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Process evaluation of the receipt of an exercise intervention for fatigued employees: the role of exposure and exercise experiences

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ABSTRACT

Work-related fatigue among employees is related to negative consequences. Therefore, it is valuable to evaluate interventions that potentially reduce fatigue and increase health and well-being among these employees. The present study investigated whether variations in the receipt of an exercise intervention for fatigued employees were related to intervention effectiveness. We investigated (a) whether exposure to the exercise intervention was related to differences in employees' health and well-being trajectories throughout the intervention, (b) the amount of exposure that is minimally required before health and well-being effects become visible, and (c) whether exercise experiences (pleasure, psychological detachment, and effort) were related to differences in health and well-being trajectories throughout the intervention. Fatigued employees were randomly allocated to a 6-week exercise intervention (n = 49) or a wait list (n = 47). Participants were measured before, 5 times during, and at the end of the intervention concerning health and well-being indicators (all participants) and exercise experiences (only exercisers). Latent growth curve modelling showed that sufficient exposure and optimal exercise experiences contribute to the success of an exercise intervention for fatigued employees. Furthermore, it was shown that health and well-being effects of exercise are visible early in time.

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Physical activity; burnout; intervention; process evaluation; exercise experiences; exposure

Introduction

Prolonged job stress may result in a serious and persistent form of fatigue among employees, which is also referred to as "work-related fatigue" (De Vries, 2017). It can be described as feelings of being worn out, depleted, and debilitated by one's work (Leiter & Maslach, 2016). Work-related fatigue is seen as the most important proxy of burnout, but is not sufficient to fully capture the burnout phenomenon, as burnout also consists of feelings of cynicism and a sense of professional inefficacy (Leiter & Maslach, 2016). Work-related fatigue among employees can be best understood as a process, ranging from acute fatigue that for instance, occurs after a work day and disappears after a relatively short rest period (i.e., a day), to a more serious and persistent form of fatigue that occurs after a long period of work stress and only disappears after a longer rest period. The "end-stage" of the process is often labelled "exhaustion" or "burnout" (Brenninkmeijer & Van Yperen, 2003; De Vries, 2017), which refers to extreme fatigue levels (Kristensen et al., 2005) that are present for a long term (Oosterholt et al., 2016). In the current study, we will use the terms "work-related fatigue" and "fatigue". Doing so, we point to a serious and persistent form of fatigue caused by work, which thus may be considered a mild burnout symptom (De Vries, 2017).

Work-related fatigue is often accompanied by other symptoms, such as cognitive problems, emotional dysregulation, sleep problems, low mood and psychosomatic symptoms (Bianchi et al., 2015; Desart et al., 2017; Maslach & Leiter, 2016; Oosterholt et al., 2016), and even more serious negative consequences, such as an increased risk of cardiovascular and mental disorders (Toppinen-Tanner et al., 2009). These findings illustrate that work-related fatigue is associated with substantial losses in employees' health and well-being. Within organizations, work-related fatigue is related to negative consequences such as reduced productivity, and absenteeism (Toppinen-Tanner et al., 2005). Taking into account the negative consequences of work-related fatigue on both employees and employers, it is valuable to develop interventions that potentially reduce this fatigue, and increase health and well-being among fatigue employees.

Exercise, which refers to a subset of physical activity that is planned, structured, and repetitive and has a final or an intermediate objective to improve or maintain physical fitness (Caspersen et al., 1985), has gained attention as a promising intervention to reduce fatigue (De Vries et al., 2017). The relatively few intervention studies that have so far been conducted mostly show that exercise works to reduce the main component of burnout, fatigue (Brenninkmeijer & Van Yperen, 2003; Naczenski et al., 2017; Ochentel et al., 2018; De Vries et al., 2017). These previous studies generally emphasized the effect evaluation of their exercise interventions, and hence focused on the comparison of pre- and post-intervention fatigue levels, or other burnout symptoms. Although these "traditional" effect evaluations provide insight in the extent to which exercise interventions reduce work-related fatigue, they do not shed light on the processes that take place during the intervention that may affect an intervention's success or failure. In other

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Supplemental data for this article can be accessed here.

words, effect evaluation is informative in answering the question "if" the exercise intervention works, but does not provide insight into questions such as 'when, how and why' the exercise intervention reduces work-related fatigue.

Therefore, it is recommended that an effect evaluation of an intervention (addressing the "if") study is supplemented by a process evaluation (addressing the "when, how and why") of the same study (Kompier & Aust, 2016; Moore et al., 2015). The "why" refers to moderators of the intervention. That is, factors that hindered or stimulated favourable intervention outcomes (MacKinnon, 2011; Steckler & Linnan, 2002). These factors may include varying or stable characteristics of individuals or circumstances that have resulted in differential intervention outcomes (Kompier & Aust, 2016; MacKinnon, 2011; Moore et al., 2015). The "how" corresponds to mediators of an intervention. That is, ingredients of the intervention that predict intervention outcomes (MacKinnon, 2011; Moore et al., 2015). The "when" corresponds to the point in time at which intervention outcomes become visible (Voils et al., 2014). On a more general note, process evaluation is important for distinguishing between interventions that are not correctly designed (i.e., "theory failure") and those that are not correctly delivered ("implementation failure"; Kristensen, 2005; Nelson & Mathiowetz, 2004). If a well-implemented intervention is found to be ineffective, most probably, the theory underlying the intervention is not correct and needs to be revised (Kristensen, 2005). However, a truly effective intervention could be found to be ineffective because it was poorly implemented. This latter scenario can mislead researchers and practitioners into assuming that an intervention is ineffective when in reality the intervention may work very well if it was well implemented. After all, "it is not evidence-based programs that are effective, but it is well-implemented evidence-based programs that are effective" (Durlak, 2015, p. 1124). As such, a process evaluation may help to refine theories behind the intervention, to (re)design interventions and to successfully implement future exercise interventions (Durlak, 2015; Moore et al., 2015; Saunders et al., 2005; Steckler & Linnan, 2002).

To our knowledge, process evaluation of exercise interventions aimed at decreasing work-related fatigue has, as yet, received hardly any attention in the scholarly literature. An exception is a recent process evaluation of an exercise intervention designed to reduce fatigue and increase well-being among students (De Vries et al., 2018), which showed that effects of exercise on fatigue and well-being became visible after 2 to 4 intervention weeks, and (partly) depended on the exercise dose that was received and the extent of psychological detachment that students experienced during the exercise sessions. However, to our knowledge, so far, no published studies report a process evaluation of an exercise intervention aimed at reducing fatigue, and increasing health and well-being among fatigued employees. The purpose of the present study, therefore, is to fill this gap in the literature by conducting a process evaluation of an exercise intervention for fatigued employees. Specifically, in the present study, we focused on 1) the "why" part of the intervention process, by examining the "receipt" of the intervention (i.e., the extent to which participants actively engage with, interact with, are receptive to and are satisfied with the intervention; Nielsen et al., 2007; Saunders et al., 2005) and, p. 2) the "when" part of the intervention process, by examining at what point in time the intervention starts to work. We aimed to disentangle how 1) participants' exposure to the intervention and 2) participants' experience of pleasure, psychological detachment and effort during the exercise intervention relate to their fatigue levels and their health and well-being during the course of the intervention. We used a quantitative approach for our process evaluation. So far, two quantitative approaches of process evaluations have been used: 1) process factors that are presented by means of descriptive statistics or 2) process factors that are questioned in a follow-up questionnaire, and are later integrated in statistical analyses of intervention implementation and effect (Steckler & Linnan, 2002). Regarding the first, process factors and outcomes cannot adequately be linked to each other, since the link between process factors and outcomes cannot be quantified. Regarding the latter, process factors during the intervention may not be adequately recalled, and the development of outcomes and processes during the intervention remained largely unknown. Therefore, to overcome these limitations, we used a different approach. That is, employees who participated in the intervention reported on process factors, fatigue, and six health and well-being indicators before, each week during, and immediately after either a six-week period of regular exercise (i.e., exercise condition) or being on the wait-list (i.e., control condition). Our weekly measure of fatigue reflects the primary outcome that we addressed in a previous effect evaluation of this exercise intervention (see De Vries et al., 2017), but is more sensitive for weekly fluctuations than measures in the previous effect evaluation. The other weekly six health and well-being indicators reflect secondary outcomes addressed in a previous effect evaluation ("sleep quality and quantity", "self-efficacy"; see De Vries et al., 2017) and other aspects of health and well-being relevant for fatigued employees (i.e., "health", "positive affect" and "stress"), which could fluctuate from week to week and could be positively impacted by regular exercise (De Vries et al., 2015, 2017). The weekly measurements of fatigue, health and well-being enabled us to portray the development of fatigue, health and well-being before, during, and after the intervention period, and to investigate whether differential fatigue, health and well-being trajectories could be explained by process indicators (Biron & Karanika-Murray, 2020; Moore et al., 2015). In the next paragraphs, the specific hypotheses and research questions of the present study are presented. We formulated hypotheses if we could build on theory and/or previous empirical work, and (exploratory) research questions if we could not.

Exposure

Exposure points to the extent to which participants actively engage in intervention activities (Steckler & Linnan, 2002). Synonyms for exposure are "dose received", "compliance" or the "uptake" of an intervention (Moore et al., 2015; Saunders et al., 2005). When an intervention is delivered, it is important that all participants are sufficiently exposed to the (proposed) working mechanisms of the intervention. If participants are sufficiently exposed to the intervention and the intervention is found to be effective, this effectiveness is likely to be the result of the theoretical model upon which the intervention is based. On the contrary, if participants are insufficiently exposed to the intervention and the intervention is found to be ineffective, it is unknown whether this ineffectiveness is the result of the incorrectness of the underlying theoretical model, or is instead caused by lack of exposure to the intervention (Kristensen, 2005). In the latter case, the underlying theoretical model may still be correct, but participants are simply insufficiently exposed to the proposed working mechanisms to elicit favourable changes. Taking into account intervention exposure is thus a prerequisite for the correct interpretation of intervention outcomes (Kristensen, 2005; Steckler & Linnan, 2002).

Although the exact working mechanisms underlying the potential of exercise to reduce work-related fatigue and to increase health and well-being are not fully clear, many plausible biological and psychological working mechanisms have been put forward, such as a better functioning stress and endocrine system, provision of social support during exercise, mastery feelings that spill-over to the workplace, and reduced rumination (see the study protocol: De Vries et al., 2015; and see, e.g., De Vries et al., 2017; Kandola et al., 2019; Wiese et al., 2018). Given that a sound theoretical model underlies the relationship between exercise on the one hand and fatigue, health and well-being on the other hand, and that more exposure to these working mechanisms may result in more favourable outcomes, we expect:

Hypothesis 1. During the course of the intervention period, participants with higher exposure to the exercise intervention show larger improvements in weekly health and well-being compared to participants with lower exposure.

Minimal exposure

Within available exercise intervention studies that are aimed to reduce burnout, a broad range of exercise doses has been applied (Dreher et al., 2018; Naczenski et al., 2017), and programmes with a duration of 4 to 18 weeks with exercise sessions ranging from one to three times a week have been shown to be effective (Naczenski et al., 2017). However, so far, it has rarely been examined which amount of exposure to exercise is minimally required for the interventions' beneficial effects on burnout symptoms to become visible (Naczenski et al., 2017). An exception is a study among university students experiencing study-related fatigue (De Vries et al., 2018). In this study – encompassing three exercise sessions weekly -, it was shown that the effect of exercise on health and well-being became visible in the third intervention week. Studying the minimum exposure (i.e., "dose") to exercise is relevant for employees, researchers and practitioners who take part in, design and implement exercise interventions for burnout. As this information remains yet to be explored for employees, we formulated the following research question:

Research Question 1: What is the minimal exposure to the exercise intervention to observe beneficial health and well-being effects?

Exercise experiences

Research shows that participant appraisals may impact intervention outcomes (Nielsen et al., 2007), as these perceptions may explain participants' reactions and behaviours during the intervention period and hence affect the effectiveness of an intervention. Indeed, it has been shown that the subjective experience of a(n) (leisure) activity, such as exercise, is related to health and well-being outcomes (Oerlemans et al., 2014). Therefore, we examined how three exercise experiences—pleasure, psychological detachment, and effort—during the exercise sessions were related to intervention effectiveness.

Pleasure

Pleasure can be considered a positive emotion (Berger, 1996; Raedeke, 2007; Wankel, 1993) that is described as "a state or feeling of happiness or satisfaction resulting from an experience that one enjoys" (Esch & Stefano, 2004; Longman dictionary of contempory English, 1987). Exercise pleasure specifically points to positive feelings during exercising. It has been suggested that pleasure during exercising may help to maximize the psychological benefits of exercise (Berger & Motl, 2000; Wankel, 1993). This idea is in line with the Broaden-and-Build theory (Frederickson, 2001). This theory argues that positive emotions may broaden people's scope of attention and cognition, undo negative emotional arousal, and result in a broadened action repertoire (Frederickson, 2001). This broadened action repertoire enhances people's ability to interact with their environment. For employees, this enhanced interaction ability may enable them to increase their resources or to regain resources that were lost due to dealing with stressful work situations (Gross et al., 2011). For instance, if employees experience positive emotions during exercising after work, these emotions may undo negative states, such as work-related stress, and result in employees being more open to or having more energy to interact with others during leisure time. This increased interaction with others may eventually lead to lasting social resources that are important for well-being enhancement. In this way, positive emotions may initiate upward spirals towards enhanced health and well-being. Research shows that there is inter-individual variation in the experience of positive emotions during exercising (see Bourke et al., 2020 for an overview of factors that may explain this variation). This means that the pleasure people experience during an exercise session may differ between people. Experiencing pleasure during exercising seems important to obtain most beneficial health and well-being effects (Abrantes et al., 2017; Oerlemans et al., 2014; Raedeke, 2007). For instance, Oerlemans et al. (2014) found that exercise was related to better recovery states before going to bed when happiness during exercise was high, but not when happiness was low. Given that pleasure may trigger upward health and well-being spirals, and that the scarcely available research provides support for this notion, we expect that:

Hypothesis 2. The level of pleasure participants experience during their weekly exercise sessions is positively related to the improvement in health and well-being they show during the course of the intervention

Psychological detachment

Psychological detachment refers to a state in which an employee distances oneself from job-related thoughts during non-work time (Sonnentag & Bayer, 2005), implying that an employee is preoccupied with work neither in a physical nor in a mental way (Wendsche & Lohman-Haislah, 2017). Psychological detachment is an important experience for health and well-being preservation and enhancement (Wendsche & Lohman-Haislah, 2017). The Effort-Recovery Model (ER-Model; Meijman & Mulder, 1998) and the perseverative cognition hypothesis (Brosschot et al., 2006) are helpful in explaining this relation. According to the ER-Model, work elicits (short-term) physiological (e.g., cortisol) and psychological load reactions (e.g., fatigue) within employees. During non-work time, these short-time load reactions need to be reduced (i.e., recovery) in order to prevent that they accumulate over time and eventually result in decreased health and well-being, such as burnout (Geurts & Sonnentag, 2006). Perseverative cognition, as manifested by worry and rumination about work, may interfere with recovery and prolong these load reactions, because it causes the stress system to remain activated (Brosschot et al., 2006). Research indeed shows that work-related rumination is a predictor of work-related fatigue over time (Firoozabadi et al., 2018). On the other hand, not thinking about work during non-work time, i.e., psychological detachment, reduces load reactions (e.g., fatigue, see Bennet et al., 2017). Furthermore, psychological detachment not only reduces load reactions but also increases positive mental states, such as optimism, that may further improve well-being (Sonnentag & Fritz, 2015).

Exercise itself may foster psychological detachment (Feuerhahn et al., 2014), since during exercise attention could be drawn to bodily processes rather than worrying thoughts ("distraction hypothesis"; Morgan, 1985). Nonetheless, it has also been previously shown that people might differ in the extent to which they experience psychological detachment on days when they exercise (Cho & Park, 2018) or specifically during exercising (De Vries et al., 2018). Detachment may thus vary across and within individuals and moderate the effect of exercise on health and well-being. Indeed, it has been shown that higher detachment during exercise was positively related to well-being over time, while lower detachment was related to stable or unfavourable well-being over time (De Vries et al., 2018). Furthermore, Cho and Park (2018) showed that time spent on weekend exercise was related to increased well-being at the beginning of the work week if employees were able to detach from work during the weekend, but decreased well-being if employees were not able to so. As psychological detachment may vary across individuals, seems crucial to decrease load reactions from work, and may open the way to enhanced health and well-being over time, our hypothesis is:

Hypothesis 3. The level of psychological detachment participants experience during their weekly exercise sessions is positively related to the improvement of health and well-being they show during the course of the intervention.

Effort

The experience of effort can be described as a feeling of energy exertion that is accompanied by a sensation of strain and labour (Preston & Wegner, 2009). It is a feeling that intensifies the harder a person tries (Preston & Wegner, 2009). It has been argued that effort is both costly and valued (Inzlicht et al., 2018). On the one hand, research points to a curvilinear relationship between effort during exercise and health and well-being effects. That is, research shows that low to moderate effort during exercise is associated with acute positive effects on well-being, while high effort is associated with acute negative effects on well-being, such as higher stress and fatigue (Ekkekakis et al., 2011). High effort may thus be considered costly, and people therefore do not like it and want to avoid it (Inzlicht et al., 2018). Similarly, on the longer term, effortful activities without sufficient recovery (i.e., periods of low effort) have been proposed to lead to poor health and well-being outcomes (Meijman & Mulder, 1998). On the other hand, it has been shown that experience of effort is associated with rewarding feelings, and thus may be valued (Inzlicht et al., 2018). This means that an effortful activity is chosen because it demands a great deal of effort (e.g., the activity is seen as challenging; see Loewenstein, 1999) and that people gain greater well-being effects following an activity they have worked for compared to an activity that required no or less effort (Inzlicht et al., 2018; Lyubomirsky et al., 2011). Exercise is, by definition, an effortful activity. However, people may differ in the extent to which they perceive exercise to be effortful. This is not only the consequence of the actual physical effort that is invested but also related to a cognitive evaluation of the invested effort (Abbiss et al., 2015). Given that the experience of effort has been found to relate both positively and negatively to health and well-being, we examined the role of effort during exercise in relation to health and well-being trajectories in an explorative way.

Research Question 2: Is the experience of effort during exercise related to health and well-being trajectories during the course of the intervention?

Materials and methods

Design

This study was designed as a two-arm parallel randomized controlled superiority trial in which an exercise intervention was compared against a wait list. The study was approved by Radboud University's Ethical Commission of Social Sciences (registration number: ECSW2015-1901-278). Before data collection, the study protocol of this study was registered at The Netherlands Trial Register (NTR5034) and published (De Vries et al., 2015). Results of the effect evaluation of this study, based on the same sample as used in the current study, can be found elsewhere (De Vries et al., 2017). Given that the effect evaluation and the process evaluation address different research questions and incorporate different sets of variables, we decided to present the intervention's results in two separate papers. Details relevant to the process evaluation are given below.

Participants and procedure

Participants were employees with work-related fatigue who were still working. Inclusion was based on the key symptom of burnout, i.e., fatigue/exhaustion. Inclusion criteria were based on validated cut-off scores on two questionnaires that reliably and validly measure burnout and fatigue in the working population (De Vries et al., 2003): a score of ≥2.2 (theoretical range: 0–6) on the exhaustion scale of the Dutch version of the Maslach Burnout Inventory (Schaufeli & Van Dierendonck, 2000) and a score of ≥22 (10–50) on the Fatigue Assessment Scale (De Vries et al., 2004). Exclusion criteria were a) 1 h exercising a week; b) fatigue attributable to a medical condition; c) currently or in the past 6 months receiving psychological and/or pharmacological treatment; d) drug dependence; e) contraindications to exercise. Participants were randomly assigned to either a six-week exercise condition or a wait list condition. Full details of the study procedure can be read elsewhere (De Vries et al., 2015, 2017).

In total, 96 participants were included in the study. Their mean age was 45.25 years (*SD* = 10.68), and most were female (81.30%). Participants were relatively highly educated (61.5% at least a bachelor's degree), and worked in a variety of sectors, such as healthcare (21.65%), support services (9.28%), and education (7.22%). They worked on average 29.33 (SD = 9.94) hours per week. On average, exercisers were physically active at 3.34 (*SD* = 2.37) and controls at 2.57 (*SD* = 2.20) days a week. The two conditions did not significantly differ regarding demographic characteristics and physical activity behaviour before the intervention.

Exercise condition

Participants (n = 49) in the exercise condition followed a six-week intervention consisting of low-intensity running. Participants ran three times a week. Twice a week, the running sessions were supervised by a trainer, and once a week, participants ran independently. Including warm-up and cooling-down, the duration of the exercise session was about 1 h. During a session, running was alternated with walking. Over the 6 weeks, running minutes increased and walking minutes decreased. See for more details De Vries et al. (2015).

Wait list condition

Participants (n = 47) in the wait list condition did not receive any intervention during the 6 weeks. They were given the opportunity to follow the exercise intervention after 6 weeks of waiting though.

Measures

Participants were measured pre (T0), and at the end of each of the six intervention weeks (T1-T6). At each measurement point, the participants in both conditions filled out a short questionnaire. In total, 594 (88.39%) of the 672 questionnaires were completed (i.e., 7 measurement points * 96 participants). The non-significant *p*-value of the Little's MCAR test suggested there exists no pattern in the missing data, and thus data were missing completely at random (χ^2 (681) = 730.62, *p* = .09).

Health and well-being

Health and well-being were measured by means of a combination of single-item measures and a multiple-item scale. Since single-items measures are short to fill out, these measures were chosen to reduce the burden placed upon our participants, and to preserve a high response rate (Bowling, 2005). Single-item measures are found to be valid and reliably capture short-term fluctuations in unidimensional and global health and well-being constructs (e.g., DeSalvo et al., 2006; Fisher et al., 2016; Van Hooff et al., 2007). Health and well-being were measured among all participants at all time points (T0-T6).

The single items *"healthy"*, *"fatigued"*, *"tense"*, *"happy"*, *"satisfied"*, *"energetic"*, *"stressed"*, *"vital"*, and *"irritated"* were introduced as follows: "Can you indicate with a report mark between 1 (not at all applicable) to 10 (extremely applicable) to what extent the following states of mind were applicable to you during the last two days?" Additionally, a single-item measure was presented to assess participants' *self-efficacy* regarding exercise: "Can you indicate with a report mark between 1 (not at all certain) to 10 (extremely certain) how certain you are that you can reach your goals regarding exercise during the previous two days?" The response scale ranging from 1 to 10 was based on the typical Dutch grade notation system. Two days were chosen to reduce the risk of recall bias (Stull et al., 2009).

To measure employees' *sleep quality*, the 6-item sleep quality scale derived from the Dutch Questionnaire on the Experience and Evaluation of work was used (Van Veldhoven & Meijman, 1994). As these items were originally developed for chronic sleep complaints, the scale was adapted for weekly measurement. A higher sum score means lower sleep quality. Reliability ranged from α = .59 to α = .68. An example item is: "I slept well the last two nights" (reversed; 1 = *yes*, 0 = *no*). To measure *sleep quantity*, participants reported their mean hours of sleep a night during the past two nights.

Post hoc, it appeared that the correlation between the weekly aggregated vitality, satisfaction, and happy, energy measures on the person-level were high (correlations ranging from .73 to .89; see Supplementary File 1). Given that these indicators all refer to pleasant affect states (see circumplex model; Posner et al., 2005), we decided to combine these four variables into a new variable called *"positive affect"*. Cronbach's alpha for positive affect ranged from α = .83 to α = .94. In a similar vein, *"tension"*, *"stress"*, and *"irritation"* were highly correlated (correlations ranging from .77 to 91). These indicators all refer to high activation, and negative affect (Posner et al., 2005). Therefore, a new variable *"stress"*, was computed. Cronbach's alpha for stress ranged from α = .83 to α = .92. For all new variables, factor analyses indeed recommended one factor (see Supplementary File 2).

Exercise exposure and experiences

Participants on the waiting list did not receive the exercise intervention. Therefore, only participants in the exercise condition filled out exposure and exercise experiences items. Measurement points comprised T1 – T6, since at T0, no intervention was delivered yet, and exposure and experiences of the intervention were thus not applicable.

Exposure

Exercise participants were asked to indicate their attendance to the guided and individual running sessions. Additionally, if applicable, they were asked to indicate whether they performed a missed guided running session on their own. This means that three exercise sessions could be carried out each week. The mean number of weekly attended sessions over the six intervention weeks was included in the analysis.

Pleasure and effort

Single-item measures were also used to assess *pleasure* and *effort* during the exercise sessions. The items are introduced as follows: “Can you indicate with a report mark between 1 and 10 how you experienced last week’s running sessions?” The items were answered on a Likert scale ranging from 1 (not at all applicable) – 10 (extremely applicable). The average score of pleasure and effort over the six intervention weeks was included in the analysis.

Psychological detachment

The extent to which employees were able to detach from work during the running sessions was measured using an adapted version of the 4-item *psychological detachment* scale of the Recovery Experience Questionnaire (Sonnentag & Fritz, 2007). An example item is: “During the running sessions of last week, I forgot about work”. The items were answered on a 5-point Likert scale ranging from 1 = totally disagree to 5 = totally agree. Reliability was on average $\alpha = .91$ for all time points. The average score of psychological detachment over the six intervention weeks was included in the analysis.

Statistical analysis

Latent growth curve modelling (LGCM) using the Mplus software package (version 7.4; Muthén & Muthén, 2010) was used to test our hypotheses. LGCM was chosen, since the data were longitudinally nested within two hierarchical levels (i.e., level 1: time, level 2: participants), and this technique allowed us to track inter-individual and intra-individual changes of phenomena over time (Curran et al., 2011).

To test *Hypothesis 1* (exercise exposure in relation to health and well-being), only participants in the exercise condition were included in the analyses, since wait list participants did not receive the exercise intervention. For each health and well-being indicator, a LGCM-model was computed. The model consisted of the intercept (i.e., the first time point [T0] of the curve of health and well-being indicator; average across individuals), slope (i.e., the growth rate of the health and well-being indicator over time: T1-T6; average across individuals), variances of the intercept and slope (i.e., random effects that allow the intercept and slopes to vary across individuals), a time-specific residual, and covariance between intercept and slope (Hesser, 2015). Time was coded as 0 (T0), 3 (T1), 4 (T2), 5 (T3), 6 (T4), 7 (T5), and 8 (T6). This coding scheme was used, since there was unequal spacing between measurement points. That is, the intervention period started – on average – 2.52 ($SD = 0.73$) weeks after the pre-measurement, and thus, the time interval between T0 and T1 was not exactly 1 week, as was the time interval between the other measurement points (T1-T6). Exposure (i.e., mean number of weekly attended exercise sessions) was included as a time-invariant predictor (i.e., a fixed predictor that did not vary across time within individuals, but varies across individuals), and a time*exposure interaction term was added to the model as well. As such, it was investigated whether the health and well-being indicator before the start of the intervention (intercept) or the development of the health and well-being indicator over time (slope) differed according to participants’ attendance to the exercise sessions. The fit of the model was evaluated by using Chi-square tests, the Comparative Fit Index (CFI), the Tucker Lewis Index (TLI), and the root-mean-square error of approximation (RMSEA) (Bentler & Bonnett, 1980). Model fit was considered acceptable if the TLI, and the CFI were ≥0.90 and RMSEA was ≤0.10 (i.e., guidelines for growth models including N < 100, see DeRoche, 2009).

To test *Hypothesis 2, Hypothesis 3*, and to answer *Research Question 2*, similar analyses were conducted as those that were used to test Hypothesis 1. Again, only exercise participants were analysed. For all models, respectively, the mean level of pleasure (*H2*), psychological detachment (*H3*), and effort (*RQ2*) were included as time-invariant predictors, and predictors of the intercept, and (quadratic) slope. It was investigated whether the intercept or (quadratic) slope differed according to participants’ average exercise pleasure, psychological detachment, and effort over the six intervention weeks.

To answer *Research Question 1* (minimal exposure of the intervention required for beneficial effects to start manifesting), data of all participants were included in the analyses. For each health and well-being indicator, a series of two models were computed. Again, Model 1 consisted of an intercept, slope, random effects that allow the intercept and slopes to vary across individuals, a time-specific residual, and covariance between intercept and slope (Hesser, 2015). Also, in this model, condition (0 = wait list, 1 = exercise) was included as a time-invariant predictor of the intercept and slope. Differences in the trajectory of the health and well-being indicator between the two conditions were present if condition significantly predicted the slope. In case a significant condition*slope interaction was found, additional analyses were performed to further explore at what time point the health and well-being indicator significantly differed between the conditions. To this purpose, the variable “time” was rescaled. In the original model, the intercept (i.e. the ‘0’) represented the initial status of the health and well-being indicator (i.e., just before the start of the intervention). When condition significantly predicted the intercept, it could be concluded that the conditions differed regarding their initial status of health and well-being. In LGCM, it is possible to rescale the intercept (i.e., the ‘0’), and, in this way, it could be investigated at which time point the level of the health and well-being indicator differed per condition (Hesser, 2015). For instance, when it was explored whether level of the health and well-being indicator differed between conditions at T3, time was rescaled as −5 (T0), −2 (T1), −1 (T2), 0 (T3), 1 (T4), 2 (T5), and 3 (T6), so that the intercept referred to T3 instead of T0. If condition significantly predicted the intercept, it could be concluded that conditions significantly differ from each other in their level of health and well-being at T3. The intercept was rescaled for every time point.

Additional analyses

As it was unknown how health and well-being trajectories would develop over time, and it was well possible that health and well-being would follow a non-linear pattern, for each health and well-being indicator a second model was estimated. This model was identical to the linear, except for the additional inclusion of a quadratic slope ($time^2$), an interaction between the quadratic slope and the moderator, and a random effect that allows the quadratic slope to vary across individuals. To interpret significant nonlinear interaction accurately, we followed recent methodological recommendations to calculate and probe simple slopes for curvilinear effects (see Miller et al., 2013). This allowed us to see whether the health and well-being trajectory accelerated or decelerated at a certain time point and the extent to which this was related to the moderator. For the sake of parsimony, details of these quadratic models are presented in Supplementary File 3, and only presented in the results section if the quadratic model fitted the data better than the linear model (using Chi-square difference test).

Results

Descriptive statistics

Intraclass correlations (ICCs), means and standard deviations of the health and well-being indicators for each time point per condition are depicted in Table 1. The ICCs show that 34.62% (sleep quantity) – 68.28% (health) of the variance was explained by fluctuations at the weekly level, and that there is sufficient between-person variance for an analysing technique that acknowledges the hierarchical structure of the data. Additionally, Table 2 presents the means and standard deviations of exposure, and exercise experiences for participants in the exercise condition. Between- and within-person correlations between study variables can be found in the supplementary materials.

Hypothesis 1 (exposure as moderator of the effectiveness of the intervention)

Exposure to the intervention was quite good. On average, two out of three exercise sessions a week were attended (see Table 2). Results of the analyses that were conducted to test hypothesis 1 are depicted in Table 3. No significant time*-exposure interactions were found for fatigue, health, stress, and sleep quality and quantity (see Table 3), indicating that exposure to the exercise intervention was not related to the development of these health and well-being indicators during the course of the intervention.

As regards positive affect, a significant time*exposure interaction was found. Figure 1 shows the development of positive affect over time for low exposure (one exercise session a week) and high exposure (three exercise sessions a week). Simple slope tests (Curran et al., 2004) revealed that high exposure was related to increased positive affect over time (b = 0.13, $p < .01$), and that low exposure was unrelated to positive affect over time (b = −0.02, $p = .63$).

Table 1. Intra-class correlations (ICC), means (standard deviations) of health and well-being outcomes at each time point.

		Pre intervention		During intervention										Post intervention	
		T0		T1		T2		T3		T4		T5		T6	
	1-ICC	I (n = 46)	C (n = 41)	I (n = 45)	C (n = 44)	I (n = 43)	C (n = 44)	I (n = 42)	C (n = 43)	I (n = 38)	C (n = 43)	I (n = 38)	C (n = 43)	I (n = 41)	C (n = 44)
Fatigue	66.34%	6.65 (1.58)	6.68 (1.75)	6.11 (1.82)	7.07 (1.40)	6.43 (1.94)	6.43 (1.63)	5.91 (1.91)	6.10 (1.90)	5.97 (1.64)	6.47 (1.56)	5.55 (1.70)	6.53 (1.55)	5.63 (1.98)	6.50 (1.53)
Health	68.28%	6.70 (1.81)	6.29 (1.74)	7.02 (1.42)	6.52 (1.46)	6.60 (1.89)	6.48 (1.41)	6.71 (1.61)	6.49 (1.35)	6.97 (1.37)	6.56 (1.18)	7.45 (1.13)	6.42 (1.24)	7.28 (1.32)	6.39 (1.35)
Stress	40.71%	4.93 (1.80)	5.14 (2.03)	5.22 (1.53)	5.14 (2.32)	5.08 (1.88)	4.87 (2.04)	4.98 (1.79)	4.63 (2.12)	4.88 (1.69)	4.71 (2.06)	4.91 (2.03)	4.71 (1.63)	4.62 (2.06)	5.11 (2.12)
Positive affect	44.50%	6.32 (1.28)	5.82 (1.22)	6.34 (1.20)	5.65 (1.37)	6.05 (1.56)	5.76 (1.27)	6.21 (1.30)	5.79 (1.36)	6.61 (1.23)	5.80 (1.36)	6.99 (1.00)	5.78 (1.10)	6.83 (1.15)	5.50 (1.34)
Exercise self-efficacy	44.97%	6.54 (1.64)	5.22 (2.29)	6.84 (2.01)	5.84 (2.02)	6.26 (2.45)	5.61 (2.24)	6.07 (2.30)	5.60 (2.04)	6.68 (2.18)	5.72 (2.15)	6.82 (2.13)	5.84 (1.86)	6.60 (2.12)	5.66 (2.32)
Sleep quality	48.43%	3.42 (1.50)	3.32 (1.44)	3.07 (1.61)	3.57 (1.48)	3.19 (1.68)	3.59 (1.56)	3.24 (1.76)	3.42 (1.58)	2.79 (1.74)	3.53 (1.74)	2.57 (1.77)	3.53 (1.59)	2.68 (1.89)	3.63 (1.37)
Sleep quantity	34.62%	6.98 (0.92)	7.03 (1.05)	7.00 (0.85)	6.91 (1.03)	7.00 (1.30)	6.98 (1.02)	7.22 (1.35)	7.08 (0.96)	7.05 (0.88)	6.90 (1.11)	7.05 (1.00)	6.84 (1.14)	6.95 (1.18)	6.90 (0.93)

I = intervention condition; C = control condition. 1-ICC reflects the percentage of within-person variance.

Table 2. Means (standard deviations) of exposure to exercise and exercise experiences for each time point (only participants in the exercise condition).

	Theoretical range	T1 (n = 45)	T2 (n = 43)	T3 (n = 42)	T4 (n = 38)	T5 (n = 38)	T6 (n = 41)	Overall
Exposure	0–3	2.55 (0.94)	2.18 (1.67)	1.94 (1.30)	1.96 (1.22)	2.07 (1.25)	1.46 (1.38)	1.98 (0.98)
Pleasure	1–10	7.38 (1.17)	7.47 (0.84)	7.31 (1.07)	7.62 (0.92)	7.47 (1.06)	7.72 (0.86)	7.37 (0.88)
Psychological detachment	1–5	4.18 (0.78)	4.10 (0.73)	4.13 (0.73)	4.26 (0.67)	4.15 (0.74)	4.20 (0.83)	4.09 (0.63)
Effort	1–10	6.41 (1.82)	6.47 (1.84)	6.51 (1.66)	6.65 (1.78)	6.85 (1.67)	6.68 (1.58)	6.70 (1.43)

Table 3. Fit statistics and estimates (SE) of linear models predicting health and well-being outcomes over time as a function of exposure (only participants in the exercise condition).

	Intercept	Variance intercept	Time	Variance Time	Exposure on intercept	Time * Exposure	χ2	*df*	RMSEA	CFI	TLI
Fatigue	6.94 (0.46)**	0.24 (0.42)	−0.18 (0.08)*	0.01 (0.01)	−0.12 (0.20)	0.02 (0.03)	40.84	28	0.10	0.85	0.85
Health	6.78 (0.58)**	1.24 (0.54)*	−0.10 (0.11)	0.04 (0.02)**	−0.06 (0.26)	0.08 (0.05)	44.40*	28	0.11	0.80	0.80
Stress	5.30 (0.70)**	1.94 (0.81)*	−0.03 (0.12)	0.02 (0.02)	0.06 (0.30)	−0.02 (0.05)	74.42**	28	0.19	0.70	0.70
Positive affect	6.29 (0.45)**	1.25 (0.35)**	−0.10 (0.08)*	0.03 (0.01)**	−0.01 (0.03)	**0.01 (0.01)***	52.56*	28	0.14	0.78	0.78
Exercise self-efficacy	6.52 (0.56)**	1.70 (0.71)*	−0.51 (0.10)**	0.04 (0.02)*	0.01 (0.04)	**0.04 (0.01)****	70.51**	28	0.19	0.75	0.75
Sleep quality	3.04 (0.53)**	1.72 (0.47)**	−0.09 (0.10)	0.04 (0.01)**	0.17 (0.23)	0.01 (0.04)	34.08	28	0.07	0.95	0.95
Sleep quantity	7.02 (0.33)**	0.64 (0.20)**	−0.02 (0.05)	0.01 (0.00)*	−0.01 (0.14)	0.01 (0.02)	24.88	28	<.01	1.00	1.00

Relevant effects are in bold.
* p <.05, ** p <.01 (two-tailed)

With regard to exercise self-efficacy, a significant time * exposure interaction was found. Simple slope tests revealed that high exposure was related to increased exercise self-efficacy over time (b = 0.21, *p* < 0.01), and that low exposure was related to decreased exercise self-efficacy over time (b = −.27, *p* < .01; see Figure 1 for a graphical representation of the interaction effect).

Given that high exposure was related to favourable changes in positive affect and exercise self-efficacy trajectories compared to low exposure, but did not moderate fatigue, health, stress, and sleep quality and quantity trajectories, we conclude that *Hypothesis 1* is partially supported.

Research question 1 (minimal exposure)

To explore when intervention effects became visible, exercisers and controls were compared regarding their health and well-being trajectories. Table 4 depicts the results of these analyses. As can be seen in this table, significant time*condition effects were found for the indicators fatigue, positive affect, and sleep quality, indicating that the course of these indicators over time differed between participants in the exercise and control condition.

As regards fatigue, simple slopes tests indicated a decrease of fatigue over time among exercisers (b = –0.14, *p* < .01) and no change in fatigue among controls (b = –0.04, *p* = 0.24; see Figure 2). To explore at which time point the level of fatigue

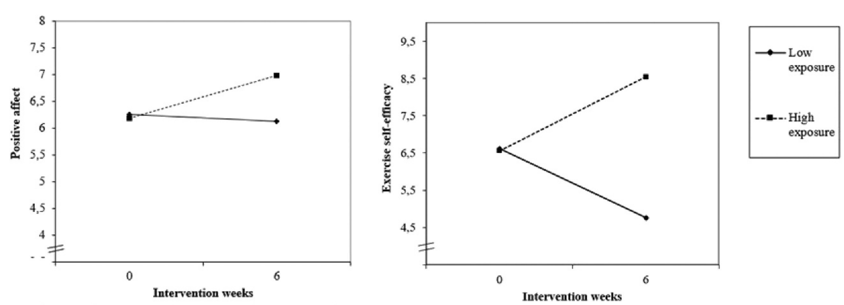

Figure 1. Positive affect and exercise self-efficacy over time under low exposure (one exercise session a week) and high exposure (three exercise sessions a week).

Table 4. Fit statistics and estimates (SE) of linear models predicting health and well-being outcomes over time as a function of condition (exercise vs. control).

	Intercept	Variance intercept	Time	Variance Time	Condition on intercept	Time * Condition	χ2	*df*	RMSEA	CFI	TLI
Fatigue	6.75 (0.20)**	0.30 (0.32)	−0.04 (0.03)	<.01 (<.01)	−0.04 (0.28)	**−0.10 (0.05)***	56.45**	28	0.11	0.83	0.83
Health	6.44 (0.23)**	1.17 (0.38)**	0.01 (0.04)	0.04 (0.01)**	0.17 (0.33)	0.07 (0.06)	24.04	28	<.01	1.00	1.00
Stress	5.13 (0.27)**	2.58 (0.54)**	−0.03 (0.03)	0.02 (0.01)	−0.06 (0.39)	0.01 (0.05)	47.88*	28	0.09	0.94	0.94
Positive affect	5.81 (0.19)**	1.20 (0.24)**	−0.02 (0.03)	0.02 (0.01)**	0.40 (0.26)	**0.09 (0.04)***	50.79**	28	0.09	0.93	0.93
Exercise self-efficacy	5.28 (0.30)**	3.62 (0.70)**	0.06 (0.04)	0.07 (0.02)	1.10 (0.41)**	−0.03 (0.06)	41.08	28	0.09	0.95	0.94
Sleep quality	3.40 (0.22)**	1.54 (0.32)**	0.03 (0.03)	0.03 (0.01)	0.08 (0.31)	**−0.13 (0.05)***	41.95	28	0.07	0.95	0.95
Sleep quantity	7.02 (0.15)**	0.77 (0.15)**	−0.02 (0.02)	0.01 (<.01)	<.01 (0.20)	0.02 (0.03)	35.51	28	0.05	0.98	0.98

Relevant effects are in bold.
* p <.05, ** p <.01 (two-tailed)

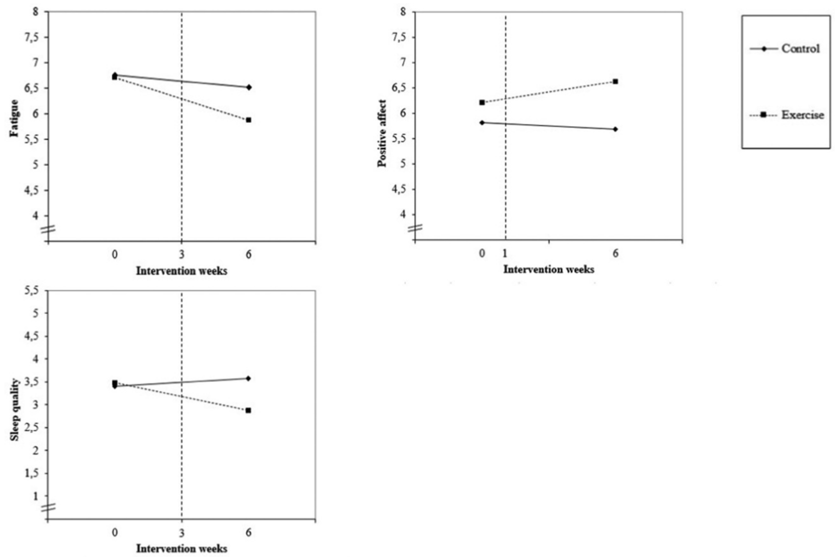

Figure 2. Health and well-being trajectories for exercisers and controls (dotted vertical line represents minimal exposure; the point in time at which exercisers and controls significantly differ from each other).

differed per condition, the intercept was rescaled six times (i.e., '0' scaled at T1–T6, respectively). Condition significantly predicted the intercept when the intercept was rescaled at T3, T4, T5, and T6, but not at T0, T1, and T2. This means that from T3 onwards, the level of fatigue differed per condition. As can be seen in Table 1, from T3 onwards, the level of fatigue is lower among exercisers compared to controls. At T3, this difference between exercisers and controls can be regarded as small (Cohen's *d*: 0.10), and at T6 as moderate (Cohen's *d*: 0.49).

As regards positive affect, simple slopes indicated that being in the exercise condition was related to an increase of positive affect throughout the intervention ($b = 0.07$, $p < .01$), while being in the control condition was not related to significant changes in positive affect over time ($b = 0.02$, $p = .43$). See Figure 2 for graphical representation of positive affect over time per condition. Rescaling the intercept revealed that condition significantly predicted the intercept when the intercept was rescaled at T1, T2, T3, T4, T5, and T6, but not at T0. This means from T1 onwards, the level of positive affect differed per condition. Inspecting Table 1 reveals that, from T1 onwards, positive affect is higher among exercisers than controls. At T1, this difference between exercisers and controls can be regarded as moderate (Cohen's *d*: 0.54), and at T6 as large (Cohen's *d*: 1.07).

With regard to sleep quality, simple slope tests showed that exercisers showed increased sleep quality over time (i.e., a decrease in sleep problems, $b = -0.10$, $z = -4.04$, $p < .01$), while controls did not show a change in sleep quality over time ($b = 0.03$, $z = 0.85$, $p = .40$). Rescaling the intercept revealed that condition significantly predicted the intercept when the intercept was rescaled at T3, T4, T5, and T6, but not at T0, T1, and T2. This means that from T3 onwards, the level of sleep quality differed per condition. As can be seen in Table 1, at these time points, higher sleep quality was found among exercisers (i.e., less sleep problems) compared to controls. At T3, this difference between exercisers and controls can be regarded as small (Cohen's *d*: 0.11), and at T6 as moderate (Cohen's *d*: 0.57).

Additional analyses research question 1

A significant time^2 * condition interaction was found for stress (see Table 4A and Figure 2 in Supplementary File 3). Simple slopes of stress at all time points throughout the intervention were not significant for exercisers (*b*'s varying from −0.07 to 0.17, all *p*'s > .05) and controls (*b*'s varying from −0.16 to 0.08, all *p*'s > .05). Furthermore, rescaling the intercept did not reveal a time point at which condition significantly predicted the intercept. Therefore, even though there is a significant interaction effect, we conclude that no minimal exposure could be detected.

In sum, the minimal exposure to the exercise intervention was 1 week to observe a change in positive affect, and 3 weeks to observe changes in fatigue and sleep quality. For health, stress, exercise self-efficacy and sleep quantity, no minimal exposure could be detected.

Hypothesis 2 (exercise pleasure as moderator of the effectiveness of the exercise intervention)

In general, exercisers experienced the exercise sessions as pleasurable (see Table 2). Furthermore, Table 5 shows that exercise pleasure levels significantly moderated trajectories of health, positive affect, and exercise self-efficacy, but did not moderate trajectories of fatigue, stress, and sleep quantity and quality.

As regards health, a significant time*pleasure interaction was found. See Figure 3 for a graphical representation of the interaction. In this figure, low pleasure indicates an insufficient report mark regarding exercise pleasure (i.e., '4'), and high pleasure indicates a good report mark regarding exercise pleasure (i.e., '8'). Simple slope analysis showed that high pleasure was related to increased health over time ($b = 0.16$, $z = 4.55$, $p < .01$), but that low pleasure was unrelated to changes in health over time ($b = -0.27$, $z = -1.63$, $p = .10$).

Table 5. Fit statistics and estimates (SE) of linear models predicting health and well-being outcomes over time as a function of pleasure (only participants in the exercise condition).

	Intercept	Variance intercept	Time	Variance Time	Pleasure on intercept	Time * pleasure	χ2	*df*	RMSEA	CFI	TLI
Fatigue	5.76 (1.63)**	0.26 (0.42)	0.10 (0.24)	−0.01 (0.01)	0.13 (0.22)	−0.03 (0.03)	43.72*	28	0.11	0.83	0.83
Health	9.45 (1.90)**	0.88 (0.49)	−0.69 (0.35)**	0.04 (0.02)*	−0.38 (0.26)	**0.11 (0.05)***	35.00	28	0.08	0.90	0.90
Stress	6.98 (2.00)**	1.89 (0.64)**	0.15 (0.26)	0.02 (0.01)	−0.27 (0.27)	−0.02 (0.04)	62.13**	28	0.17	0.80	0.80
Positive affect	5.92 (1.57)**	1.17 (0.33)**	−0.48 (0.25)	0.03 (0.01)**	0.04 (0.21)	**0.08 (0.03)***	57.72**	28	0.15	0.75	0.75
Exercise self-efficacy	6.72 (2.05)*	1.80 (0.67)**	−0.88 (0.36)	0.05 (0.02)*	−0.02 (0.28)	**0.12 (0.05)***	52.59**	28	0.16	0.81	0.78
Sleep quality	4.69 (1.88)*	1.81 (0.48)**	0.34 (0.31)	0.04 (0.01)**	−0.16 (0.25)	−0.06 (0.04)	27.67	28	<.01	1.00	1.00
Sleep quantity	5.37 (1.13)**	0.62 (0.19)**	−0.10 (0.16)	0.01 (<.01)*	0.22 (0.15)	0.02 (0.02)	28.89	28	0.03	0.99	0.99

* p <.05, ** p <.01 (two-tailed)

As regards positive affect, a significant time*pleasure interaction was found (see Table 5 and Figure 3). Simple slope analysis indicated that high pleasure was related to an increased positive affect over time (b = 0.16, $p < .01$), and that low pleasure was related to decreased positive affect over time (b = −0.08, $p < .01$).

Also, regarding exercise self-efficacy, a time*pleasure interaction was found (see Table 5 and Figure 3). Simple slope analysis indicated that high pleasure was related to an increase in exercise self-efficacy over time (b = 0.12, $p = 0.03$), and that low pleasure was related to a decrease in exercise self-efficacy over time (b = −0.38, $p = 0.03$).

Altogether, we found partial support for *Hypothesis 2*, as exercise pleasure was related to favourable health, positive affect, and exercise self-efficacy trajectories, and unrelated to fatigue, stress, and sleep quantity and quality trajectories.

Hypothesis 3 (psychological detachment as the moderator of the effectiveness of the exercise intervention)

On average, participants were very well able to psychologically detach from work during the exercise sessions (see Table 2). Results of the analyses that were conducted to test hypothesis 3 are depicted in Table 6. As can be seen in this table, no significant time * detachment interactions were found for all indicators.

Additional analyses hypothesis 3

For health, see Supplementary File 3 (Table 6A and Figure 3), in the quadratic model, a significant time*psychological detachment interaction was found and, consequently, interpreted. Simple slope analysis revealed that high psychological detachment was related to increased health over time (b = 0.54, p = 0.03), and that low psychological detachment was unrelated to changes in health over time (b = 0.11, p = 0.34).

As participants who experience more psychological detachment during their weekly exercise sessions show larger improvements in health than participants who experience less psychological detachment, but did not show improvements in the other health and well-being indicators, we conclude that *Hypothesis 3* is partially supported.

Research question 2 (effort as the moderator of the effectiveness of the exercise intervention)

In general, exercisers experienced the exercise sessions as moderately effortful (see Table 2). Results of the analyses that were conducted to answer Research Question 2 are

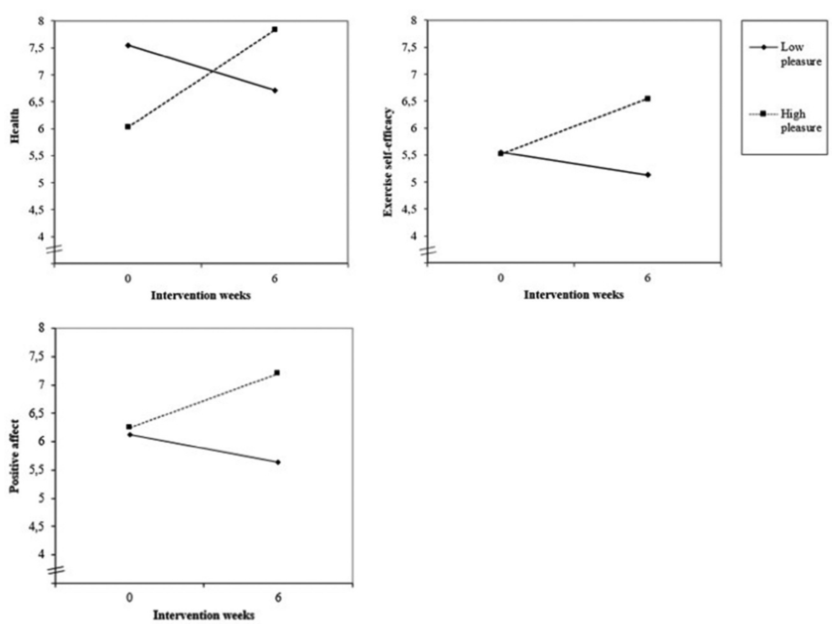

Figure 3. Health and well-being trajectories for low pleasure (report mark '4') and high pleasure (report mark '8').

Table 6. Fit statistics and estimates (SE) of linear models predicting health and well-being outcomes over time as a function of psychological detachment (only participants in the exercise condition).

	Intercept	Variance intercept	Time	Variance Time	Detachment on intercept	Time * detachment	χ2	df	RMSEA	CFI	TLI
Fatigue	6.88 (0.92)**	0.26 (0.42)	−0.07 (0.14)	−0.01 (0.01)	−0.06 (0.27)	−0.02 (0.04)	43.15*	28	0.11	0.83	0.83
Health	7.36 (1.11)**	1.14 (0.52)*	−0.16 (0.20)	0.04 (0.02)	−0.21 (0.33)	0.07 (0.06)	40.71	28	0.10	0.82	0.82
Stress	6.18 (1.13)**	1.93 (0.66)**	0.20 (0.15)	0.02 (0.01)	−0.36 (0.33)	−0.07 (0.04)	58.41**	28	0.16	0.82	0.82
Positive affect	6.19 (1.22)**	1.014 (0.33)**	−0.02 (0.20)	0.03 (0.01)**	<.01 (0.29)	0.03 (0.05)	53.29**	28	0.14	0.76	0.76
Exercise self-efficacy	6.45 (1.16)**	1.59 (0.60)**	−0.38 (0.24)	0.06 (0.02)	0.03 (0.35)	0.12 (0.07)	100.98**	28	0.24	0.47	0.47
Sleep quality	4.42 (1.04)**	1.77 (0.48)**	−0.02 (0.18)	0.04 (0.01)**	−0.28 (0.31)	−0.02 (0.05)	32.00	28	0.06	0.97	0.97
Sleep quantity	6.00 (0.60)**	0.57 (0.18)**	−0.13 (0.08)	0.01 (<.01)	0.29 (0.18)	0.04 (0.03)	28.09	28	0.01	1.00	1.00

* p <.05, ** p <.01 (two-tailed)

Table 7. Estimates (SE) predicting health and well-being outcomes over time as a function of effort (only participants in the exercise condition).

	Intercept	Variance intercept	Time	Variance Time	Effort on intercept	Time * effort	χ2	df	RMSEA	CFI	TLI
Fatigue	6.44 (0.94)**	0.29 (0.42)	−0.37 (0.13)**	0.01 (0.01)	0.04 (0.14)	0.04 (0.02)	40.38*	28	0.10	0.86	0.86
Health	5.15 (1.09)**	0.87 (0.49)	0.18 (0.20)	0.04 (0.02)*	0.23 (0.16)	−0.02 (0.03)	30.92	28	0.06	0.95	0.95
Stress	3.26 (1.14)**	1.78 (0.62)**	−0.01 (0.15)	0.02 (0.01)	0.26 (0.17)	<.01 (0.02)	60.13**	28	0.16	0.81	0.81
Positive affect	6.51 (0.91)**	1.14 (0.33)**	0.09 (0.15)	0.03 (0.01)**	−0.05 (0.14)	<.01 (0.02)	55.30**	28	0.15	0.74	0.74
Exercise self-efficacy	6.85 (1.23)**	1.73 (0.71)*	0.20 (0.25)	0.06 (0.03)	−0.05 (0.18)	−0.03 (0.04)	66.07**	28	0.19	0.71	0.67
Sleep quality	2.92 (1.10)**	1.81 (0.49)**	−0.19 (0.18)	0.04 (0.01)**	0.09 (0.16)	0.01 (0.03)	28.38	28	0.01	1.00	1.00
Sleep quantity	7.19 (0.68)**	0.66 (0.20)	−0.04 (0.09)	0.01 (0.01)	−0.03 (0.10)	0.01 (0.01)	36.13	28	0.08	0.95	0.95

* p <.05, ** p <.01 (two-tailed)

depicted in Table 7. As can be seen in this table, no significant time*exposure interactions were found for all indicators.

Additional analyses RQ2

Significant time^2*effort interactions were found for positive affect, exercise self-efficacy, and sleep quantity (see Table 7A and Figure 4 in Supplementary File 3). Simple slope analysis for curvilinear models (Miller et al., 2013) indicated that (T0-T3) low effort was related to increasing positive affect over time in the beginning of the intervention (*b*'s varying from 0.26 to 0.42, all *p*'s < .05), and not significantly related to positive affect in the second half of the intervention (T4-T6; b's varying from −0.06 to 0.18, *p*'s >.05). In the beginning of the intervention (T0-T1), high effort was related to decreased positive affect over time (*b*'s varying from −0.39 to −0.29, *p*'s < .05), and in the remaining time of the intervention it was unrelated to positive affect (*b*'s varying from −0.19 to 0.21, *p*'s < .05).

As regards exercise self-efficacy, simple slope analysis indicated that, during the beginning of the intervention (T0-T2), low effort was related to increasing exercise self-efficacy (*b*'s varying from 0.31 to 0.62, *p*'s <.05). From the third to the 6th-week intervention (T3-T5), low effort was related to stable exercise self-efficacy (estimates varying from −0.16 to 0.15, *p*'s > .05), and in the last week of the intervention it was related to a decrease in exercise self-efficacy (T6; estimate: −0.31, *p* < .05). On contrary, high effort was not significantly related to exercise self-efficacy during the intervention period (b's varying from −0.23 to 0.09, *p*'s <.05).

As regards sleep quantity, simple slope analysis indicated that low effort was not significantly related to the development of sleep quantity over time (*b*'s varying from −0.18 to 0.06, *p*'s > .05), neither was high effort (*b*'s varying from −0.10 to 0.14, *p*'s > .05). Therefore, we conclude that effort did not moderate sleep quantity throughout the intervention.

In sum, low effort was positively related to positive affect and exercise self-efficacy in the beginning of the intervention.

Discussion

The aim of the current study was to obtain insight in the "receipt" of an exercise intervention for employees with work-related fatigue, a mild burnout symptom. We specifically focused on participants' exposure to the intervention and their exercise experiences (i.e., pleasure, psychological detachment, and effort) in relation to their health and well-being trajectories throughout the intervention. In Table 8, the found support for our hypotheses and answers to research questions are summarized.

Exposure

Exercisers who attended more exercise sessions showed more favourable well-being trajectories (i.e., positive affect and exercise self-efficacy). These found dose–response relationships between exercise on the one hand, and well-being on the other hand are consistent with previous studies (e.g., Hamer et al., 2009). As nearly all participants in our study received a high intervention dose, low exposure and high exposure in the current study may actually reflect a moderate versus a high intervention dose. This relatively low contrast between low and high exposure may be a reason why not all health and well-being trajectories were related to participants' received exercise sessions.

As regards minimal exposure, it was shown that health and well-being effects of exercise among fatigued employees may occur relatively early in time (i.e., after 1 week for positive affect, and after 3 weeks for fatigue and sleep quality), which is comparable with the onset of intervention effects found in previous studies (Bretland & Thorsteinsson, 2015; De Vries et al., 2018). As most beneficial effects in the current study

Table 8. Synthesis of evidence.

	Analysis of intervention and/or control group	Support and/or results[a]						
		fatigue	health	stress	positive affect	exercise self-efficacy	sleep quality	sleep quantity
Hypothesis								
1. More exposure to exercise → better health and well-being over time	Intervention group	0	0	0	+	+	0	0
2. More exercise pleasure → better health and well-being over time	Intervention group	0	+	0	+	+	0	0
3. More psychological detachment → better health and well-being over time	Intervention group	0	+	0	0	0	0	0
Research Question								
1. What is the minimal exposure to exercise to observe health & well-being effects?	Intervention & control group	3 weeks	0	0	1 week	0	3 weeks	0
2. Is effort during exercise related to health and well-being over time?	Intervention group	- [b]	- [b]	0	0	0	0	0

[a]+ positive association; – negative association; 0 no association. [b] Only in the first half of the intervention (0–3 weeks).

were found after six-week intervention completion, it is likely that exercise behaviour should be maintained to observe stronger and sustained effects (cf. De Vries et al., 2018). On a more general note, significant differences between the intervention and control group were only observed in energy-related outcomes (fatigue, positive affect, and sleep). This might be due to our sample of fatigued employees, for whom it is likely that most room for improvement can be obtained in this type of outcomes. Another explanation may be that effects on the other health and well-being indicators may depend on participants' experiences during exercise.

Exercise experiences

Despite the generally high absolute level and low variance of exercise pleasure reported in this sample, still differences in health and well-being trajectories were found depending on exercise pleasure (i.e., for health, positive affect and exercise self-efficacy). This result is in line with Broaden-and-Build theory that suggests that a positive emotion, such as exercise pleasure, may trigger upward well-being trajectories (Frederickson, 2001). We did not find that exercise pleasure affected the undoing of negative well-being outcomes (i.e., fatigue, stress), which contrasts the Broaden-and-Build theory (Frederickson, 2001). However, the results are in agreement with suggestions that positive and negative affective states have distinct correlates (O'Connor & Puetz, 2005; Raedeke, 2007) and that positive emotions during activities may particularly trigger affective states that are more positive in nature than those that are more negative in nature (Raedeke, 2007).

As regards psychological detachment, most participants were well able to switch off from work-related thoughts during exercise, and there was little variation between participants. It is therefore not surprising that most health and well-being trajectories were not affected by psychological detachment. The finding that psychological detachment affected the trajectory of health – which might be viewed as a more distal health and well-being indicator – may thus be considered somewhat surprising, although this result is in accordance with a large body of evidence that shows that psychological detachment is an important experience for employees during non-work time for health preservation and enhancement (Sonnentag & Fritz, 2015; Wendsche & Lohman-Haislah, 2017). A possibility for the lack of support for the moderating role of psychological detachment is that exercise itself (e.g., attention focus to bodily sensations) or features of the intervention (e.g., exercising together) may have fostered psychological detachment among our participants (Morgan, 1985; Wininger & Gieske, 2010), and that psychological detachment thus rather acted as a mechanism through which the intervention works, which have been found previously (Feuerhahn et al., 2014). Sonnentag and Fritz (2015) suggest that psychological detachment can be both a mediator and moderator in the relationship between job stressors on the one hand and poor well-being on the other hand. In a similar vein, it may be that psychological detachment can be both a mediator (Feuerhahn et al., 2014) and moderator (De Vries et al., 2018) in the relationship between exercise and fatigue, health and well-being.

Lastly, we explored whether the experience of effort during the exercise sessions affected health and well-being trajectories during the intervention. In general, participants did not experience the exercise sessions as highly effortful. This is likely the result of the instructions of the intervention trainers, who gave advice to run on a low intensity (see study protocol; De Vries et al., 2015). The findings of this study show that high effort was related to decreased positive affect in the first 2 weeks of the intervention, and low effort was related to positive affect and exercise self-efficacy in the first 3 weeks of the intervention. These findings match observations in earlier studies (Ekkekakis et al., 2011; O'Connor & Puetz, 2005). As nearly no negative nor positive associations between high effort and health and well-being trajectories were found, our results did not provide support for the idea that effort is costly (e.g., O'Connor & Puetz, 2005), nor for the idea that effort is valued (e.g., Inzlicht et al., 2018). It should be noted, though, that low effort during exercise was only related to a more favourable development of two out of seven health and well-being indicators, and only in the first half of the intervention period. This is likely the result of the restriction of range in the effort experience in the current sample.

Theoretical and practical implications

The present study has several theoretical implications. First, as the intervention was found to be effective (see also De Vries et al., 2017), and as more exposure was found to be related to more beneficial effects, current results indicate that the theoretical model underlying the relationship between exercise and work-related fatigue, and health and well-being (Kristensen, 2005) is valid. Although indeed several plausible mechanisms have been put forward (Kandola et al., 2019; De Vries et al., 2015, 2017; Wiese et al., 2018), additional research on the "how" (how does the intervention work?) and "why" (which factors hindered or stimulated intervention outcomes?) may be relevant for theory refinement (MacKinnon, 2011). It would be interesting for future research to not only examine the moderating ("why") but also the mediating ("how") role that exercise experiences play in explaining the effectiveness of exercise interventions.

Second, this study contributes to the idea that people are not passive receivers of the intervention, but that people actively interact with the intervention, and that this interaction may partly explain intervention effectiveness (Moore et al., 2015; Nielsen et al., 2007). More specifically, this study provides additional support for the idea that not only characteristics of exercise itself (e.g., type, duration), but also the subjective evaluation of exercise matters for health and well-being effects among fatigued employees (Oerlemans et al., 2014). Although the intervention was generally well received, and, as such, no "poor" receipt of exercise could be studied, this study suggests that "sufficient" receipt of exercise may reduce fatigue, the main symptom of burnout, and that fatigued employees may receive additional benefits in secondary outcomes in case of a "good receipt", i.e., in case of high exposure, exercise pleasure and psychological detachment, and low effort. Obtaining improvements in these secondary outcomes may be important as well, as these outcomes have been shown to be relevant for functioning of fatigued employees at work and exercise participation on the longer term (Lee et al., 2016; Neupert et al., 2009).

Third, the quantitative weekly measurements in the current study enabled to portray the development of health and well-being throughout the intervention period, and to relate these developments to process factors. This approach differs from previous quantitative process evaluations, as these did not relate process factors to outcomes or only measured process factors at follow-up and related them to intervention outcomes (Steckler & Linnan, 2002). We showed that how people experience the intervention or to what extent they are exposed to the intervention not only affected outcomes after the end of the intervention but also affected the increment or decrement of outcomes during the intervention period.

This study has also several practical implications. The findings of the current study imply that the exercise is generally well received among employees with work-related fatigue. That is, most participants attended the exercise sessions and exercise were experienced as pleasurable. To optimize exercise intervention effectiveness for employees experiencing work-related fatigue, exposure to the intervention may be stimulated, for instance, by making use of motivational strategies such as positive feedback (Nicolson et al., 2017). Furthermore, exercising 3 weeks for three times a week seems a minimal intervention dose to observe effects in fatigue, the core symptom of burnout. A higher intervention dose seems desirable in order to observe stronger and sustained intervention effects. Furthermore, we suggest to design the intervention in a way that exercise pleasure will be promoted. Previous research shows that exercising in a group that is supportive (by both group members and the trainer, with the absence of interpersonal competition), may increase exercise pleasure (Berger & Motl, 2000; Dunton et al., 2015; Fox et al., 2000). Future exercise interventions for work-related fatigue may also be designed in a way that psychological detachment during the exercise sessions will be facilitated, for instance, by instructing participants to exercise in nature (Barton & Pretty, 2010). Lastly, it might be advisable to instruct participants to exercise in a way that feeling of expended effort during exercise is (relatively) low. Participants may be learned that one should be able to speak comfortably and breath easily during exercise in order to ensure that effort is low (Loose et al., 2012; Persinger et al., 2004).

Limitations and future research

This study is not without limitations. First, in the current process evaluation, we particularly focused on the receipt of the intervention (Moore et al., 2015; Nielsen et al., 2007; Saunders et al., 2005; Steckler & Linnan, 2002), and we did not pay attention to other process factors, such as the context, and mechanisms of impact, that may impact intervention effectiveness too (Moore et al., 2015; Steckler & Linnan, 2002). Future research may consider studying these process factors to get a better understanding of "when", "how", and "why" an exercise intervention may work for employees who experience work-related fatigue.

Second, in the present study, outcomes and exercise experiences were measured at the same point in time, namely, pre (T0), and at the end of each of the six intervention weeks (T1-T6). This might have resulted in affective states impacting the recall of exercise experiences or vice versa. To better disentangle the associations between exercise experiences on the one hand, and health and well-being on the other hand, we suggest that future research measures exercise experiences during or immediately after exercise sessions, and health and well-being at a different point in time. This would also allow for examining reversed or reciprocal relationships between exercise experiences and health and well-being indicators. For instance, it has been shown that exercise self-efficacy and effort could be reciprocally related (Hutchinson et al., 2008).

A third limitation is that not all latent growth models showed sufficient model fit, even when significant parameter estimates were found in these models. This is likely to be related to our relatively low sample size, which may impact measures of model fit, and the proportional variability of the parameter estimates (i.e., the degree to which the empirical parameter estimates fluctuate around the true population value; Hamilton et al., 2003). The group of exercise participants on which we based our analyses consisted of 47 participants, whereas research suggests that sample sizes of at least 50 should be included when using Latent Growth Curve Modelling (Hamilton et al., 2003). Although it is suggested that a small sample size in combination with multiple measurements does not bias parameter estimates to a substantial degree in LGM analyses (Hamilton et al., 2003), we suggest that future research may include larger sample sizes to increase model fit and proportional variability of the estimates.

Fourth, as fatigue, six health and well-being indicators, and four process factors were examined in the current study, multiple statistical tests were carried out. Multiple tests may result in an increased risk of Type I errors (Feise, 2002). A solution to reduce problems related to multiple testing is to adopt a more stringent p-value. However, we chose not to do so, because we based our hypotheses a priori on strong theoretical foundations (De Vries et al., 2015), and a downside of p-value adjustment is that the chance of Type II errors is higher, which may limit further investigation of potentially valuable research questions (Feise, 2002). We *certainly* acknowledge that multiple testing is suspect to bias (Feise, 2002), though. Therefore, we suggest to interpret results of this study with some caution, and we suggest that future research incorporates a limited amount of outcome and process measures. Researchers are advised to carefully consider what aspects of the intervention process should be measured to best understand "when", "why" and "how" an intervention works (Steckler & Linnan, 2002). Outcome measures should be chosen that best define success of an intervention (Coster, 2013).

Fifth, related to the previous point, despite the fact that the current study incorporated a theoretically relevant set of exercise experiences, it is likely that several other exercise experiences could have moderated the relationship between exercise on the one hand and fatigue, health and well-being on the other hand as well. Examples of such experiences are mastery experiences (one's feeling of succeeding in overcoming exercise challenges; Sonnentag & Fritz, 2007), the sense of belonging (one's feeling of being meaningfully integrated in the exercise environment; Feuerhahn et al., 2014), control (one's feeling of having control over what to do during an exercise session; Sonnentag & Fritz, 2007), and positive work reflection (thinking about the positive aspects of one's job during exercise; Meier et al., 2016). Further research on the moderating role of other experiences is therefore suggested. When studying experiences as moderators, we suggest to adapt existing scales (e.g., recovery experiences questionnaire; Sonnentag & Fritz, 2007) to measure experiences specific for exercise, and refer to experiences *during* exercise.

General conclusion

All in all, this study showed that there is no one-size-fits-all approach regarding an exercise intervention for employees with work-related fatigue, as variation in exercise exposure and exercise experiences resulted in differential intervention effects. This study has highlighted that paying attention to the receipt of an exercise intervention, i.e., sufficient exposure and exercise experiences, may contribute to the success of an exercise intervention for employees with work-related fatigue. As we were among the first to report a process evaluation of an exercise intervention aimed at reducing fatigue and increasing health and well-being among fatigued employees, we suggest that other researchers may adopt a comparable approach for process evaluations of exercise interventions for work-related fatigue to better determine when, how and why exercise interventions for fatigued employees work. This may have positive implications for research and practice.

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References

Abbiss, C. R., Peiffer, J. J., Meeusen, R., & Skorski, S. (2015). Role of ratings of perceived exertion during self-paced exercise: What are we actually measuring? *Sports Medicine*, *45*(9), 1235–1243. https://doi.org/10.1007/s40279-015-0344-5

Abrantes, A. M., Farris, S. G., Garnaat, S. L., Minto, A., Brown, R., Price, L. H., & Uebelacker, L. A. (2017). The role of physical activity enjoyment on the acute mood experience of exercise among smokers with elevated depressive symptoms. *Mental Health and Physical Activity*, *12*, 37–43. https://doi.org/10.1016/j.mhpa.2017.02.001

Barton, J., & Pretty, J. (2010). What is the best dose of nature and green exercise for improving mental health? A multi-study analysis. *Environmental Science & Technology*, *44*(10), 3947–3955. https://doi.org/10.1021/es903183r

Bennet, A. A., Bakker, A. B., & Field, J. G. (2017). Recovery from work-related effort: A meta-analysis. *Journal of Organizational Behavior*, *39*(3), 262–275. https://doi.org/10.1002/job.2217

Bentler, P. M., & Bonnett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin*, *88*(3), 588–606. https://doi.org/10.1037/0033-2909.88.3.588

Berger, B. G. (1996). Psychological benefits of an active lifestyle: What we know and what we need to know. *Quest*, *48*(3), 330–353. https://doi.org/10.1080/00336297.1996.10484201

Berger, B. G., & Motl, R. W. (2000). Exercise and mood: A selective review and synthesis of research employing the profile of mood states. *Journal of Applied Sport Psychology*, *12*(1), 69–92. https://doi.org/10.1080/10413200008404214

Bianchi, R., Schonfeld, I. S., & Laurent, E. (2015). Is burnout separable from depression in cluster analysis? A longitudinal study. *Social Psychiatry and Psychiatry Epidemiology*, *50*(6), 1005–1011. https://doi.org/10.1007/s00127-014-0996-8

Biron, C., & Karanika-Murray, M. (2020). Process evaluation for organizational stress and well-being interventions: Implications for theory, method, and practice. *International Journal of Stress Management, 21*(1), 85–111. https://doi.org/10.1037/a0033227

Bourke, M., Hilland, T. A., & Craike, M. (2020). Variance in the valenced response during moderate-to-vigorous physical activity: A review of cognitive and contextual mechanisms. *International Review of Sport and Exercise Psychology*. https://doi.org/10.1080/1750984X.2020.1780626

Bowling, A. (2005). Just one question: If one question works, why ask several? *Journal of Epidemiology Community Health*, *59*(5), 342–345. https://doi.org/10.1136/jech.2004.021204

Brenninkmeijer, V., & Van Yperen, N. (2003). How to conduct research on burnout: Advantages and disadvantages of a unidimensional approach in burnout research. *Occupational and Environmental Medicine*, *60*(Suppl. 1), i16–20. https://doi.org/10.1136/oem.60.suppl_1.i16

Bretland, R. J., & Thorsteinsson, E. B. (2015). Reducing workplace burnout: The relative benefits of cardiovascular and resistance exercise. *PeerJ*, *3*, e891. https://doi.org/10.7717/peerj.891

Brosschot, J. F., Gerin, W., & Thayer, J. F. (2006). The perseverative cognition hypothesis: A review of worry, prolonged stress-related physiological activation, and health. *Journal of Psychosomatic Research*, *60*(2), 113–124. https://doi.org/10.1016/j.jpsychores.2005.06.074

Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: Definitions and distinctions for health-related research. *Public Health Reports*, *100*(2), 126–131. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1424733/

Cho, S., & Park, Y. (2018). How to benefit from weekend physical activities: Moderating role of psychological recovery experiences and sleep. *Stress and Health*, *34*(5), 639–648. https://doi.org/10.1002/smi.2831

Coster, W. J. (2013). Making the best match: Selecting outcome measures for clinical trials and outcome studies. *American Journal of Occupational Therapy*, *67*(2), 162–170. https://doi.org/10.5014/ajot.2013.006015

Curran, P. J., Bauer, D. J., & Willoughby, M. T. (2004). Testing main effects and interactions in latent curve analysis. *Psychological Methods*, *9*(2), 220–237. https://doi.org/10.1037/1082-989X.9.2.220

Curran, P. J., Obeidat, K., & Losardo, D. (2011). Twelve frequently asked questions about growth curve modeling. *Journal of Cognition and Development*, *11*(2), 121–136. https://doi.org/10.1080/15248371003699969

De Vries, J., Michielsen, H. J., & Van Heck, G. L. (2003). Assessment of fatigue among working people: A comparison of six questionnaires. *Occupational Environmental Medicine*, *60*(Suppl. 1), i10–i15. https://doi.org/10.1136/oem.60.suppl_1.i10

De Vries, J., Michielsen, H. J., Van Heck, G. L., & Drent, M. (2004). Measuring fatigue in sarcoidosis: The Fatigue Assessment Scale (FAS). *British Journal of Health Psychology*, *9*(3), 279–291. https://doi.org/10.1348/1359107041557048

De Vries, J. D. (2017). *Exercise as intervention to reduce burnout* [Doctoral dissertation]. Radboud University. https://www.publicatie-online.nl/publicaties/j-d-vries

De Vries, J. D., Van Hooff, M. L. M., Geurts, S. A. E., & Kompier, M. A. J. (2015). Efficacy of an exercise intervention for employees with work-related fatigue: Study protocol of a two-arm randomized controlled trial. *BMC Public Health*, *15*(1), 1117. https://doi.org/10.1186/s12889-015-2434-6

De Vries, J. D., Van Hooff, M. L. M., Geurts, S. A. E., & Kompier, M. A. J. (2016). Exercise as an intervention to reduce study-related fatigue among university students: A two-arm parallel randomized controlled trial. *PLoS ONE*, *11*(3), e0152137. https://doi.org/10.1371/journal.pone.0152137

De Vries, J. D., Van Hooff, M. L. M., Geurts, S. A. E., & Kompier, M. A. J. (2017). Exercise to reduce work-related fatigue among employees: A randomized controlled trial. *Scandinavian Journal of Work, Environment & Health*, *43*(4), 337–349. https://doi.org/10.5271/sjweh.3634

De Vries, J. D., Van Hooff, M. L. M., Geurts, S. A. E., & Kompier, M. A. J. (2018). Trajectories of well-being during an exercise randomized controlled trial: The role of exposure and exercise experiences. *Stress & Health*, *34*(1), 24–35. https://doi.org/10.1002/smi.2758

DeRoche, K. K. (2009). *Functioning of global fit statistics in latent growth curve modeling* [Dissertations]. 104. https://digscholarship.unco.edu/dissertations/104

DeSalvo, K. B., Bloser, N., Reynolds, K., He, J., & Muntner, P. (2006). Mortality prediction with a single general self-rated health question. A meta-analysis. *Journal of General Internal Medicine*, *21*(3), 267–275. https://doi.org/10.1111/j.1525-1497.2005.00291.x

Desart, S., Schaufeli, W. B., & De Witte, H. (2017). *Op zoek naar een nieuwe definitie van burn-out*. [Blog post]. https://kuleuvenblogt.be/2017/02/20/op-zoek-naar-een-nieuwe-definitie-van-burn-out

Dishman, R. K., Motl, R. W., Saunders, R., Felton, G., Ward, D. S., Dowda, M., & Pate, R. R. (2005). Enjoyment Mediates Effects of a School-Based Physical-Activity Intervention. *Medicine and Science in Sports and Exercise*, *37*(3), 478–487. https://doi.org/10.1249/01.MSS.0000155391.62733.A7

Dreher, M., Dößereck, N., & Lachtermann, E. (2018). Körperliche Aktivität und deren Effekte auf das Burn-out-Syndrom. *Physikalische Medizin Rehabilitationsmedizin Kurortmedizin*, *29*, 15–25. https://doi.org/10.1055/A-0826-1014

Dunton, G. F., Liao, Y., Intille, S., Huh, J., & Leventhal, A. (2015). Momentary assessment of contextual influences on affective response during physical activity. *Health Psychology*, *34*(12), 1145–1153. https://doi.org/10.1037/hea0000223

Durlak, J. A. (2015). What everyone should know about implementation. In J. A. Durlak, C. E. Domitrovich, R. P. Weissberg, & T. P. Gullotta (Eds.), *Handbook of social and emotional learning: Research and practice* (pp. 395–405). Guilford.

Ekkekakis, P., Parfit, G., & Petruzello, S. J. (2011). The pleasure and displeasure people feel when they exercise at different intensities: Decennial update and progress towards a tripartite rationale for exercise prescription. *Sports Medicine*, *41*(8), 641–671. https://doi.org/10.2165/11590680-000000000-00000

Esch, T., & Stefano, G. B. (2004). The neurobiology of pleasure, reward processes, addiction and their health implications. *Neuroendocrinology Letters*, *25*(4), 235–251. https://pubmed.ncbi.nlm.nih.gov/15361811/

Feise, R. J. (2002). Do multiple outcomes measures require p-value adjustment? *BMC Medical Research Methodology*, *2*(1), 8. https://doi.org/10.1186/1471-2288-2-8

Feuerhahn, N., Sonnentag, S., & Woll, A. (2014). Exercise after work, psychological mediators, and affect: A day-level study. *European Journal of Work and Organizational Psychology*, *23*(1), 62–79. https://doi.org/10.1080/1359432X.2012.709965

Firoozabadi, A., Uitdewilligen, S., & Zijlstra, F. R. H. (2018). Should you switch off or stay engaged? The consequences of thinking about work on the trajectory of psychological well-being over time. *Journal of Occupational Health Psychology*, *23*(2), 278–288. https://doi.org/10.1037/ocp0000068

Fisher, G. G., Matthews, R. A., & Gibbons, A. M. (2016). Developing and investigating the use of single-item measures in organizational research. *Journal of Occupational Health Psychology*, *21*(1), 3–23. https://doi.org/10.1037/a0039139

Fox, L. D., Rejeski, W. J., & Gauvin, L. (2000). Effects of leadership style and group dynamics on enjoyment of physical activity. *American Journal of Health Promotion*, *14*(5), 277–283. https://doi.org/10.4278/0890-1171-14.5.277

Frederickson, B. L. (2001). The role of positive emotions in positive psychology. *American Psychologist Journal*, *56*(3), 218–226. https://doi.org/10.1037/0003-066X.56.3.218

Geurts, S. A., & Sonnentag, S. (2006). Recovery as an explanatory mechanism in the relation between acute stress reactions and chronic health impairment. *Scandinavian Journal of Work, Environment & Health*, *32*(6), 482–492. https://doi.org/10.5271/sjweh.1053

Gross, S., Semmer, N. K., Meier, L. L., Kälin, W., Jacobshagen, N., & Tschan, F. (2011). The effect of positive events at work on after-work fatigue: They matter most in face of adversity. *Journal of Applied Psychology*, *96*(3), 654–664. https://doi.org/10.1037/a0022992

Hamer, M., Stamatakis, E., & Steptoe, A. (2009). Dose-response relationship between physical activity and mental health: The Scottish Health Survey. *British Journal of Sports Medicine*, *43*(14), 1111–1114. https://doi.org/10.1136/bjsm.2008.046243

Hamilton, J., Gagne, P. E., & Hancock, G. R. (2003). *The effect of sample size on latent growth models*. https://eric.ed.gov/?id=ED476862

Hesser, H. (2015). Modeling individual differences in randomized experiments using growth models: Recommendations for design, statistical analysis and reporting of results of internet interventions. *Internet Interventions*, *2*(2), 110–120. https://doi.org/10.1016/j.invent.2015.02.003

Hutchinson, J. C., Sherman, T., Martinovic, N., & Tenenbaum, G. (2008). The effect of manipulated self-efficacy on perceived and sustained effort. *Journal of Applied Sport Psychology*, *20*(4), 457–472. https://doi.org/10.1080/10413200802351151

Inzlicht, M., Shenhav, A., & Olivola, C. Y. (2018). The effort paradox: Effort is both costly and valued. *Trends in Cognitive Sciences*, *22*(4), 337–349. https://doi.org/10.1016/j.tics.2018.01.007

Kandola, A., Ashdown-Franks, G., Hendrikse, J., Sabiston, C. M., & Stubbs, B. (2019). Physical activity and depression: Towards understanding the antidepressant mechanisms of physical activity. *Neuroscience and Biobehavioral Reviews*, *107*, 525–539. https://doi.org/10.1016/j.neubiorev.2019.09.040

Kompier, M., & Aust, B. (2016). Organizational stress management interventions: Is it the singer not the song? *Scandinavian Journal of Work, Environment & Health*, *42*(5), 355–358. https://doi.org/10.5271/sjweh.3578

Kristensen, T. (2005). Intervention studies in occupational epidemiology. *Occupational and Environmental Medicine*, *62*(3), 205–210. https://doi.org/10.1136/oem.2004.016097
Kristensen, T. S., Borritz, M., Villadsen, E., & Christensen, K. B. (2005). The Copenhagen Burnout Inventory: A new tool for the assessment of burnout. *Work and Stress*, *19*(3), 192–207. https://doi.org/10.1080/02678370500297720
Lee, H. H., Emerson, J. A., & Williams, D. M. (2016). The exercise-affect-adherence pathway: An evolutionary perspective. *Frontiers in Psychology*, *7*, 1285. https://doi.org/10.3389/fpsyg.2016.01285
Leiter, M. P., & Maslach, C. (2016). Latent burnout profiles: A new approach to understanding the burnout experience. *Burnout Research*, *3*(4), 89–100. https://doi.org/10.1016/j.burn.2016.09.001
Loewenstein, G. (1999). Because it is there: The challenge of mountaineering ... for Utility Theory. *Kyklos*, *52*(3), 315–343. https://doi.org/10.1111/j.1467-6435.1999.tb00221.x
Longman dictionary of contempory English. (1987). *Harlow, Essex*. Longman.
Loose, B. D., Christiansen, A. M., Smolczyk, J. E., Roberts, K. L., Buziszewska, A., Hollatz, C. G., & Norman, J. F. (2012). Consistency of the counting talk test for exercise prescription. *Journal of Strength and Conditioning Research*, *26*(6), 1701–1707. https://doi.org/10.1519/JSC.0b013e318234e84c
Lyubomirsky, S., Dickerhoof, R., Boehm, J. K., & Sheldon, K. M. (2011). Becoming happier takes both a will and a proper way: An experimental longitudinal intervention to boost well-being. *Emotion*, *11*(2), 391–402. https://doi.org/10.1037/a0022575
MacKinnon, D. P. (2011). Integrating mediators and moderators in research design. *Research on Social Work Practice, 21*(6), 675–681. https://doi.org/10.1177/1049731511414148
Maslach, C., & Leiter, M. P. (2016). Understanding the burnout experience: Recent research and its implications for psychiatry. *World Psychiatry*, *15*(2), 103–111. https://doi.org/10.1002/wps.20311
Meier, L. L., Cho, E., & Dumani, S. (2016). The effect of positive work reflection during leisure time on affective well-being: Results from three diary studies. *Journal of Organizational Behavior*, *37*(2), 255–278. https://doi.org/10.1002/job.2039
Meijman, T. F., & Mulder, G. (1998). Psychological aspects of workload. In P. J. D. Drenth & H. Thierry (Eds.), *Handbook of work and organizational psychology: Work psychology* (pp. 5–33). Psychology Press.
Miller, J. W., Stromeyer, W. R., & Schwieterman, M. A. (2013). Extensions of the Johnson-Neyman Technique to linear models with curvilinear effects: Derivations and analytical tools. *Multivariate Behavioral Research*, *48*(2), 267–300. https://doi.org/10.1080/00273171.2013.763567
Moore, G. F., Audrey, S., Barker, M., Bond, L., Bonell, C., Hardeman, W., Moore, L., O'Cathain, A., Tinati, T., Wight, D., & Baird, J. (2015). Process evaluations of complex interventions: Medical Research Council guidance. *BMJ*, *350*(mar19 6), h1258. https://doi.org/10.1136/bmj.h1258
Morgan, W. P. (1985). Affective beneficence of vigorous physical activity. *Medicine and Science in Sport and Exercise*, *17*(1), 94–100. https://doi.org/10.1249/00005768-198502000-00015
Muthén, L. K., & Muthén, B. O. (2010). *Mplus User's Guide* (6th ed.). Muthén & Muthén.
Naczenski, L. M., de Vries, J. D., Van Hooff, M. L. M., & Kompier, M. A. J. (2017). Systematic review of the association between physical activity and burnout. *Journal of Occupational Health*, *59*(6), 477–494. https://doi.org/10.1539/joh.17-0050-RA
Nelson, D. L., & Mathiowetz, V. (2004). Randomized controlled trials to investigate occupational therapy research questions. *The American Journal of Occupational Therapy*, *58*(1), 24–34. https://doi.org/10.5014/ajot.58.1.24
Neupert, S. D., Lachman, M. E., & Whitbourne, S. B. (2009). Exercise self-efficacy and control beliefs: Effects on exercise behavior after an exercise intervention for older adults. *Journal of Aging and Physical Activity*, *17*(1), 1–16. https://doi.org/10.1123/japa.17.1.1
Nicolson, P. J. A., Bennell, K. L., Dobson, F. L., Van Ginckel, A., Holden, M. A., & Hinman, R. S. (2017). *British Journal of Sports Medicine*, *51*(10), 791–799. https://doi.org//10.1136/bjsports-2016-096458
Nielsen, K., Randall, R., & Albertsen, K. (2007). Participants' appraisal of process issues and the effects of stress management interventions. *Journal of Organizational Behavior*, *28*(6), 793–810. https://doi.org/10.1002/job.450
O'Connor, P. J., & Puetz, T. W. (2005). Chronic physical activity and feelings of energy and fatigue. *Medicine and Science in Sports and Exercise*, *37*(2), 299–305. https://doi.org/10.1249/01.MSS.0000152802.89770.CF
Ochentel, O., Humphrey, C., & Pfeifer, K. (2018). Efficacy of exercise therapy in persons with burnout. A systematic review and meta-analysis. *Journal of Sports Science & Medicine*, *17*(3), 475–484. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6090391/
Oerlemans, W. G. M., Bakker, A. B., & Demerouti, E. (2014). How feeling happy during off-job activities helps successful recovery from work: A day reconstruction study. *Work and Stress*, *28*(2), 198–216. https://doi.org/10.1080/02678373.2014.901993
Oosterholt, B. G., Maes, J. H. R., Van der Linden, D., Verbraak, M. J. P. M., & Kompier, M. A. J. (2016). Getting better, but not well: A 1.5 year follow-up of cognitive performance and cortisol levels in clinical and non-clinical burnout. *Biological Psychology*, *117*, 89–99. https://doi.org/10.1016/j.biopsycho.2016.02.009
Persinger, R., Foster, C., Gibson, M., Fater, D. C., & Porcari, J. P. (2004). Consistency of the talk test for exercise prescription. *Medicine and Science in Sports and Exercise*, *36*(9), 1632–1626. https://pubmed.ncbi.nlm.nih.gov/15354048/
Posner, J., Russell, J. A., & Peterson, B. S. (2005). The circumplex model of affect: An integrative approach to affective neuroscience, cognitive development, and psychopathology. *Development and Psychopathology*, *17*(3), 715–734. https://doi.org/10.1017/S0954579405050340
Preston, J., & Wegner, D. M. (2009). Elbow grease: The experience of effort in action. In E. Morsella, J. A. Bargh, & P. M. Gollwitzer (Eds.), *Oxford handbook of human action* (pp. 17–43). Oxford University Press.
Raedeke, T. D. (2007). The relationship between enjoyment and affective responses to exercise. *Journal of Applied Sport Psychology*, *19*(1), 105–115. https://doi.org/10.1080/10413200601113638
Saunders, R. P., Evans, M. H., & Joshi, P. (2005). Developing a process evaluation plan for assessing health promotion program implementation: A how-to-guide. *Health Promotion Practice*, *6*(2), 134–147. https://doi.org/10.1177/1524839904273387
Schaufeli, W. B., & Van Dierendonck, D. (2000). Utrechtse Burnout Schaal (UBOS). [The Utrecht Burout Scale (UBOS)]. *De Psycholoog*, *36*, 9–12.
Sonnentag, S., & Bayer, U. (2005). Switching off mentally: Predictors and consequences of psychological detachment from work during off-job time. *Journal of Occupational Health Psychology*, *10*(4), 393–414. https://doi.org/10.1037/1076-8998.10.4.393
Sonnentag, S., & Fritz, C. (2007). The recovery experience questionnaire: Development and validation of a measure for assessing recuperation and unwinding from work. *Journal of Occupational Health Psychology*, *12*(3), 204–221. https://doi.org/10.1037/1076-8998.12.3.204
Sonnentag, S., & Fritz, C. (2015). Recovery from job stress: The stressor-detachment model as an integrative framework. *Journal of Organizational Behavior*, *36*(S1), S72–S103. https://doi.org/10.1002/job.1924
Steckler, A. B., & Linnan, L. (2002). *Process evaluation for public health interventions and research*. Jossey Bass.
Stull, D. E., Leidy, N. K., Parasuraman, B., & Chassany, O. (2009). Optimal recall periods for patient-reported outcomes: Challenges and potential solutions. *Current Medical Research and Opinion*, *25*(4), 929–942. https://doi.org/10.1185/03007990902774765
Toppinen-Tanner, S., Ahola, K., Koskinen, A., & Väänänen, A. (2009). Burnout predicts hospitalization for mental and cardiovascular disorders: 10-year prospective results from industrial sector. *Stress and Health: Journal of the International Society for the Investigation of Stress*, *25*(4), 287–296. https://doi.org/10.1002/smi.1282
Toppinen-Tanner, S., Ojajärvi, A., Väänänen, A., Kalimo, R., & Jäppinen, P. (2005). Burnout as a predictor of medically certified sick-leave absences and their diagnosed causes. *Behavioral Medicine*, *31*(1), 18–27. https://doi.org/10.3200/BMED.31.1.18-32
Van Hooff, M. L., Geurts, S. A. E., Kompier, M. A. J., & Taris, T. W. (2007). "How fatigued do you currently feel?" Convergent and discriminant validity of a single-item fatigue measure. *Journal of Occupational Health*, *49*(3), 224–234. https://doi.org/10.1539/joh.49.224
Van Veldhoven, M., & Meijman, T. (1994). *Het meten van psychosociale arbeidsbelasting met een vragenlijst: De vragenlijst beleving en beoordeling van de arbeid (VBBA)* [The measurement of psychosocial workload with the help of a questionnaire: The questionnaire of

experience and evaluation of work]. Nederlands Instituut voor Arbeidsomstandigheden.

Voils, C. I., King, H. A., Maciejewski, M. L., Allen, K. A., Yancy, W. S., & Shaffer, J. A. (2014). Approaches for informing optimal dose of behavioral interventions. *Annals of Behavioral Medicine*, *48*(3), 392–401. https://doi.org/10.1007/s12160-014-9618-7

Wankel, L. M. (1993). The importance of enjoyment to adherence and psychological benefits from physical activity. *International Journal of Sport Psychology*, *24*(2), 151–169.

Wendsche, J., & Lohman-Haislah, A. (2017). A meta-analysis on antecedents and outcomes of detachment from work. *Frontiers in Psychology*, *7*, 2072. https://doi.org/10.3389/fpsyg.2016.02072

Wiese, C. W., Kuykendall, L., & Tay, L. (2018). Get active? A meta-analysis of leisure-time physical activity and subjective well-being. *The Journal of Positive Psychology*, *13*(1), 57–66. https://doi.org/10.1080/17439760.2017.1374436

Wininger, S. R., & Gieske, D. (2010). Measure of attentional focus: Cognitive interviews and a field study. *Athletic Insight*, *2*(2), 125–146.