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Improving Employees' Work-Related Well-Being and Physical Health Through a Technology-Based Physical Activity Intervention: A Randomized Intervention-Control Group Study

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Although activity trackers are becoming more popular, little is known whether this new technology qualifies to improve employees' health. This study aimed to evaluate the effect of a workplace intervention applying activity trackers (behavioral approach) along with an online coach (cognitive approach) on work-related well-being (e.g., burnout) and physical health (e.g., body mass index). To test for intervention effects, 116 employees at risk were recruited at 1 large mobility enterprise in Germany and randomly assigned to an intervention group (n = 59) and a control group (n = 57). Intervention effects were assessed 1 month, 3 months, and 1 year after the intervention. Analyses of variance for repeated measures revealed no intervention or long-term effects on work-related well-being. In the intervention group, we found a significant increase in health perception and a significant decrease in body mass index. These effects were stable over time 3 months after the intervention for health perception and 1 year after the intervention for body mass index. Our study shows that a cognitive–behavioral intervention with activity trackers improved physical health over time but was not effective in enhancing work-related well-being.

Keywords: randomized control group design, workplace health promotion, burnout, employees' health, activity trackers

Physical activity is defined as any bodily movement produced by skeletal muscles that results in energy expenditure (Caspersen, Powell, & Christenson, 1985). Previous research has shown that physical activity has a major impact on various physical and mental health outcomes (Reiner, Niermann, Jekauc, & Woll, 2013; Warburton, Nicol, & Bredin, 2006). For example, physically active employees show a lower level of burnout and feel more vigorous during working hours. (Jonsdottir, Rödjer, Hadzibajramovic, Börjesson, & Ahlborg, 2010; ten Brummelhuis & Bakker, 2012). As regard physical health, it has been shown that physical activity is associated with a more positive perception of employees' health (Bogaert, De Martelaer, Deforche, Clarys, & Zinzen, 2014) and leads to a decrease in employees' body mass index (BMI; Anderson et al., 2009). Given these consistent positive effects, different worksite interventions have been implemented to increase employees' physical activity. In their meta-analysis, Taylor, Conner, and Lawton (2012) showed that worksite interventions could increase employees' physical activity with a small effect size (d = .21). Most studies focused either on a cognitive (e.g., Spittaels, De Bourdeaudhuij, Brug, & Vandelanotte, 2007) or a behavioral approach (Schuna et al., 2014). However, Hutchinson and Wilson (2012) pointed out that there is encouraging evidence from one intervention study combining cognitive and behavioral approaches for increasing physical activity with a large effect (d = .90). Even though intervention studies are available, there is still a great need for sound randomized controlled intervention studies with employees (Rongen, Robroek, van Lenthe, & Burdorf, 2013) and for studies focusing on long-term effects exceeding several weeks (Hutchinson & Wilson, 2012).

In this study, we tested whether a combined cognitive–behavioral intervention would improve employees' work-related well-being (i.e., burnout and vigor) and physical health (i.e., health perception and BMI). The effectiveness of the intervention was examined using a randomized control group design (RCT design) with employees in one company. We moreover tested for long-term effects within the intervention group 1 month, 3 months, and 1 year after the intervention. During the intervention employees received an activity tracker as a behavioral approach to monitor their physical activity (e.g., number of steps taken). Activity trackers are a new technology which might be interesting for occupational health promotion, as they are cost-effective and easy accessible (can be used anywhere, at any time; Borrelli & Ritterband, 2015). Due to

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these advantages, activity trackers can be easily integrated into daily work routines, as employees are able to use them whenever or wherever in their spare time at work. To further raise awareness and motivation for health behavior change, we implemented an online coach as a cognitive approach offering advice on health behavior change (e.g., how to set health behavior goals).

Overall, our study advances the literature in several ways. First, we evaluate the effectiveness of an activity tracker based intervention, which broadens the theoretical understanding of a new technology for health behavior change. By investigating the effect on work-related well-being (i.e., burnout and vigor) and physical health (i.e., body mass index and health perception), we consider new outcome measures, as so far research including activity trackers has concentrated solely on non–work-related outcomes. Second, we focused specifically on employees at risk recruited at one large enterprise in Germany. This allowed us access to a population of physically inactive employees at risk who are usually difficult to approach. Finally, the effectiveness of the intervention was assessed using an RCT design, which enables us to draw causal conclusions on the effects of the intervention. Due to the limited evidence of the long-term effects of activity trackers (Cadmus-Bertram, Marcus, Patterson, Parker, & Morey, 2015), multiple points of measurement were considered. This enabled us to evaluate the sustainability of a possible intervention effect 1 month, 3 months, and 1 year after the intervention.

Theoretical Background, Previous Empirical Investigations, and Hypotheses

Work-Related Well-Being

Burnout. Burnout is considered as an affective reaction occurring due to exposure to prolonged stress at work (Shirom, Melamed, Toker, Berliner, & Shapira, 2005). According to Shirom (1989), burnout is a multidimensional construct characterized by a combination of physical fatigue, emotional exhaustion, and cognitive weariness (Shirom, Nirel, & Vinokur, 2006). Employees experiencing physical fatigue are tired and lack energy to manage daily tasks at work. Emotional exhaustion is defined as the feeling of being too weak to invest in relationships with colleagues or clients (e.g., displaying empathy). Cognitive weariness refers to one's feelings of thinking slowly and a reduction of mental agility (Melamed, Shirom, Toker, Berliner, & Shapira, 2006; Shirom & Melamed, 2006).

Besides these negative consequences for the employee, burnout also entails disadvantages for the employer due to its association with absenteeism (Duijts, Kant, Swaen, van den Brandt, & Zeegers, 2007; Petitta & Vecchione, 2011) and a decline in performance (Dewa, Loong, Bonato, Thanh, & Jacobs, 2014; Swider & Zimmerman, 2010; Taris, 2006).

Promoting physical activity can function as an effective intervention to reduce burnout. For instance Tsai et al. (2013) implemented a 12-weeks exercise program at a bank and insurance company. One hundred and nine employees were randomly assigned to a low-intensity exercise group, a high-intensity exercise group, or a control group. The low-intensity group participated in exercise sessions led by a professional trainer once a week, whereas the high-intensity group took these sessions twice a week. The control group did not engage in any of the exercise sessions; they had to plan and carry out exercise regimes on their own. The results revealed that after the intervention participants' burnout was significantly lower than before the intervention for both intensity groups. Further studies supported the effectiveness of workplace interventions promoting physical activity to alleviate burnout (Bretland & Thorsteinsson, 2015; Gerber et al., 2013). Nevertheless, these studies had some limitations. Besides not considering possible long-term effects, two of these studies included relatively small sample sizes (Gerber et al., 2013: $n = 12$; Bretland & Thorsteinsson, 2015: $n = 49$). Regarding long-term effects, van Rhenen, Blonk, van der Klink, van Dijk, and Schaufeli (2005) tested the effectiveness of an intervention involving relaxation and physical exercise directly after the intervention period and at 6-week follow-up. The results showed that employees had a lower burnout level after the intervention. Moreover, a persistent reduction of burnout at 6-month follow-up could be found as well. However, this study did not include a control group, which is why it is not possible to draw causal conclusions. Therefore, Naczenski, Vries, van Hooff, and Kompier (2017) pointed out that there is still a lack of high-quality long-term intervention studies investigating the influence of physical activity on burnout.

Vigor. Vigor is one core component of work engagement according to Schaufeli, Bakker, and Salanova (2006). It can be defined as high levels of energy and mental resilience at work. Vigorous employees invest effort in their work and persist even in the face of difficulties (Schaufeli et al., 2006). As this definition implies, vigor is a conceptual opposite to emotional exhaustion, which is a core dimension of burnout (González-Romá, Schaufeli, Bakker, & Lloret, 2006).

So far only a few studies have tested whether employees' vigor can be enhanced through physical activity interventions. While being physically active, various physiological reactions are caused within the body (e.g., endorphin release; Mikkelsen, Stojanovska, Polenakovic, Bosevski, & Apostolopoulos, 2017). One of these physiological mechanisms could particularly be related to vigor. Physiologically, physical activity is perceived by the body as a stressor (Anderson & Wideman, 2017), thus being physically active releases a high level of cortisol into the body resulting in an increased cortisol concentration (Gomes de Souza Vale, Rosa, José, Júnior, & Dantas, 2012). As one function of cortisol is to obtain energy by promoting gluconeogenesis (Gomes de Souza Vale et al., 2012), it is likely that increased cortisol level enhances vigor. Cortisol was indeed found to reduce fatigue and increase vigor directly, as shown by Tops, van Peer, Wijers, and Korf (2006). Participants who received cortisol capsule showed less fatigue and more vigor than did participants receiving a placebo. Moreover, cortisol is a hormone that helps the organism to adapt to stress or exertion (Anderson & Wideman, 2017). Accordingly, regular physical activity accelerates recovery from stress reaction (Jackson & Dishman, 2006; Teisala et al., 2014). In sum, it can be assumed that physical activity has a positive effect on vigor via increased cortisol concentration in the short term and reduced stress reaction in the longer term, which together results in higher vigor.

This assumption has been supported by Hansen, Blangsted, Hansen, Søgaard, and Sjøgaard (2010), who showed that physically active employees generally feel more energetic. Additionally, they found that employees who were physically active during their leisure time showed higher cortisol levels in the evening, which was associated with higher perceived energy. These results can also be supported by ten Brummelhuis and Bakker (2012), who showed that being physically active after work increased employees' vigor in the following morning. Pronk, Katz, Lowry, and Payfer (2012) conducted an intervention to enhance activity at work by reducing sitting time. The results showed that employees in the intervention group felt more vigorous after the intervention than did employees in the control group.

Nevertheless some studies have found no association between physical activity and vigor (Isoard-Gautheur, Scotto-di-Luzio, Ginoux, & Sarrazin, 2018; Strijk, Proper, van Mechelen, & van der Beek, 2013; van Berkel et al., 2013). Van Berkel et al. (2013) assumed that they found no effect as their participants were not sufficiently physically active. This is supported by the fact that a rise in cortisol only occurs if the physical activity is strenuous for the individual (Anderson & Wideman, 2017; Gomes de Souza Vale et al., 2012). As Strijk et al. (2013) found that only participants who were extremely complied in activities to increase physical activity showed an increase in work-related vitality, whereas less compliant participants showed no intervention effect. Based on this evidence, we conducted an intervention focusing on moderate to vigorous physical activity.

In light of the foregoing, we assume that a cognitive–behavioral intervention with activity trackers would improve work-related well-being. We therefore hypothesize as follows:

Hypothesis 1: Employees in the intervention group show lower levels of burnout after the intervention than employees in the control group.

Hypothesis 2: Employees in the intervention group show higher levels of vigor after the intervention than employees in the control group.

Physical Health

Health perception. Health perception is defined as individuals' subjective perceptions of their own health status (Benyamini, 2012). Even though these perceptions are not always medically accurate (Benyamini, 2012), they serve as an important measure, as they integrate several relevant health factors such as physiological factors, symptom status, and functioning (Havranek et al., 2001; Wilson & Cleary, 1995). As earlier studies have shown, health perception is a strong predictor for mortality (DeSalvo, Bloser, Reynolds, He, & Muntner, 2006), which makes it a useful health outcome measure (Burström & Fredlund, 2001). Moreover, employees' health perception is relevant, as it is associated with job absenteeism (Roelen, Koopmans, de Graaf, van Zandbergen, & Groothoff, 2007), work ability (Rongen, Robroek, Schaufeli, & Burdorf, 2014), and employee's performance (van Scheppingen et al., 2013).

Given that health perception is related to bodily sensations and symptoms that may reflect diseases in their clinical and preclinical stages (Benyamini, 2011), it is likely that physical activity that lowers the risk for several diseases (Jeon, Lokken, Hu, & van Dam, 2007; Li & Siegrist, 2012; Mammen & Faulkner, 2013), also has a positive effect on health perception. This assumption has been supported by several studies. For instance, Bogaert et al. (2014) showed in a population of secondary school teachers that teachers who were physically active during their leisure time reported more positive perceived health. Okano, Miyake, and Mori (2003) surveyed various lifestyle factors (e.g., nutritional status and physical activity) and their contribution to health perception in a population of middle-aged male employees. The results revealed that physical activity was the only lifestyle factor which predicted good health perception. Further studies have corroborated the positive association between physical activity and health perception (Eurenius & Stenström, 2005; Kaleta, Makowiec-Dąbrowska, Dziankowska-Zaborszczyk, & Jegier, 2006; Pohjonen & Ranta, 2001).

Body mass index. BMI is a traditional index for body weight relative to height (kg/m^2 or lbs/inch^2). Based on the BMI, an individual's body weight can be categorized into underweight (BMI $<$18.5), normal weight (BMI 18.5–25), overweight (BMI 25–30), and obese (BMI $\geq$30; World Health Organization, 2000).

Research has shown that high BMI is a serious risk factor for several diseases, such as coronary heart disease (Bogers et al., 2007), different types of cancer (Renehan, Tyson, Egger, Heller, & Zwahlen, 2008), and depression (Luppino et al., 2010). Seen from an economic perspective, high BMI entails increased costs for employers (Finkelstein, DiBonaventura, Burgess, & Hale, 2010). As Van Nuys et al. (2014) pointed out, employers' costs rise when BMI exceeds 25. Although a normal weight employee causes costs about \$3,830 per year, an obese employee costs the employer more than twice that amount, \$8,067. This expenditure is mainly due to absenteeism, health care costs, and loss of productivity (Finkelstein et al., 2010; van Nuys et al., 2014).

Because past research has shown that inactivity is a major risk factor for high BMI or associated diseases (e.g., obesity; Mummery, Schofield, Steele, Eakin, & Brown, 2005; Vandelanotte, Sugiyama, Gardiner, & Owen, 2009), it follows that physical activity is conducive to BMI reduction. Empirically this association has been confirmed by several studies (Goodpaster et al., 2010; Koepp et al., 2013; Morgan et al., 2011). With regard to workplace intervention research, Anderson et al. (2009) found by reviewing 15 studies that a workplace intervention involving physical activity and nutrition could decrease employees' weight and BMI. At 6 and 12 months after the intervention employees showed a weight reduction of 1.3 kg on average. Consequently, the intervention reduced employee BMI by 0.5 points. More recent studies corroborate the beneficial effect of physical activity interventions on employees' BMI (Burn, Norton, Drummond, & Ian Norton, 2017; Viester, Verhagen, Bongers, & van der Beek, 2018). For instance, Reed et al. (2017) conducted a meta-analysis concentrating on working-aged women in high-income countries. They showed that workplace physical activity interventions reduced employees' BMI by 0.35 points. Nevertheless, Tam and Yeung (2018) stated that there is still a high need for high-quality intervention studies. Moreover, they suggested that physical activity interventions should include a motivational component, as these studies were most effective. These results led to the assumption that an intervention promoting physical activity in a work setting, while rising employees motivation and awareness for behavior change through a cognitive approach, is beneficial for employees' health perception and BMI. Based on the results of previous studies, we therefore assume the following hypotheses:

Hypothesis 3: Employees in the intervention group show higher levels of health perception after the intervention than employees in the control group.

Hypothesis 4: Employees in the intervention group show a lower BMI after the intervention than employees in the control group.

Activity Trackers in Intervention Research

To date only a few studies have used activity trackers for health interventions. Nevertheless, there is sound evidence of the effectiveness of pedometers, which can be seen as a predecessor of activity trackers (i.e., simply tracks steps, no further health-related data). For instance, Bravata et al. (2007) in a review of 26 studies showed that participants using pedometers increased their physical activity by 26.9% in comparison to their baseline physical activity. More recent studies have elaborated on these findings by including modern activity trackers in interventions (Choi, Lee, Vittinghoff, & Fukuoka, 2016; Wang et al., 2015). Cadmus-Bertram et al. (2015) assigned 51 overweight women to two different intervention groups. The activity tracker group each received a Fitbit activity tracker, whereas the participants in the other group each received a pedometer. The results showed that the activity tracker group increased their physical activity, whereas the pedometer group showed no significant increase in physical activity. Despite this initial evidence on physical activity, there are only a few studies showing that using an activity tracker improves health (Abrantes et al., 2017; Lunney, Cunningham, & Eastin, 2016; O'Brien, Troutman-Jordan, Hathaway, Armstrong, & Moore, 2015; Wilson, Ramsay, & Young, 2017). So far only one study has investigated the effect of activity trackers on health in a work setting (Finkelstein et al., 2016). Employees from 13 companies were assigned to one control group and three intervention groups, all of whom received and activity tracker. The results showed that all intervention conditions increased employees' physical activity. Nevertheless, no changes in weight or other health-related outcomes were found, possibly because the participants had better health conditions than the average worker. Moreover, it may be that in addition to an activity tracker, a cognitive approach is necessary to raise employees' awareness to bring about change in health behavior.

Our Physical Activity Intervention and Study Design

Intervention. To enhance employees' physical activity, we integrated a behavioral and a cognitive intervention approach. At the beginning of the intervention, participants were provided with the Garmin Vivofit 3 activity tracker, which constitutes the behavioral approach of the intervention. The Vivofit 3 is a wristband that registers daily steps or energy consumption. A summary of this information can be monitored on the activity tracker itself or in more detail on the Garmin Connect App. According to Shuger et al. (2011), this type of self-monitoring is a key aspect of how activity trackers affect health. Besides the opportunity to gain information about one's own activity, the Vivofit 3 provides a reminder function, to encourage participants to become physically active after an hour of inactivity. We would like to note at this point that the activity tracker was only used as an intervention approach and did not serve to measure physical activity for a data collection purpose.

To raise employees' awareness and motivate them for a behavior change, an online coach was implemented, which constitutes the cognitive approach of the intervention. The online coach was a website from which participants could retrieve advice on how to increase their physical activity. In total four pieces of advice were offered over the course of 3 weeks, and these were based on recent studies or approved methods of behavior change (Bauman et al., 2012; Biagini et al., 2012; Heath et al., 2012; Sniehotta, Schwarzer, Scholz, & Schüz, 2005; Ziegelmann, Lippke, & Schwarzer, 2006). As the first piece of advice, participants were offered a tool for goal setting. Several studies have shown that generating action plans benefits behavior change (Luszczynska, 2006; Wiedemann, Lippke, Reuter, Ziegelmann, & Schüz, 2011; Williams & French, 2011). We therefore asked participants to set an individual health behavior goal. As a second step they were required to generate a plan on how they could achieve their individual goals. Further advice on physical activity was given twice a week (Monday and Friday) and aimed to support the participants in achieving their health behavior goals. For instance, the online coach informed participants about the benefits of coping plans in physical activity (Wiedemann et al., 2011; Ziegelmann et al., 2006). Coping planning is an approved method of health behavior change, where individuals are required to indicate internal and external barriers that inhibit them from achieving the desired health behavior (Sniehotta et al., 2005; Wiedemann et al., 2011). An example for a coping plan could be: "If it rains and I want to go out for a run, I will go to the gym instead." By linking anticipated risk situations to suitable coping responses, coping plans facilitate participants to act on their intentions (Sniehotta et al., 2005). Thus, coping plans are important for the maintenance of a desired health behavior such as physical activity (Ziegelmann et al., 2006).

In the second week of the intervention, we conducted a step challenge as a gamification element to increase participants' motivation and pleasure at being physically active (Cugelman, 2013; Hamari, Koivisto, & Sarsa, 2014; Lin, Mamykina, Lindtner, Delajoux, & Strub, 2006). The term *gamification* refers to the process of including game design elements (e.g., challenges) into nongame context to invoke a gameful experience (e.g., enjoyment) while performing nongame-related activities (Groh, 2012; Huotari & Hamari, 2012). The step challenge took 4 days in total. During this period participants were required to walk more than 40,000 steps, which, according to current research, is a reasonable target for healthy adults (Schneider, Bassett, Thompson, Pronk, & Bielak, 2006; Tudor-Locke et al., 2011). If this goal was achieved by at least 50% of the participants a reward was given for winning the challenge. Subsequently to the step challenge, the online coach supported the participants with two more pieces of advice to enhance their physical activity in the last week of the intervention. On average the online coach was visited 11.5 times per participant over the course of the intervention. This illustrates that on average every time new information (e.g., advice) was uploaded to the online coach participants visited the website.

Study design. The effectiveness of the intervention was examined using an RCT design over a 3-week period. Due to requirements of the enterprise from which participants were recruited, the control group (CG) had to engage in intervention activities immediately after completion of the intervention group

(IG). Therefore, we only had access to the IG to assess long-term effects. Thus, measurements at five points were collected for the IG to evaluate the sustainability of intervention effects. Before the intervention group engaged in the intervention activities, IG and CG completed a prequestionnaire (Time 1 [T1]; $n = 116$; 95.9%). After finishing the intervention, IG and CG answered a postquestionnaire (Time 2 [T2]; $n = 105$; 86.8%). Three more follow-up questionnaires were distributed to the IG 1 month after the intervention (Time 3 [T3]; IG: $n = 47$; 78.3%), 3 months after the intervention (Time 4 [T4]; IG: $n = 35$; 58.3%), and 1 year after the intervention (Time 5 [T5]; IG: $n = 35$; 58.3%). Before starting data collection, the study design was approved by the works council and the data protection officer of the enterprise from which participants were recruited. The works council is a committee that is responsible for representing the interest of the employees. Thus, we guaranteed the works council and the data protection officer that confidentiality was given at any time of the study and that the data do not permit conclusions on the individual level.

Materials and Method

Sample

To evaluate the effectiveness of the intervention, we recruited employees in one large enterprise in Germany between December 2016 and January 2017. The enterprise belonged to the mobility industry focusing on the transportation of freight and passengers. During recruitment the focus was explicitly on physically inactive employees at risk, who wanted to improve their health behavior. By means of posters, flyers, and an e-mail sent by the executive, employees' attention was drawn to a website offering information about the study (e.g., information about data security) and the opportunity to register for participation. Participation was voluntary and free of charge (including the use of the activity tracker), but employees had to be aged 18 or older and were not medically required to be on a diet or activity plan. In total 121 employees were enlisted as participants and were randomly assigned to the IG ($n = 60$) or the waitlist CG ($n = 61$). At the beginning of the study both groups received an invitation to complete the prequestionnaire (T1). Participants who did not complete the first questionnaire were excluded from further analysis. Therefore, the final sample consisted of 116 employees (IG: $n = 59$; CG: $n = 57$). In the final sample the age ranged from 19 to 62 years ($M = 43.01$; $SD = 12.72$), and 45.7% were female. The majority had acquired vocational training and worked full-time (86.1%). Because we focused on physically inactive employees at risk during the recruiting procedure, employees worked in rather sedentary jobs. Moreover, 68.1% of the employees in the sample were classified as overweight or obese (BMI: $M = 27.21$, $SD = 4.74$).

Because only a very small number of employees dropped out due to not answering any further questionnaire after T1 ($n = 4$; 3.45%), we could not conduct a dropout analysis. However, we conducted a randomization check, testing whether the IG and CG differed in relation to sociodemographic variables and study variables at baseline (T1). No significant difference in sociodemographic variables and study variables were found.

Measures

The five questionnaires (T1–T5) were assessed online and included all study variables at each point of measurement. To match the questionnaires, participants were requested to create a personal code at the beginning of each questionnaire.

Physical activity. Physical activity was measured with a modified version of the Godin Leisure-Time Exercise Questionnaires (GLTEQ; Godin & Shephard, 1985). Participants were asked how many times per week they had engaged in moderate and strenuous physical activity during the last month. Moderate physical activity was defined as not exhausting activities with a light perspiration (e.g., fast walking, gentle bicycling, badminton). Strenuous physical activity included activities such as running, vigorous long-distance cycling, or football, where the heartbeats rapidly and the perspiration is intense. To calculate a total score of weekly moderate to vigorous physical activity (MVPA), answers were converted to their metabolic equivalent. Metabolic equivalent (MET) expresses the energy expenditure as a result of being physical active (Byrne, Hills, Hunter, Weinsier, & Schutz, 2005). According to the different categories of physical activity, we multiplied the frequency of moderate physical activity by five MET and the frequency of strenuous physical activity by nine MET (Godin, 2011). The products of the various categories were then summed up into a total weekly MVPA score. For instance, for an employee who cycled to work four times a week (moderate physical activity) and played football twice a week (vigorous physical activity), the total MVPA would be calculated in the following way:

$$\underbrace{(4 \text{ times cycling to work} \times 5 \text{ MET})}_{\textit{moderate physical activity}} + \underbrace{(2 \text{ times football} \times 9 \text{ MET})}_{\textit{vigorous physical activity}} = \underline{38 \text{ MVPA}}$$

Outliers were truncated to seven sessions of activity per week based on the assumption that most people engage in both moderate and strenuous activity only once per day. Accordingly the total MVPA score ranged from 0 to 98 MVPA (7 sessions $\times$ 5 MET + 7 sessions $\times$ 9 MET) per week. The GLTEQ yields a retest reliability at 1 month of .62 for the total MVPA score (Sallis & Saelens, 2000). Moreover, the GLTEQ has been validated with physiological measures such as body fat and maximum oxygen intake (Amireault & Godin, 2015; Godin & Shephard, 1985).

Burnout. We assessed participants' burnout with the German version of the Shirom–Melamed Burnout Measure (Shirom & Melamed, 2006). The Shirom–Melamed Burnout Measure consists of 14 items divided into three subscales: Physical Fatigue (e.g., "I feel physically drained"), Cognitive Weariness (e.g., "I have difficulty concentrating"), and Emotional Exhaustion (e.g., "I feel I am unable to be sensitive to the needs of coworkers and customers"). Participants were asked how often they had experienced these feelings at work during the last 3 weeks. Response alternatives were given on a scale from 1 (*never or almost never*) to 7 (*always or almost always*). Based on the participants' ratings, a global burnout score was calculated by aggregating the three different subscales.

Vigor. To assess vigor we used the three-item-subscale taken from the German Version of the Utrecht Work Engagement Scale (Sautier et al., 2015; Schaufeli et al., 2006). A sample item reads: "When I get up in the morning, I feel like going to work."

Participants could rate their individual vigor on a scale ranging from 1 (*never*) to 7 (*always/everyday*).

The results of the reliability analysis for burnout and vigor are presented in Table 1 and show good internal consistencies at all measurement points. We conducted a confirmatory factor analysis (CFA) including burnout and vigor measured at T1 using MPLUS 8. Concerning the two-factor model with correlated but independent factors, the CFA revealed an acceptable fit for burnout (respecting the subscale structure) and vigor: $\chi^2(115, N = 116) = 227.64, p = .000$; comparative fit index (CFI) = .92; root mean square error of approximation (RMSEA) = .09; standardized root mean square residual (SRMR) = .09.

General health perception. General health perception was measured with a single-item of the Short-Form-36 Health Survey (Bullinger, 1995; Ware & Sherbourne, 1992). Participants were requested to indicate on a scale from 1 (*excellent*) to 5 (*poor*) how they perceive their health in general. The reliability and validity of this single-item measure has been confirmed by DeSalvo et al. (2006).

Body mass index. To assess participants' BMI we asked participants for information about their weight in kilograms ("How much do you weight?") and their height in centimeters ("What is your height?"). To calculate BMI, we divided the weight of each participant by their height in meters squared (kg/m^2).

Time pressure. Besides the dependent variables, we assessed time pressure as a control variable at T1. Time pressure was measured by using the subscale of the German Instrument for Stress-Oriented Task Analysis (Semmer, Zapf, & Dunckel, 1995, 1999). In total the subscale consisted of four items, which can be rated on a scale reaching from 1 (*very seldom/never*) to 5 (*very often*). An examples item said: "How often are you under time pressure?." Cronbach's α for time pressure was .73 within our sample.

Statistical Analysis

Analyses were conducted using IBM SPSS Statistics 24. First, the data were tested for normal distribution as a requirement for applying repeated analyses of variance. The Sharipov-Wilk test did not show normal distribution for all study variables; therefore, nonparametric tests were performed additionally. However, the results remained qualitatively unchanged for all analyses.

Intervention effects were tested with repeated analyses of variance (ANOVA) comparing the intervention with control condition between T1–T2 with $\alpha = .05$ as a criterion for significance. For the investigation of long-term effects, ANOVAs for repeated measures were conducted with the IG only. Additionally, a manipulation check was conducted by using a repeated analysis of covariance (ANCOVA), investigating the effect of the intervention on physical activity by controlling for time pressure.

Partial eta-squared (η_p^2) was used to interpret the relevance of the effects. A small effect is taken to be $\eta_p^2 \geq .01$, a medium effect, $\eta_p^2 \geq .06$, and a large effect $\eta_p^2 \geq .14$ (Cohen, 1988).

Results

Before testing for intervention effects, we conducted a manipulation check to test whether the IG showed a higher level of physical activity after completing the intervention. An ANCOVA for repeated measures revealed a significant interaction effect of Group × Time after controlling for time pressure at T1, $F(1, 102) = 4.20, p = .043. \eta_p^2 = .04$. Thus, the ANCOVA confirmed that the IG showed increased physical activity after the intervention compared with the CG (see Table 2), which indicates that the intervention was effective in increasing employees' physical activity. The covariate, time pressure, was not significantly related to employees' physical activity, $F(1, 102) = 0.61, p = .801, \eta_p^2 = .00$. Additionally to the manipulation check, we conducted a post hoc analysis testing Baseline × Treatment effects, namely, whether em-

Table 1
Zero-Order Correlations and Reliability of Study Variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. Burnout T1	(.93)																			
2. Burnout T2	.77**	(.96)																		
3. Burnout T3	.79**	.85**	(.95)																	
4. Burnout T4	.71**	.84**	.83**	(.97)																
5. Burnout T5	.72**	.60**	.65**	.50**	(.98)															
6. Vigor T1	−.61**	−.66**	−.58**	−.44**	−.44**	(.90)														
7. Vigor T2	−.53**	−.69**	−.63**	−.48**	−.44**	.84**	(.91)													
8. Vigor T3	−.61**	−.72**	−.66**	−.64**	−.62**	.84**	.91**	(.95)												
9. Vigor T4	−.60**	−.71**	−.77**	−.62**	−.46**	.78**	.80**	.86**	(.94)											
10. Vigor T5	−.62**	−.54**	−.64**	−.43**	−.70**	.70**	.63**	.76**	.56**	(.95)										
11. Health perception T1	−.33**	−.31**	−.32**	−.27*	−.25*	.28**	.28**	.18	.16	.25*	—									
12. Health perception T2	−.35**	−.34**	−.34**	−.23*	−.33**	.28**	.32**	.24*	.14	.49**	.69**	—								
13. Health perception T3	−.20	−.23	−.15	−.29	−.34	.13	.28	.08	−.05	.35*	.71**	.73**	—							
14. Health perception T4	−.38*	−.40*	−.46**	−.48**	−.49**	.42*	.40*	.33	.50**	.42**	.31	.35*	.57**	—						
15. Health perception T5	−.00	−.03	−.05	−.11	−.22	.20	.18	.09	−.14	.33	.39*	.32	.62**	.24	—					
16. BMI T1	−.06	.05	−.02	.06	.04	−.06	−.07	−.01	.05	.00	−.24**	−.30**	−.24*	−.06	−.24*	—				
17. BMI T2	.03	.07	.03	.09	.05	−.12	−.08	−.05	−.02	−.11	−.20	−.27**	−.20	−.08	−.19	.99**	—			
18. BMI T3	−.11	.06	−.02	.09	−.06	−.08	−.17	.01	.00	.00	−.28	−.17	−.28	−.14	−.34*	.99**	.99**	—		
19. BMI T4	−.00	.07	−.00	.12	.01	−.08	−.03	.04	.07	.00	−.26	.16	−.17	−.06	−.13	.98**	.98**	.98**	—	
20. BMI T5	−.07	.02	−.05	.12	−.03	−.08	−.13	.01	.18	−.00	−.35*	−.30	−.31	.05	−.35*	.97**	.98**	.97**	.98**	—

Note. T1 = Time 1; T2 = Time 2; T3 = Time 3; T4 = Time 4; T5 = Time 5; BMI = body mass index. Correlations involving T3, T4, and T5 only include participants of the intervention group (*n*: follow-up I = 47, follow-up II = 35, follow-up III = 35).
$^{*} p < .05$. $^{**} p < .01$.

Table 2
Means and Standard Deviation for Study Variables at All Points of Measurement for Intervention and Control Group

Variable	Group	*M* (*SD*)				
		Pre (T1)	Post (T2)	Follow-up I (T3)	Follow-up II (T4)	Follow-up III (T5)
Physical activity (MVPA)	IG	18.98 (16.36)	24.86 (21.91)			
	CG	20.05 (16.91)	19.89 (16.45)			
Burnout	IG	2.75 (0.94)	2.57 (1.11)	2.47 (1.03)	2.60 (1.26)	2.45 (1.18)
	CG	3.01 (0.97)	3.05 (1.12)	—	—	—
Vigor	IG	4.77 (1.19)	4.72 (1.33)	4.67 (1.34)	4.77 (1.23)	4.89 (1.22)
	CG	4.43 (1.19)	4.20 (1.16)	—	—	—
Health perception	IG	3.56 (0.75)	3.87 (0.82)	3.85 (0.71)	3.94 (0.73)	3.83 (0.75)
	CG	3.51 (0.83)	3.53 (0.83)	—	—	—
Body mass index	IG	26.95 (4.55)	26.77 (4.63)	26.77 (4.68)	26.50 (4.71)	26.87 (4.89)
	CG	27.48 (4.94)	27.53 (4.91)	—	—	—

Note. T1 = Time 1; T2 = Time 2; T3 = Time 3; T4 = Time 4; T5 = Time 5; MVPA = moderate to vigorous physical activity; IG = intervention group; CG = control group. *n* (IG): pre = 59, post = 48, follow-up I = 47, follow-up II = 35, follow-up III = 35; *n* (CG): pre = 57, post = 57.

ployees in the IG who were inactive at T1 benefited more from the intervention than active employees. Therefore, a median split (*Mdn* = 14) was used with the physical activity data at T1 creating a group of inactive employees (n = 29) and a group of active employees (n = 28). The ANOVA for repeated measures could find a significant interaction of Group × Time, $F(1, 45) = 4.47$, $p = .040$, $\eta_p^2 = .09$. Inactive employees benefited significantly more from the intervention than employees who were already active at T1. Nevertheless, the analysis still revealed a significant main effect showing that both groups increase their physical activity form T1 to T2, $F(1, 45) = 5.53$, $p = .023$, $\eta_p^2 = .11$.

As a second manipulation check, participants were asked if they were still using the activity tracker 3 months and 1 year after the intervention and 84.2% of them reported that they were still using the activity tracker 3 months after the intervention. One year after the intervention, 74.3% of the participants were still using their activity trackers. Zero-order correlations between all study variables for all times of measurements are shown in Table 1.

Intervention Effects on Work-Related Well-Being

Intervention effects on burnout. Our first hypothesis proposed that the employees engaging in the intervention activities show a lower level of burnout than employees not performing the intervention. To test this assumption, we conducted an ANOVA for repeated measures between T1–T2. The results showed no significant interaction effect for Group × Time, $F(1, 103) = .57$, $p = .452$, $\eta_p^2 = .01$ (see Figure 1a). Thus, Hypothesis 1 was not supported.

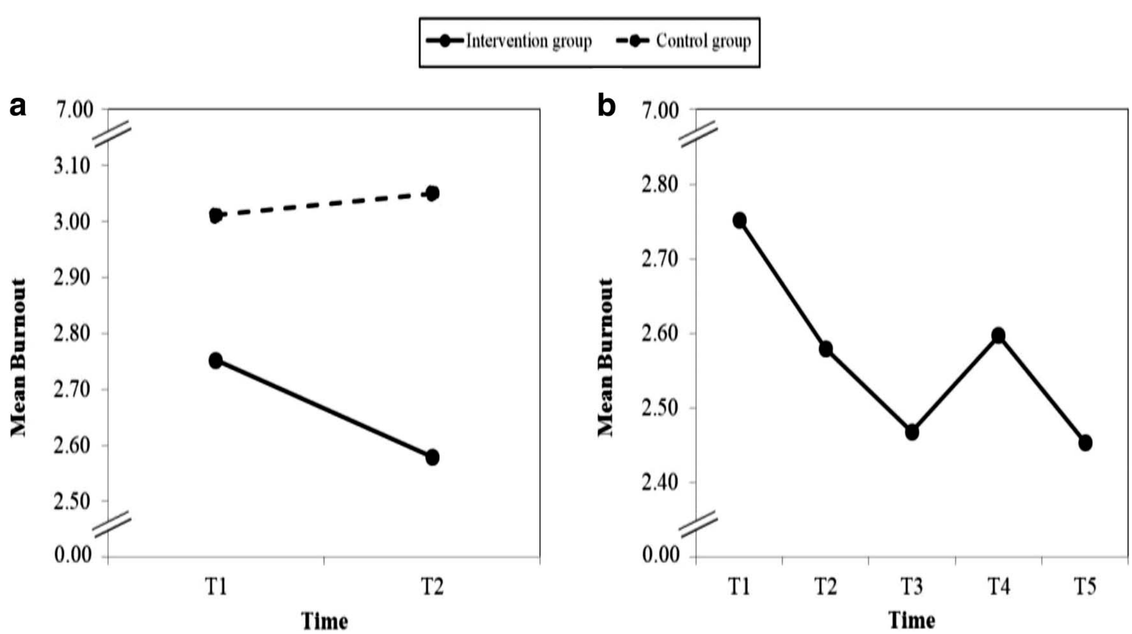

Figure 1. (a). Development of means for burnout for the IG and CG between T1 and T2. (b) Development of means for burnout within the IG across T1, T2, T3, T4, and T5. IG = intervention group; CG = control group; T1 = Time 1; T2 = Time 2; T3 = Time 3; T4 = Time 4; T5 = Time 5.

We tested for long-term effects within the IG 1 month, 3 months, and 1 year after the intervention (see Figure 1b). One month after the intervention participants showed a significant reduction in burnout compared with burnout at baseline (see Table 2). The ANOVA for repeated measures between T1–T3 revealed a significant effect on burnout with a medium effect size, $F(1, 46) = 5.10$, $p = .029$, $\eta_p^2 = .10$. No significant effect could be found 3 months (T1–T4) after the intervention, $F(1, 34) = .05$, $p = .82$, $\eta_p^2 = .00$, or 1 year after the intervention, $F(1, 34) = 1.47$, $p = .234$, $\eta_p^2 = .04$. In summary, we found a significant reduction in burnout level 1 month after the intervention, but this effect did not persist 3 months and 1 year after the intervention.

Intervention effects on vigor. To test the second hypothesis, stating that the intervention has a positive effect on vigor, we performed an ANOVA for repeated measures between T1–T2. The results revealed no significant interaction effect for Group × Time, $F(1, 103) = .74$, $p = .391$, $\eta_p^2 = .01$ (see Figure 2a). Hence, Hypothesis 2 was not supported.

Long-term effects were tested by conducting an ANOVA for repeated measures within the IG between T1–T3, T1–T4, and T1–T5 (see Figure 2b). No significant intervention effect could be found 1 month after the intervention (T1–T3), $F(1, 46) = 1.43$, $p = .237$, $\eta_p^2 = .03$, 3 months after the intervention, $F(1, 34) = 2.02$, $p = .165$, $\eta_p^2 = .06$, and 1 year after the intervention, $F(1, 34) = 1.86$, $p = .181$, $\eta_p^2 = .05$.

Intervention Effects on Physical Health

Intervention effects on health perception. As proposed in Hypothesis 3, we expected that employees engaging in intervention activities show higher levels of health perception. An ANOVA for repeated measures revealed a significant interaction effect for Group × Time with a small effect size, $F(1, 103) = 4.93$, $p = .029$, $\eta_p^2 = .05$ (see Figure 3a). The IG showed significantly higher means in health perception after the intervention period (see Table 2). Thus, Hypothesis 3 was supported.

To test whether the intervention effect was persistent over time, an ANOVA for repeated measures between T1–T3 was conducted with the IG. It showed that a significant intervention effect on health perception still persisted 1 month after the intervention revealing a large effect size, $F(1, 47) = 9.40$, $p = .004$, $\eta_p^2 = .17$. Further long-term effects were tested 3 months (T1–T4) and 1 year (T1–T5) after the intervention. Three months after the intervention the IG showed significant higher means in health perception than before engaging in the intervention activities, $F(1, 34) = 4.99$, $p = .032$, $\eta_p^2 = .13$. However, 1 year after the intervention the ANOVA for repeated measures revealed no significant intervention effect, $F(1, 34) = 1.09$, $p = .304$, $\eta_p^2 = .03$. The significant increase in health perception within the IG is shown in Figure 3b.

Intervention effects on BMI. Our fourth hypothesis proposed that the intervention affects employees' BMI in the sense that employees in the IG have a lower BMI than employees in the CG. The ANOVA for repeated measures revealed a significant interaction effect for Group × Time between T1–T2 with a medium effect size, $F(1, 103) = 9.07$, $p = .003$, $\eta_p^2 = .08$ (see Figure 4a). Hence, Hypothesis 4 was supported.

We moreover tested if the intervention effect on BMI within the IG was long-lasting and therefore conducted an ANOVA for repeated measures between T1–T3. It showed that there was still a reduction of BMI with a large effect 1 month after the intervention, $F(1, 47) = 13.77$, $p = .001$, $\eta_p^2 = .23$. Additionally, we tested for

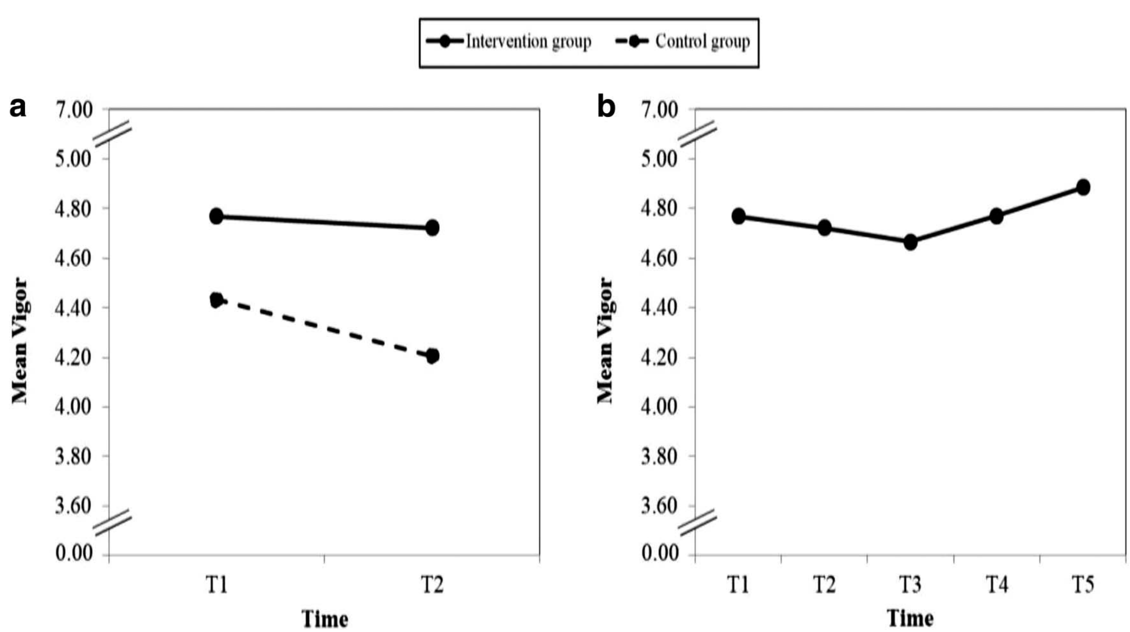

Figure 2. (a) Development of means for vigor for the IG and CG between T1 and T2. (b) Development of means for vigor within the IG across T1, T2, T3, T4, and T5. IG = intervention group; CG = control group; T1 = Time 1; T2 = Time 2; T3 = Time 3; T4 = Time 4; T5 = Time 5.

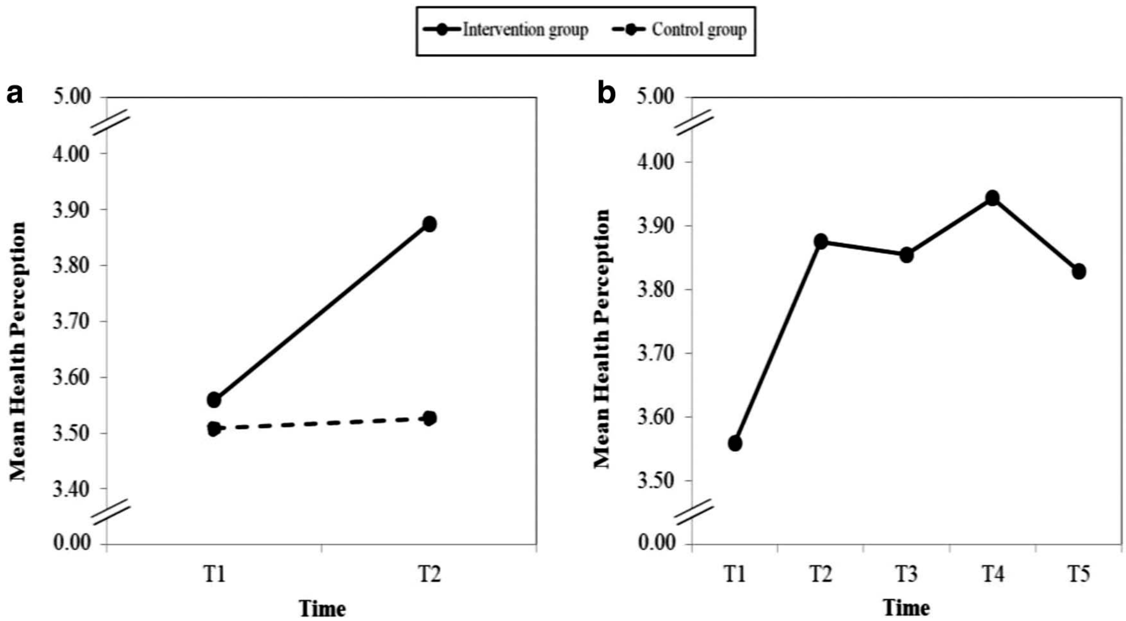

Figure 3. (a) Development of means for health perception for the IG and CG between T1 and T2. (b) Development of means for health perception within the IG across T1, T2, T3, T4, and T5. IG = intervention group; CG = control group; T1 = Time 1; T2 = Time 2; T3 = Time 3; T4 = Time 4; T5 = Time 5.

long-term effects 3 months after the intervention (T1–T4) and 1 year after the intervention (T1–T5). The ANOVA for repeated measures revealed a significant intervention effect with a large effect size 3 months after the intervention, $F(1, 36) = 18.25$, $p = .000$, $\eta_p^2 = .34$. One year after the intervention the ANOVA for repeated measures between T1–T5 showed a significant intervention effect on BMI with a large effect size, $F(1, 34) = 6.85$, $p = .013$, $\eta_p^2 = .17$. Consequently, 1 year after the intervention, employees in the IG had a lower BMI than before engaging in the intervention activities (see Table 2). The significant reduction of mean in BMI overtime within the IG is illustrated in Figure 4b.

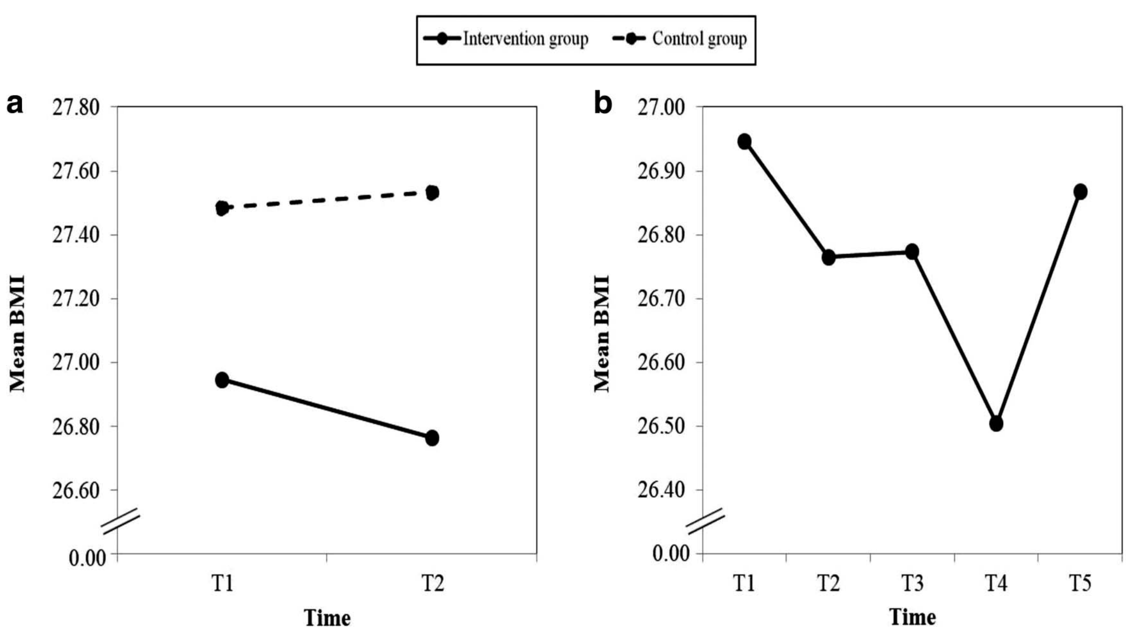

Figure 4. (a) Development of means for BMI for the IG and CG between T1 and T2. (b) Development of means for BMI within the IG across T1, T2, T3, T4, and T5. IG = intervention group; CG = control group; BMI = body mass index; T1 = Time 1; T2 = Time 2; T3 = Time 3; T4 = Time 4; T5 = Time 5.

Discussion

The aim of this study was to examine the effect of a cost-effective new technology on physical activity as well as work-related well-being and physical health in a sample of employees at risk within one company. By combining a behavioral intervention approach using activity trackers and a cognitive intervention approach providing an online coach, we offered an attractive intervention tool that was still being used by most of the participants even 1 year after the intervention. With an RCT design and long-term follow-up analyses, we were able to show that high-risk employees benefited substantially from the intervention through an increase in health perception and a reduction of BMI.

Long-term analyses were conducted with the IG only and revealed that the intervention effect on health perception and BMI were persistent over time (3 months for health perception and 1 year for BMI). Contrary to our expectations we found no effect on work-related well-being. Interestingly, long-term analyses showed a significant reduction in burnout in the IG with a medium effect size 1 month after completion of the intervention. However, no further long-term effects on work-related well-being were found. Overall, the results demonstrate that the intervention did indeed improve employees' physical health, but had no impact on work-related well-being.

To the best of our knowledge, this is the first study to investigate the effectiveness of a combined cognitive–behavioral intervention using activity trackers. Due to their accessibility and availability (can be used anywhere, at any time; Borrelli & Ritterband, 2015), activity trackers combined with an online tool are an effective and economic way to improve employees' physical health. We discuss the findings in relation to work-related well-being (i.e., burnout and vigor) and physical health (i.e., health perception and BMI) in the following text.

Enhancing Work-Related Well-Being

Contrary to our hypotheses, we found no direct intervention effect on burnout and vigor. We found a delayed effect for burnout 1 month after the intervention in the IG. However, this effect was not maintained 3 weeks or 1 year after the intervention. Contrary to our findings, various studies have indeed reported significant associations between physical activity and burnout (Bretland & Thorsteinsson, 2015; Gerber et al., 2013; Naczenski et al., 2017; Tsai et al., 2013; Van Rhenen et al., 2005). Given that our manipulation check showed an increase in physical activity, we would also have expected to see effects on burnout. The following explanations are possible.

In contrast to these studies, we aimed to reduce burnout by introducing activity trackers as a cost-effective intervention supported by an online coach. Most of the interventions capable of significantly reducing burnout have included face-to-face exercise sessions with a professional trainer (Bretland & Thorsteinsson, 2015; Gerber et al., 2013; Tsai et al., 2013; van Rhenen et al., 2005). One typical symptom of burnout is withdrawal from social contacts and consequently the danger of isolation (Maslach & Pines, 1977). Face-to-face exercise sessions may possibly extenuate this symptom by linking the positive experience of being physically active (e.g., enjoyment) to social interaction. Moreover, meeting with a professional trainer may be experienced as social support, so that factors other than physical activity alone may have contributed to reduction in burnout. This assumption is supported by findings from Tsai et al. (2013), who showed that participants who attended exercise sessions led by a professional trainer experienced significantly reduced burnout whereas participants who had to plan and carry out exercises on their own showed no alleviation of burnout. Another study that reported a significant decrease in burnout included relaxation techniques in addition to physical activity exercises that possibly boost the positive effect of physical activity on burnout (Van Rhenen et al., 2005). Because our intervention did not address these factors, this might also be the reason why we only found an intervention effect on burnout 1 month after the intervention. As Schaufeli, Maassen, Bakker, and Sixma (2011) postulated 72–77% of the variance in burnout is accounted to a change component influenced by several factors such as long working hours (Lim, Kim, Kim, Yang, & Lee, 2010) or social support (Adriaenssens, De Gucht, & Maes, 2015; Halbesleben, 2006). It is possible that these factors fluctuate over the course of the study, which might have caused the effect on burnout 1 month after the study. Apart from the intervention design involving no face-to-face interaction, the assessment of burnout which we used in our study may also have yielded different results. Contrary to many studies, we assessed all dimensions of burnout, whereas other studies have focused on subscales, primarily the Emotional Exhaustion subscale (Naczenski et al., 2017). Reducing burnout overall instead of its components is likely to be harder to achieve or may require different intervention approaches.

In relation to vigor, we found no intervention effects. Here, the correlational studies are also more inconsistent: Some studies have reported a positive association between physical activity and vigor (ten Brummelhuis & Bakker, 2012), whereas other studies report no such association (van Berkel et al., 2013). The only RCT-intervention study to report a positive effect of physical activity on employees' vigor consisted of a very small sample size (IG: $n = 24$; CG: $n = 10$; Pronk et al., 2012). The second RCT study on physical activity and employees' vigor found no overall effect of the intervention (Strijk et al., 2013). In this study only employees engaging intensively in physical activity (i.e., yoga workouts), felt significantly more vigorous after the intervention. First, the study by Strijk et al. (2013) may indicate that a large amount of physical activity is necessary to significantly increase vigor. Other components such as mental relaxation and mindfulness inherent in the practice of yoga accentuated the effect on vigor. We argued above that being physically active produces higher cortisol concentration (Anderson & Wideman, 2017), which in turn is associated with feeling more vigorous (Tops et al., 2006). However, González-Romá et al. (2006) pointed out that high intensity of physical activity is needed to raise cortisol concentration. It may be that our intervention did not enhance the intensity of employees' physical activity sufficiently so as to increase cortisol concentration and in turn vigor. Charmas et al. (2009) corroborated this when showing that a 1-hr aerobic session occasioned no increase in cortisol concentration. Van Berkel et al. (2013) moreover assumed that they failed to find an association between vigor and physical activity because the employees did not perform enough physical activity. Because the rise of cortisol as a bodily response to physical activity occurs short term, it is also plausible that we found no intervention effect on vigor because no measurements were taken immediately after employees were physically active. It may be that the increase in physical activity caused by our intervention did indeed increase vigor, but that effect declined before the employees reported their vigor.

It may well be overall that physical activity affects work-related well-being less directly than other health outcomes. One option for more effective physical activity interventions could be to include components such as face-to-face sessions and mental relaxation to support the positive effect of physical activity on burnout and vigor. By including such components in our intervention the slight effect of the intervention on burnout could likely be reinforced and vigor significantly enhanced.

Improving Physical Health

In line with our hypotheses, the intervention did effectively improve employees' health perceptions and reduce BMI. Additionally, we were able to show that the IG benefited from the intervention as evidenced a continuous improvement in health perception with a medium effect size up to 3 months after the intervention and a constant decrease in BMI with a large effect size up to 1 year after the intervention. Large effect sizes in workplace intervention research, especially with interventions involving no face-to-face interactions or multiple workshops over several months are rare and serve to underline the efficacy of this intervention.

Our results support the findings of various other intervention studies on physical activity that increased employees' health perceptions and lowered their BMI (Anderson et al., 2009; Bogaert et al., 2014; Okano et al., 2003; Reed et al., 2017). Interestingly, the only study to investigate the effect of an intervention with activity trackers on employees' health found no effects in relation to health outcomes (Finkelstein et al., 2016). These inconclusive results may be attributable to differences in intervention design. Finkelstein et al. (2016) offered employees a financial incentive in addition to the activity tracker when they walked a certain number of steps per week. The external reward offered by Finkelstein et al. (2016) rather enhances extrinsic motivation, whereas our intervention was intended to increase extrinsic and intrinsic motivation by enhancing enjoyment (e.g., the step challenge), competence for behavior change (advice from the online coach), or setting personal objectives (tool for goal setting; Ryan, Patrick, Deci, & Williams, 2008). It is well established that intrinsic motivation is more effective than extrinsic motivation with regard to promoting health behavior change and health, especially when aiming at long-term effects (Ng et al., 2012; Silva et al., 2010; Teixeira, Carraça, Markland, Silva, & Ryan, 2012). We therefore believe that the combination of a cognitive and behavioral approach is effective and necessary to ensure strong effects over time.

Limitations and Future Research

In the following we will discuss the limitations of our study and provide suggestions for future research. First, 43.3% of the participants in the IG dropped out between the first and the last questionnaire 1 year later. Although other eHealth studies investigating long-term effects have reported higher dropout rates (Etter [2005]: 64.3%; Eysenbach, 2005), in our study relatively small sample sizes resulted from the dropout for the long-term analyses (T4: $n = 35$; T5: $n = 35$) given that we started the study with a relatively small sample of 60 employees.

One major strength of our study was the use of an RCT design that enabled causal conclusions on the effectiveness of the intervention. We can firmly state that our results are not a cause of survey effects (Sitzmann & Wang, 2015) or a result of participating in a study (Hawthorne effect; Wickström & Bendix, 2000). Nevertheless, we only had access to the CG between T1–T2. Therefore, long-term effects could only be tested within the IG. However, as effects on behavior change as a result of participating in a study mainly occurs short term, it is less probable that our long-term effects are skewed due to Hawthorne effects (McCambridge, Witton, & Elbourne, 2014). However, further studies should include a CG when testing for long-term effects to totally exclude possible survey effects. Also, future studies should include an alternative intervention to contrast different types of physical activity interventions.

Despite recruiting at a single mobility enterprise in Germany enabled us to collect data from a relatively homogenous population of employees at risk, the generalizability to other occupational sectors might be reduced. Thus, it could be possible that the intervention show different efficacy under different working conditions. For instance, employees who are required to work in a fixed body positions for a longer period of time (e.g., airplane pilots), might be restricted to fulfill the intervention due to their low job control on how to carry out their job. Because it has been shown that low job control is associated with physical inactivity (Fransson et al., 2012) and a higher BMI (Berset, Semmer, Elfering, Jacobshagen, & Meier, 2011; Kottwitz, Grebner, Semmer, Tschan, & Elfering, 2014), future studies might consider the influence of job control when recruiting at specific occupational sector.

Another potential limitation of our study is that some measures may not have been sensitive enough to detect possible intervention effects. With regard to work-related well-being it is possible that the intervention would have shown an effect on a less extreme stress-syndrome than burnout. Burnout has been described as a syndrome that occurs after prolonged exposure to stress at work (Shirom & Melamed, 2006). Therefore, it would be interesting to investigate the effect of a cognitive–behavioral intervention with activity trackers on employees' stress levels using a more sensitive stress measure. Moreover, it might be possible that other work-related stressors could influence the effectiveness of the intervention. In our study we included time pressure as a stressor, which, however, had no impact on employees' physical activity. Nevertheless, previous studies showed that other work-related stressors such as long working hours could diminish physical activity among employees (Kirk & Rhodes, 2011; Schneider & Becker, 2005; Wemme & Rosvall, 2005). Thus, future intervention studies including activity trackers should consider further potential work-related stressors when aiming to improve work-related well-being. Furthermore, our intervention may not have been effective enough to increase physical activity to a level that in turn boosts cortisol levels beyond a putative threshold that is needed to improve vigor.

Practical Implications and Conclusion

The results of our study show that activity trackers are a promising technology for workplace health promotion. In combination with an online coach as a cognitive approach, activity trackers are effective in improving physical health for employees at risk over time. Given that obese employees show a 22.6% higher work absence (Duijts et al., 2007) and that a decrease of one BMI point will lower the costs for an obese employee by 3.7% (Van Nuys et al., 2014), it is most likely that a cognitive–behavioral intervention with activity tracker could reduce employers' costs for absenteeism in the long term. Moreover, activity trackers are not costly and therefore offer an interesting approach for companies to foster physical activity among employees. Also, the online coach can be developed and programmed to include considerable resources. Both approaches are extremely attractive, as they offer brief interventions that can be conducted during and after working hours. Moreover, it is noteworthy that the majority of employees in the IG continued using the activity tracker after the intervention period. Three months after the intervention, 84.2% of the employees were still using their activity trackers and 74.3% of the employees were still using the activity tracker 1 year after the intervention. This suggests that employees enjoy using activity trackers and that these serve to motivate employees to engage perseveringly in health behavior. Along with the fact that our intervention yielded large effect sizes, this seems to be a promising approach for employees at risk. We wish to note at this point that this intervention was strongly promoted by the human resources department of the enterprise. Employees received detailed information through e-mail, flyers, and the project website. Also, the works council and the data protection officer were involved at all times and supported our study. Even though the intervention itself is quite feasible it involved a considerable amount of resources from the organizers and was well-integrated into the wider health promotion strategy of the company.

We need to acknowledge that apart from positive effects for physical health, this intervention approach was not effective in reducing burnout and promoting vigor. Other approaches such as mental relaxation, positive work reflection, or mindfulness seem more promising for reducing burnout, emotional exhaustion, and increasing vigor (Clauss et al., 2018; Luken & Sammons, 2016; Steidle, Gonzalez-Morales, Hoppe, Michel, & O'Shea, 2017).

In conclusion, our study showed that a cognitive–behavioral intervention with activity trackers effectively improved employees' health perception and reduced BMI with a medium and a large effect size. These effects were sustainable over time. Three months after the intervention employees still perceived their health status to be superior to what it had been before the intervention. Regarding BMI, employees showed a significant decrease until 1 year after the intervention. We therefore conclude that our cognitive–behavioral intervention with activity trackers was effective in sustainably improving physical health for employees at risk.

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