limits estimated as necessary in terms of statistical power (90%) for a cluster randomized controlled trial and estimated drop-out rates (20%).

Prior to cluster randomization, all participants received an onsite health screening consisting of baseline assessments, followed by an individual 15-min talk with a health care practitioner. During the talk, participants were offered explanations and health recommendations based on a written individual health profile and were encouraged to ask questions. Posttest assessments, 5 months after baseline, were administered as health screenings identical to baseline and included both conditions.

### Intervention Group

Participants in the intervention group were offered six sessions of group-based intervention elements (7.5 hr in total), two workshops facilitated by an HEA, and four 1-hr PA support group meetings. To establish a needs supportive climate, three active ingredients were combined during the sessions: talks and plenary discussions facilitated by an HEA (interpersonal level), a booklet consisting of individual reflection tasks related to changing lifestyle (intrapersonal level), and mutual reflection and support together with coworkers (organizational level). The operationalization of a supportive environment was drawn from a model combining the tenets of SDT with techniques from motivational interviewing (Markland, Ryan, Tobin, & Rollnick, 2005). The model was previously applied in three SDT-based PA intervention studies (Fortier, Duda, Guerin, & Teixeira, 2012).

PA was self-organized and executed during leisure time due to shift work and lack of onsite exercise facilities. It was recommended that the participants exercise 150 min of moderate intensity per week, alternatively 75 min of high intensity (ACSM, 2014). The health-related benefits of increased CRF were emphasized, and participants were guided on the principles of high-intensity interval training (Gaesser & Angadi, 2011).

The two HEAs, employed by the company occupational health service, were both physiotherapists and experienced in behavioral change counseling. Prior to and during the intervention, the HEAs received training and feedback on how to facilitate the group workshops and provide participants with autonomy support, structure, and interpersonal involvement. During PA support group meetings, participants were divided into small groups of four to five. Each participant was given 10 to 15 min to share and discuss his or her experience, progress, setbacks, and plans for the coming weeks with the group. Participants received 1 hr of training on how to exhibit needs supportive behavior in their response to the person in focus (Williams, Grow, Freedman, Ryan, & Deci, 1996).

### Delayed Intervention Control Group

For ethical reasons, all participants in the control group were advised to follow the individual recommendations they received from health care practitioners at the baseline health screenings. Participants in the control group were offered similar group-based sessions following posttest assessments.

### Measures

The health screenings, including physical tests and questionnaires, were offered in Norwegian. All questionnaire were previously translated and validated in Norwegian studies.

**Physical activity.** Regular PA was assessed by means of a three-item questionnaire, the International Physical Activity Index: frequency ("How frequently do you exercise?"); intensity ("How hard do you push yourself?"); and duration ("How long does each session last?"). The questionnaire was previously validated in a large Norwegian population project (Kurtze, Rangul, Hustvedt, & Flanders, 2008). Item scores were weighted and summed in a total index according to measurement protocol (Kurtze et al., 2008). The scale obtained acceptable reliability levels at baseline (Cronbach’s $\alpha = .80$).

**Cardiorespiratory fitness.** CRF represents a biomedical measure of the ability to engage the respiratory, cardiovascular, and musculoskeletal systems in moderate-to-vigorous activity for a prolonged period of time (ACSM, 2014). We tested CRF by means of a single-stage submaximal test, the Astrand-Rhyming ergometer bicycle test, to reduce the risk of negative health reactions associated with maximal tests (ACSM, 2014; Astrand, 1960).

**Somatic symptoms.** Somatic symptoms were measured with the Level 2 Somatic Symptoms (adult patients), adapted from the Patient Health Questionnaire–Physical Symptoms (Kroenke et al., 2002). Participants were asked the following questions: "During the past 4 weeks, how much have you been bothered by any of the following problems?". The questionnaire consisted of 13 items: "stomach pain," "back pain," "pain in your arms, legs, or joints (knees, hips, etc.)," "headaches," "chest pain," "dizziness," "fainting spells," "feeling your heart pound or race," "shortness of breath," "constipation, loose bowel movements, or diarrhea," "nausea, gas, or
indigestion,” “feeling tired or having low energy,” and “trouble sleeping.” Two items were omitted from the survey because they were considered to be too sensitive in this workplace context (“menstrual cramps” and “problems during sexual intercourse”). Participants responded according to a 5-point Likert scale, ranging from 0 (not bothered) to 2 (very bothered). An index score was calculated by summing the items in terms of number and severity to a maximum of 26, according to measurement protocol. The reliability was \( \alpha = .76 \).

**Sickness absence.** Sickness absence was measured with a single item: “During the last 6 months, how many days in total have you been absent from work due to your own sickness?” Participants answered according to a 5-point Likert scale, ranging from 1 (0 days), 2 (1–4 days), 3 (5–8 days), 4 (9–18 days), and 5 (more than 18 days; Aronsson & Lindh, 2004).

**Autonomous motivation for PA.** Autonomous motivation for PA was assessed applying the Behavioral Regulation in Exercise Questionnaire (Markland & Tobin, 2004). The two subscales, Intrinsic and Identified Motivation, were combined to form a single construct of autonomous motivation for PA. The Intrinsic Motivation scale consisted of the following items: (1) “I exercise because it’s fun,” (2) “I enjoy my exercise sessions,” (3) “I find exercise a pleasurable activity,” and (4) “I get pleasure and satisfaction from participating in exercise.” The Identified Motivation scale included the following items: (1) “I value the benefits of exercise,” (2) “It’s important to me to exercise regularly,” (3) “I think it is important to make the effort to exercise regularly,” and (4) “I get restless if I do not exercise regularly.” Participants responded according to a 5-point Likert scale, ranging from 1 (not true for me) to 5 (very true for me). The construct obtained acceptable levels of reliability, \( \alpha = .89 \). Correlation between the two subscales was high, \( r = .75, p = .001 \).

**Perceived needs support for PA.** Perceived support for PA was measured by means of the short version of the 15-item Health Care Climate Questionnaire (HCCQ; Williams et al., 1996). The items were slightly altered to fit the worksite context and perceptions of coworkers rather than health care practitioners: (1) “I feel that my coworkers provide me with suggestions for various activities in order to exercise regularly,” (2) “I feel coworkers understand how I see things with respect to my exercising regularly,” (3) “My coworkers convey confidence in my ability to make changes regarding my exercising regularly,” (4) “My coworkers listen to how I would like to do things regarding my regular exercise,” (5) “My coworkers try to understand how I see my exercising before suggesting any changes or new ways to do things,” (6) “I feel a lot of trust in my coworkers,” and (7) “I feel that my coworkers care about me as a person.” One item from the HCCQ-short version was omitted because it was not relevant to the context of peers: “My ( . . . ) encourages me to ask questions.” Several of the items are formulated in a manner that supports more than one need (e.g., Item 5 supports both the need for autonomy and relatedness). However, the short version of HCCQ is slightly in favor of the autonomy support dimension (Items 1, 4, and 5), and the last two items from the 15-item version of the HCCQ were added to assess coworkers’ support for relatedness in particular, previously validated in a Norwegian sample by Solberg, Hopkins, Ommundsen, and Halvari (2012). Participants responded to the items on a 7-point Likert scale, ranging from 1 (not true) to 7 (very true). The scale obtained a high reliability, \( \alpha = .92 \).

**Statistical Analyses**

Repeated measures multivariate analysis of variance and analysis of variance (ANOVA) were executed on both complete-case and intention-to-treat samples to assess effects of time and intervention. Missing data were handled by means of multiple imputations (\( n = 20 \)). All analyses applied IBM SPSS Statistics 21 (IBM Corporation, Armonk, NY). Due to the small number of clusters (\( n = 6 \)), multilevel modeling methods were considered unsuitable (Snijders & Bosker, 2012), and the clustering variable (worksite location) was included in the analyses as a covariate to control for the potential clustering effect. Effect sizes were calculated applying Cohen’s \( d \) comparing two conditions, using pooled baseline SD. The statistical and clinical significance of the changes in PA and CRF, including their association with biomedical health markers, have previously been presented and discussed (Pedersen, Halvari, & Williams, 2018).

The SDT model of health behavior change was analyzed in two steps, according to the recommendations of Anderson and Gerbing (1988). First, we tested the measurement model incorporating two latent constructs, perceived support for PA and autonomous motivation for PA, by means of confirmatory factor analysis at baseline and posttest. Full information maximum likelihood estimation was applied to handle missing data, and analyses were performed using the maximum likelihood estimation with robust standard errors (MLR). Second, we tested the structural model applying a path analysis in AMOS 20.0 (IBM, Chicago, IL). Prior to the path analysis, a zero-order correlational analysis was performed in SPSS in order to assess the pattern of associations between study variables. We estimated a model including all indirect and direct paths. The SDT model of health behavior change is rather complex. Therefore we applied change scores instead of latent constructs to increase the stability of the model (Cole & Preacher, 2014). We applied a covariance-based analysis to account for the potential effects of the cluster randomization variable (worksite location).

**Results**

**Baseline Analyses**

One-way ANOVA revealed that there were significantly more men in the control group (83%) compared with the intervention group (71%). The control group obtained significantly higher levels of CRF, \( F = 9.76, p = .002 \), and reported significantly higher levels of autonomous motivation for PA, \( F = 6.43, p = .012 \). For all other demographic and study variables there were no significant differences.

**Attrition Checks and Missing Data**

Of the 202 participants, 22% (\( n = 45 \)) were lost to posttest. Little’s test of missing completely at random was significant for the sample as a whole (\( \chi^2 = 134, df = 78, p = .001 \)), albeit not for the intervention group tested separately (\( \chi^2 = 70, df = 53, p = .062 \)). We proceeded to test whether baseline measures predicted dropout rates in each of the conditions. In the intervention group, none of the study variables predicted dropout rates. In the control group, low levels of perceived support for PA (Wald = 6.29, \( p = \)
.012, odds ratio = 0.46, 95% confidence interval [CI] [0.25, 0.84]) and somatic symptoms (Wald = 5.24, p = .022, odds ratio = 1.26, 95% CI [1.10, 1.53]) were significant predictors of dropout.

## Intervention Attendance Rates and Fidelity Checks

On average, participants in the intervention group attended three sessions out of six ($M = 2.75$, $SD = 1.76$). A total of 10% ($n = 20$) completed all six sessions. Binary logistic regression analysis of baseline measures indicated that participants with low levels of autonomous motivation for PA were most likely to be absent from all sessions ($\chi^2 = 10.54$, $p = .001$). However, hierarchical multiple regression analysis indicated that attendance rates were not strongly related to posttest measures of CRF or PA. In fact, 0.8% ($p = .420$) of the total variance in posttest CRF was explained by attendance rates, and equivalent values for PA were 0% ($p = .92$). The fidelity of intervention implementation, defined as the percentage of all sessions in all clusters carried out according to plan, was 94% (Dzewaltowski, Estabrooks, Klesges, Bull, & Glasgow, 2004).

## Analysis of Intervention Effects

Hypothesis 1 posited that the intervention group would demonstrate increased levels of perceived support for PA from coworkers and autonomous motivation for PA, regular PA, and CRF, in addition to reduced levels of somatic symptoms and sickness absence, compared with a control group. Repeated measures multivariate analysis of variance demonstrated a significant overall Intervention × Time effect for both intention-to-treat, $F = 3.42$, $p = .014$, and complete-case samples, $F = 4.38$, $p = .001$. Repeated measures ANOVAs demonstrated significant between-groups changes on all variables, except PA and sickness absence (Table 2). PA increased in both groups, and we found a significant effect of time, $F = 10.10$, $p = .002$, albeit the same was not found for sickness absence. All analyses controlled for the effect of the cluster randomization (worksite location), in addition to gender. Cohen’s $d$ effect sizes were small to moderate in the complete-case analyses, and small in the intention-to-treat analyses.

## Testing SDT Model of Health Behavior Change

### Measurement model

A confirmatory factor analysis of the measurement scales for perceived support and autonomous motivation for PA at baseline and posttest was performed. The fit of the model comprising all items for each scale was poor: Baseline = $\chi^2/df = 4.82$, root mean square error of approximation (RMSEA) = .138, 95% CI [.125, .151], confirmatory fit index (CFI) = .84; Post-test = $\chi^2/df = 3.75$, RMSEA = .117, 95% CI [.104, .130], CFI = .86. Thus, items with low factor loadings were removed. The four remaining items of HCCQ represented support for autonomy (Items 1 and 5), competence (Items 1 and 3), and relatedness (Items 4 and 5). Autonomous motivation for PA consisted of seven items (omitting Item 3 from the Identified Motivation subscale). This model obtained stronger model fit at baseline ($\chi^2/df = 2.99$, RMSEA = .100, 95% CI [.080, .120], CFI = .94) and especially at posttest ($\chi^2/df = 2.19$, RMSEA = .077, 95% CI [.056, .098], CFI = .95).

### Structural model

Hypothesis 2 posited that increased perceived support for PA from coworkers would be associated with increases in autonomous motivation for PA, resulting in increased PA levels. Hypothesis 3 stated that these changes would be positively associated with changes in CRF and negatively associated with changes in somatic symptoms and sickness absence. First, all study variables were included in the structural model. Based on the zero-order correlational analysis (Table 3), and the fact that sickness absence was not significantly predicted by somatic symptoms in the path analysis, we chose to omit sickness absence from the model because changes in sickness absence did not relate to any of the other constructs in the model (Baron & Kenny, 1986). The

### Table 2

<table>
<thead>
<tr>
<th>Measures</th>
<th>Complete-case analysis</th>
<th>Intention-to-treat</th>
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<tr>
<td></td>
<td>Baseline (M/SD) Posttest (M/SD) Time × Group (F/p)</td>
<td>Effect size (Cohen’s d) Baseline (M/SD) Posttest (M/SD) Time × Group (F/p)</td>
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<td>Needs support for PA (peers)</td>
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<tr>
<td>Control</td>
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<td>4.11/1.34</td>
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<tr>
<td>Autonomous motivation for PA</td>
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<td></td>
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<tr>
<td>Intervention</td>
<td>3.40/9.00</td>
<td>3.54/0.83</td>
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<tr>
<td>Control</td>
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<td>3.59/0.83</td>
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<tr>
<td>PA</td>
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<tr>
<td>Intervention ($n = 88$)</td>
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<td>4.41/2.08</td>
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<tr>
<td>Control ($n = 61$)</td>
<td>4.29/2.27</td>
<td>4.63/2.15</td>
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<tr>
<td>CRF (mL · kg⁻¹ · min⁻¹)</td>
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<tr>
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<td>5.15/3.52</td>
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<td>Control</td>
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<td>1.62/0.64</td>
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</tbody>
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Note. ANOVA = analysis of variance; PA = physical activity; CRF = cardiorespiratory fitness.
model fit excluding sickness absence was satisfactory ($\chi^2/$df = 1.55, RMSEA = .052, 95% CI [.000, .139], CFI = .97) and did not differ significantly from the model including sickness absence ($\chi^2/$df = 1.61, RMSEA = .055, 95% CI [.000, .112], CFI = .94).

The standardized path coefficients are presented in Table 3. Based on a one-tailed test, change in perceived support for PA was significantly related to change in autonomous motivation for PA ($\beta = .25, p = .002$), and change in autonomous motivation for PA was significantly related to change in regular PA ($\beta = .42, p = .001$). Change in perceived support for PA was related to both change in somatic symptoms and change in CRF ($\beta = -.25, p = .002$, and $\beta = .19, p = .017$, respectively). Moreover, change in regular PA was significantly related to both change in somatic symptoms and change in CRF ($\beta = -.20, p = .010$, and $\beta = .19, p = .017$, respectively). Change in somatic symptoms was not significantly associated with change in CRF ($\beta = .08, p = .341$).

The standardized path coefficients are presented in Figure 1. Based on a one-tailed test, change in perceived support for PA was significantly related to change in autonomous motivation for PA ($\beta = .25, p = .002$), and change in autonomous motivation for PA was significantly related to change in regular PA ($\beta = .42, p = .001$). Change in perceived support for PA was related to both change in somatic symptoms and change in CRF ($\beta = -.25, p = .002$, and $\beta = .19, p = .017$, respectively). Moreover, change in regular PA was significantly related to both change in somatic symptoms and change in CRF ($\beta = -.20, p = .010$, and $\beta = .19, p = .017$, respectively). Change in somatic symptoms was not significantly associated with change in CRF ($\beta = .08, p = .341$).

**Discussion**

Analysis of intervention effects indicated that coworkers were perceived as supportive of basic psychological needs. In addition, the intervention was capable of creating considerable increases in
motivation for PA, regular PA and CRF. In line with our hypothesis, the results demonstrated a between-groups effect of the intervention on the participants’ burden of somatic symptoms. However, effect sizes were relatively small, possibly due to a ceiling effect, because baseline levels of somatic symptoms were quite low; 79% of the participants in the intervention group reported minimal or low levels, and 4.5% reported high levels. At posttest, the percentage reporting minimal or low levels had increased to 89%, with no one reporting high levels. People with a substantial burden of somatic symptoms tend to think catastrophically about their health and withdraw from activities, especially PA (Allen et al., 2002). We question whether the present study managed to attract employees struggling with medium-to-severe levels of symptoms. A similar PA intervention study reported that it was difficult to recruit participants with a broad range of symptoms due to “their mental state, perceived disability, and disaffection with medical care” (Peters, Stanley, Rose, Kaney, & Salmon, 2002, p. 672). Nevertheless, the latter study demonstrated that aerobic exercise was in fact feasible, despite the patients’ burden of unexplained physical symptoms, and resulted in significantly improved levels of self-reported somatic symptoms.

According to the analyses, the intervention failed to have an immediate and significant effect on sickness absence 5 months after baseline assessments. We argue that the process of basic needs satisfaction and internalization of autonomous motives for PA requires sufficient time and repeated encounters with a need-supportive social environment in order to unfold and stabilize (Rodgers, Hall, Duncan, Pearson, & Milne, 2010). Our findings may indicate that a 16-week intervention period was sufficient to bring about significant changes in autonomous motivation for PA, leading to increased levels of PA and CRF and reduced levels of somatic symptoms. However, we question whether a prolonged period of time may have been required in order for these changes to affect sickness absence. At baseline, 17% of the participants in the intervention group reported high levels of sickness absence (9 days or more) during the past 6 months, and this dropped to 10% at posttest. In the control group, 7% reported high levels, and this was reduced to 1.6% at posttest. Unfortunately, the study sample size did not provide the required statistical power to analyze between-groups effects of the intervention in the subgroup with high levels of sickness absence at baseline (n = 26).

Analysis of the SDT model of health behavior change confirmed our hypotheses related to the association between changes in perceived support for basic needs from peers, autonomous motivation for PA, and changes in PA and CRF. Change in PA was positively associated with change in CRF and negatively associated with change in somatic symptoms. However, the analysis did not demonstrate a significant association between change in CRF and change in somatic symptoms. To increase CRF, the body must be challenged above a minimum threshold of intensity (ACSM, 2014). We question whether participants with moderate-to-high levels of somatic symptoms were motivated to increase their PA intensity. Engaging in PA of vigorous intensity above the ventilatory threshold has been found to elicit negative affect and reduced enjoyment, especially among inactive participants (Ekkekakis, Parfitt, & Petruzzello, 2011). These reactions can possibly be amplified by the participants’ burden of somatic symptoms.

A growing number of intervention studies has compared the effects of different exercise modes on various subjective health complaints, and findings are inconclusive. For instance, Andersen and colleagues (2010) compared specific resistance training with all-round PA related to musculoskeletal pain in the upper body. Another study tested whether aerobic exercise differed from nonaerobic exercise related to reductions in somatic symptoms (Peters et al., 2002). Both studies failed to conclude that one exercise mode offered benefits over the others. Future studies on somatic symptoms should include physiological tests of fitness and self-reported measures of positive and negative affect.

Interestingly, change in perceived support for PA from coworkers demonstrated a unique and significant negative association with change in somatic symptoms, regardless of change in PA. The present study provides valuable information on the effectiveness of peers as a provider of support for basic psychological needs. Co-workers have been found to play a unique role in both supporting and antagonizing their peers due to their reciprocal interdependent relationships, and greater presence, compared with supervisors (Chiaburu & Harrison, 2008). The latter meta-analysis demonstrated that co-workers have a profound influence on their colleagues’ opinions and attitudes, resulting in increased work involvement, commitment, and satisfaction. In the present study, we demonstrated that the effects of co-workers’ support could be transferred to PA and lifestyle changes as well.

In the context of a health promotion program, coworkers represent a significant relationship in most peoples’ lives, typically characterized by reciprocity and equality, as opposed to the hierarchical relationship with a health care practitioners (Moreau & Mageau, 2012). Hence, we argue that coworkers are less susceptible to elicit controlled forms of motivation. Our findings have demonstrated that a complex intervention, combining strategies at the intrapersonal (reflection tasks in the booklet), interpersonal (talks and plenary discussions with the HEA), and organizational level (participation with coworkers) has a positive influence on participants’ autonomous motivation for PA, associated with actual behavioral change (Linnan et al., 2013).

Limitations

The present study has several limitations that we would like to address. First, we applied a cluster randomization approach when allocating participants to the two conditions. We argue that this approach was suitable given the group-based design and the inclusion of coworker support as an active ingredient in the intervention. However, the small number of clusters did not allow for multilevel analyses, and clustering is known to increase the risk of bias due to reduced statistical power and inflated effect size estimates (Snijders & Bosker, 2012). According to Esarey and Menger (2018), we cannot assume that outcome variables are independently distributed within a cluster, although how they are related can be difficult to understand or model. Hence, we cannot derive strong conclusions based on the present findings and recommend that the intervention is replicated with an adequate number of clusters. Second, attendance rates were moderate, and only about 10% completed all six sessions. The sessions were offered immediately before or after working hours at the worksite premises, albeit during leisure time. This could possibly have influenced the employees’ willingness and energy to attend all sessions. Third, the study applied a self-reporting measure of sickness absence over the past 6 months. This could possibly have biased...
the data, albeit studies have demonstrated a high association between self-reports and employer registers of sickness absence. (Voss, Stark, Alfredsson, Vingård, & Josephson, 2008). Fourth, the intervention was designed to include support for basic needs from others, represented by an established and relatively lasting community of coworkers, as opposed to peer educators. Coworkers will share a common history and culture, expressed in the supportive qualities of the work climate. However, supervisors’ behavior and other organizational factors will contribute to the quality of the climate, and assessments of these could possibly have enriched and elaborated our understanding of the supportive qualities of the worksite climate. We maintain that future studies should include additional sources of data at the organizational level.

Conclusions and Practical Implications

Numerous SDT-based intervention studies within the context of health care and treatment have demonstrated the feasibility and effectiveness of training health care practitioners to offer support for basic psychological needs (Ng et al., 2012). Worksite health promotion programs are capable of reaching large parts of the adult population and engaging communities of employees in preventive health measures like increased PA. However, repeated individual counseling sessions with health care practitioners over a period of months is seldom feasible within the practical and financial constraints of work organizations. The present study demonstrated the effectiveness of an intervention, both complex in nature and moderate in dose, incorporating several sources of support for PA. The effects of the intervention on regular PA, CRF, and somatic symptoms are promising.

References


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