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More Than a Simple Pastime? The Potential of Physical Activity to Moderate the Relationship Between Occupational Stress and Burnout Symptoms

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Researchers have emphasized the role of physical activity in accelerating recovery from stress. Therefore, the primary goal of the present study was to examine whether regular physical activity moderates the relationship between occupational stress and burnout symptoms in Swiss workers. 309 employees took part in the cross-sectional study. Occupational stress was operationalized with the job demands–control model and the effort–reward imbalance model. Physical activity was assessed via the International Physical Activity Questionnaire; burnout symptoms were measured with the Shirom–Melamed Burnout Measure. Higher occupational stress was positively associated with burnout symptoms, whereas higher physical activity levels were negatively associated with occupational stress and burnout symptoms. Participants with higher physical activity levels reported fewer burnout symptoms when they perceived high stress levels, independent of whether occupational stress was assessed via the job demands–control or effort–reward imbalance model. Although job constraints are seldom modifiable, we claim that regular leisure-time physical activity is more than a simple pastime and can make an important contribution to a thriving workforce that feels better able to cope with occupational stress.

Keywords: burnout, control, demands, effort, reward

Occupational stress is a common phenomenon in today's workforce (American Psychological Association, 2017), and many workers report that they experience more stress than they would like (Elfering, Brunner, Igic, Keller, & Weber, 2017). Following the European Working Conditions Survey carried out in 2015, more than one third of European workers reported that they almost always have to work under time pressure. In addition, a similarly large percentage indicated that they are not allowed to show their real emotions at work and that they are exposed to a multitude of social stressors at their workplace (Eurofound, 2016). These findings are critical from both an economic and a public health perspective. High levels of occupational stress were found to be associated with lower productivity, more absenteeism, and increased health-care costs among employees (EU-OSHA, 2014). Moreover, the costs attributed to work-related stress (due to lost productivity, treatment costs, and costs for self-medication) were estimated at 1.4% of the gross domestic product in Switzerland (Ramaciotti & Perriard, 2001), numbers which have been confirmed in Germany (Bodeker & Friedrichs, 2011) and other European countries (EU-OSHA, 2014).

Models of Occupational Stress and Health Risks Associated With Occupational Stress

Given that occupational stress can result from a multitude of different stressors (Schabracq, Cooper, Travers, & Van Maanen, 2002), some scholars have developed models that capture the main features of stress that people experience at work (Dewe, O'Driscoll, & Cooper, 2012). For instance, Karasek and Theorell (1990) argued in their job demands–control (JDC) model that (both physical and psychological) job demands or pressures, if excessive, can produce high stress perceptions among workers. However, these demands are not the most important contributor to stressful experiences. Rather, these experiences depend on whether employees have control over the demands they are facing. In other words, these two constructs interact in the sense that job control has the potential to buffer the negative consequences of high job demands. Whereas the JDC model places a focus on two specific task characteristics, the effort–reward imbalance (ERI) model (Siegrist, 1996) pays special attention to work-related exchange processes associated with effort and reward. Thus, occupational stress is mainly seen as a violation of commutative justice. That is,

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employees perceive stress if their perceived job-related efforts exceed their obtained or anticipated rewards at work (Siegrist & Marmot, 2008).

Referring to these stress theories, research over the past decades provides compelling evidence that occupational stress constitutes a major risk factor for physical diseases, as well as psychological disorders (Uchino, Smith, Holt-Lunstad, Campo, & Reblin, 2007). For instance, previous studies have shown that people with high occupational stress levels have a higher risk of hypertension (Rosenthal & Alter, 2012), overweight or obesity (Kivimäki et al., 2006), metabolic syndrome (Chandola, Brunner, & Marmot, 2006), cardiovascular diseases such as coronary heart disease or stroke (Tsutsumi, Kayaba, Kario, & Ishikawa, 2009), and, ultimately, premature cardiovascular mortality (Tobiasz-Adamczyk, Brzyski, Florek, & Brzyska, 2013). In addition, researchers showed that occupational stress significantly increases the risk of employees developing major depressive disorders (Hoven, Wahrendorf, & Siegrist, 2015; Siegrist, 2008) or burnout symptoms (Hämmig, Brauchli, & Bauer, 2012; Söderfeldt, Söderfeldt, Ohlson, Theorell, & Jones, 2000).

Resilience Against Occupational Stress: The Role of Recovery and Physical Activity

Research on resilience has shown that both vulnerability and protective factors might moderate the detrimental consequences of high occupational stress on workers' health (Luthar, Sawyer, & Brown, 2006). According to Luthar and Cicchetti (2000), resilience can be defined as "a dynamic process wherein individuals display positive adaptation despite experiences of significant adversity or trauma" (p. 858). In line with this notion, using a person-centered approach, Gerber, Jonsdottir, Lindwall, and Ahlborg (2014) showed that among Swedish employees with the highest occupational stress levels, around two thirds showed a resilient pattern (e.g., they did not display strong symptoms of depression, anxiety, and burnout), whereas one third showed symptoms of mental ill-health.

Against this background, some researchers have highlighted the importance of efficient recovery from occupational stress during off-job time as a resilience factor (Sonnentag & Fritz, 2015; Toker & Melamed, 2017). For instance, Sonnentag, Venz, and Casper (2017) found that faster recovery from work-related stress was associated with improved psychological well-being. Researchers have also argued that positive leisure-time experiences and activities can facilitate the replenishment of resources if employees are exposed to high occupational demands. Sonnentag and Jelden (2009) revealed in a daily survey over 5 working days that employees perceive exercise and sport activities as particularly suitable for recovering from job-related stress. However, they also observed that participants tended to engage in exercise and sport activities less frequently when they experienced high stress levels during the day.

Following Sonnentag and Fritz (2007), one can argue that leisure-time physical activity fosters recovery through four distinct experiences, including control (e.g., opportunity to make one's own decisions during leisure-time), mastery (e.g., feeling of success and achievement in challenging situations), psychological detachment (e.g., opportunity to have "time-out" and to leave work behind), and relaxation (e.g., activities that contribute to experiences of low sympathetic activation). Previous research has supported the idea that these experiences accelerate recovery processes (Ragsdale & Beehr, 2016; Sonnentag & Zijlstra, 2006; ten Brummelhuis & Bakker, 2012). For instance, Feuerhahn, Sonnentag, and Woll (2014) showed that exercise activities after work were associated with more positive affect in the evening, which was mainly attributable to psychological detachment, a sense of belonging, and perceived physical self-efficacy.

Does Physical Activity Moderate the Relationship Between Occupational Stress and Employees' Health?

Nevertheless, the question of whether leisure-time physical activity has the potential to moderate the relationship between occupational stress and employees' health has rarely been examined so far. This lack of research is surprising, given that a large body of evidence suggests that regular physical activity can offset the negative consequences of general high life stress (Gerber & Pühse, 2009). Iwasaki, Mannell, Smale, and Butcher (2005) suggested that the lack of attention paid to leisure-time physical activity as a potential buffer of occupational stress "is likely due to the tendency to see leisure behavior as trivial or insignificant relative to more serious behaviors" (p. 80).

Nevertheless, among some recently published studies with working populations, Holtermann et al. (2010) showed, in a 30-year follow-up study, that if exposed to high physical work demands, male participants with low or medium fitness levels had a significantly higher risk of cardiovascular and all-cause mortality than those with high fitness levels. Further, Gerber and colleagues (Gerber, Börjesson, Ljung, Lindwall, & Jonsdottir, 2016; Gerber, Lindwall, Lindegård, Börjesson, & Jonsdottir, 2013) found that among employees with high perceived stress, those with low cardiorespiratory fitness reported more symptoms of burnout and depression and less favorable cardiometabolic risk profiles. Currently, however, very few studies have specifically assessed occupational stress (Gerber, Kellmann, Hartmann, & Pühse, 2010; Siu, Cooper, & Leung, 2000), and we are only aware of two studies in which the stress-buffering hypothesis of physical activity was tested on the basis of an established occupational stress theory such as the JDC or ERI model or the self-control demands model (Schmidt & Diestel, 2015; Schmidt & Neubach, 2007). The lack of emphasis on work-related stress is surprising, given the high prevalence of occupational stress and the associated costs, as outlined in the first section of this article.

Using a latent profile approach, Gerber, Brand, et al. (2014) found that highly stressed employees (with high JDC and ERI scores) with a resilient profile reported significantly more leisure-time physical activity than equally stressed peers who showed more marked symptoms of mental ill-health. However, that investigation focused on a relatively narrow sample of Swedish health-care workers and social insurance officers. In a sample of 819 German employees working in the financial sector, Schmidt, Beck, Rivkin, and Diestel (2016) examined whether objectively assessed physical fitness moderates the relationship between self-control demands (which were understood as a source of stress) and several self-reported health outcomes (including burnout, ego-depletion, and need for recovery). Their results showed that among employees with high fitness levels, the positive association between self-control demands on mental health issues was less pronounced, compared with colleagues with low fitness levels. Schmidt et al. (2016) therefore concluded that the moderating effect of physical fitness suggests the need for preventive measures to promote fitness and health.

The present study expands on the work of Schmidt et al. (2016) in the sense that our investigation focuses on physical activity. Although physical activity and cardiorespiratory fitness are related, they are distinct concepts (Lee et al., 2011). Thus, although fitness contains a genetic component, physical activity is a behavioral variable (Bouchard, Malina, & Perusse, 1997). Despite this genetic influence, individuals generally need to engage in more moderate-to-vigorous physical activity (MVPA) if they intend to improve their fitness levels. In addition, our study focuses on two different occupational stress models and includes a broader sample of employees from different occupational sectors. Thus, the present study will show whether previous conclusions drawn by Schmidt et al. (2016) can be generalized to the JDC and ERI models, to a broader sample of employees, and to physical activity as a behavioral variable. In the present study, we will also shed light on the potential joint effect of physical activity and job-related resources (reward, control) on the relationship between occupational stress (effort, demands) and burnout. Some scholars (Meier, Semmer, Elfering, & Jacobshagen, 2008) have argued that job control and reward may be resources that can attenuate the positive relationship between occupational stress and burnout. Interestingly, such joint effects have been described previously between physical activity and other personal (hardiness) and social resources (social support; Kobasa, Maddi, & Puccetti, 1982; Kobasa, Maddi, Puccetti, & Zola, 1985). Thus, the present study will shed new light on the joint effects of leisure-based resources (such as physical activity) and job-related resources (such job-related reward and job demands).

Goals and Hypotheses

Given this background, the main goal of the present study was to examine whether regular leisure-time physical activity moderates the relationship between occupational stress and participants' mental health in a broader sample of Swiss workers. Whereas we use the JDC and ERI models to operationalize stress, mental health is assessed via self-reported burnout symptoms. Based on the research presented earlier, two hypotheses were tested:

> *Hypothesis 1*: Physical activity will moderate the positive relationship between effort–reward imbalance and burnout: The relationship will be attenuated as a function of increasing physical activity (*Hypothesis 1a*). Physical activity will also moderate the positive relationship between job demands–control imbalance and burnout: Again, the relationship will be attenuated as a function of increasing physical activity (*Hypothesis 1b*).

> *Hypothesis 2*: Physical activity and job-related reward will jointly moderate the positive relationship between effort at work and burnout: In case of higher physical activity levels and job-related reward, the positive relationship will be lowest, whereas when either physical activity or job-related reward (or both) is low, the positive relationship will be stronger (*Hypothesis 2a*). Similarly, physical activity and job control will jointly moderate the positive relationship between job demands and burnout: In case of higher physical activity levels and job control, the positive relationship will be lowest, whereas when either physical activity or job control (or both) is low, the positive relationship will be stronger (*Hypothesis 2b*).

Method

Participants and Procedures

The sample consisted of adult workers who were recruited via exercise and health science students ($N = 87$) of the University of Basel, who took part in an introductory course in research methodology. We asked every student to provide the names and e-mail addresses of six to 12 people (no relatives; between 18 and 67 years old; at least 50% employment) who would be willing to take part in an online survey. In total, the students suggested 756 potential participants (407 men, 349 women; on average 8.7 suggestions per student). We obtained written informed consent from all participants, and the local ethics committee approved the study (Ethical Commission of Northwestern and Central Switzerland, project number: 240/12). After two reminders, 311 adult workers completed the online survey (41.1% response rate). Full data were available from all responding participants. Using the Mahalanobis distance criterion, we identified two participants as multivariate outliers based on their occupational stress, physical activity, and burnout scores. We excluded these participants from all further data analyses. Therefore, the final sample size consisted of 309 participants (161 men, 148 women; $M_{age} = 42.66$ years, $SD = 14.18$). A detailed description of the study population including information about all assessed social and demographic background variables is presented in Table 1. All participants indicated that they had an employment rate of $\geq$50%, and 60.1% were working full time.

Measures

Assessment of occupational stress.

Job demand and control. We used the 11-item Job Content Questionnaire to assess an imbalance between demands and control at work (Karasek et al., 1998). To assess job-related demands, participants answered five items on a 4-point Likert scale from 1 (*never*) to 4 (*often*). For instance, we asked participants whether their job requires them to work very fast or hard or whether they have to accomplish large amounts of work. A sample item is "My job requires me to work very hard." In addition, participants completed six items to assess their perceived level of control at work. A sample item is "I have freedom to make decisions about my job." For each domain, we calculated a subscale score by summing up the values of each item, with higher scores being indicative of higher demands or control at work. We used the following formula to obtain the JDC ratio: job demand/(job control $\times$ 0.8333). A JDC ratio of $>$1.0 is associated with less favorable health outcomes (Karasek et al., 1998). Evidence for the validity and reliability of this instrument has been reported previously (Van der Doef & Maes, 1999). However, it should be noted that other indices have been calculated in previous research such as the logarithm of the ratio and subtraction of the demand and control scores (de Mello Alves, Braga, Faerstein, Lopes, & Junger, 2015). To facilitate comparison with other studies, we have therefore decided to provide the results for all three indices. We

Table 1
Description of Study Population, Descriptive Statistics, and Internal Consistency of Multiple-Item Scales

Metric variables	*M*	*SD*	Range	α (items)
Age (in years)	42.66	14.18	19 to 67	—
Employment (past 3 months; % of full employment)	88.22	7.72	50 to 100	—
Years on job (in years)	21.64	13.96	1 to 47	—
Height (in cm)	173.47	9.09	152 to 195	—
Weight (in kg)	72.13	13.84	42 to 115	—
Body mass index (in kg/m^2)	23.85	3.58	17.30 to 37.20	—
Effort	11.40	3.38	5 to 21	.76 (5)
Reward	49.47	5.05	30 to 55	.75 (11)
Effort–reward imbalance ratio	0.52	0.18	.20 to 1.38	—
Logarithm of effort–reward imbalance ratio	−0.31	0.16	−.70 to .20	—
Effort–reward subtraction	−11.03	4.64	−20 to 5.46	—
Job demands	11.97	2.75	5 to 19	.71 (5)
Job control	18.55	2.79	6 to 23	.67 (6)
Job demands–control ratio	0.79	0.20	.37 to 1.44	—
Logarithm of job demands–control ratio	−0.11	0.11	−.44 to .16	—
Job demands–control subtraction	−3.52	3.29	−12.28 to 5.43	—
Moderate-to-vigorous physical activity (min/week)	240.25	199.73	0 to 980	—
Burnout symptoms	2.41	1.00	1.00 to 6.21	.95 (14)
Categorical variables	***n***	**%**		
Sex				
Women	148	48		
Men	161	52		
Marital status				
Single	74	24		
In a relationship	235	76		
Children living at home				
Yes	125	41		
No	184	59		
Responsibility as a caregiver				
Yes	6	2		
No	303	98		
Nocturnal shift work				
Yes	26	8		
No	283	92		
Highest completed education				
Compulsory schooling	1	0		
Vocational education and training	92	30		
Commercial education or intermediate diploma school	40	13		
High school	28	9		
University or university of applied sciences	148	48		
Smoking				
Yes	45	15		
No	264	85		
Use of psychotropic medication				
Yes	4	1		
No	305	99		

Note. α = Cronbach's α.

calculated the subtraction score with the following formula: job demand − (job control × 0.8333). Higher subtraction scores reflect higher stress levels.

Effort–reward imbalance. We used the 16 items from the ERI questionnaire to assess job-related effort and reward (Siegrist, Wege, Pühlhofer, & Wahrendorf, 2009). We assessed effort at work with five items, reward with 11 items, all of which were anchored on a 5-point Likert scale. Participants completed items in a two-step process. Participants first indicated whether they agreed or disagreed with the item content, describing a typical experience of their work situation. Items were scored 1 if participants did not experience a specific type of situation. If they did experience this type of situation, participants indicated how stressful each experience usually is for them, with response options ranging from 2 (*not distressing*) to 5 (*very distressing*). Sample items for the effort scale are "I have a lot of responsibility in my job" or "I have many interruptions and disturbances in my job." Sample items for the reward scale are "I receive the respect I deserve from my superior or a similarly relevant person." or "Considering all my efforts and achievements, my job promotion prospects are adequate." Items were summed to obtain subscale scores for the effort and reward domains, with higher scores reflecting higher effort or reward.

Because of the unequal number of items, we used the following formula to generate the ERI ratio: effort/(reward × 0.4545). Evidence for the validity and reliability of this instrument has been presented previously (Siegrist et al., 2009). According to Siegrist et al. (2004), a value close to 0 is reflective of favorable conditions (high reward and low effort), whereas values exceeding 1.0 point toward high effort together with low (received or expected) rewards. Whereas Siegrist et al. (2004) argued that such a ratio best captures the theoretical assumption of an imbalance between effort and reward, we also calculated the logarithm of the ratio as well as a subtraction score. For the subtraction score, we used the following formula: effort − (reward × 0.4545). Accordingly, higher subtraction scores reflect higher stress levels.

Assessment of physical activity. To assess MVPA, participants filled in a written version of the German short form of the International Physical Activity Questionnaire (IPAQ-SF; Craig et al., 2003). The IPAQ-SF assesses time spent in moderate physical activity (e.g., bicycling at a regular pace, low-intensity sports such as doubles tennis) and vigorous physical activity (VPA; e.g., aerobics, fast bicycling) during leisure time, over the past week, using a frequency-by-duration format. Although the IPAQ focuses on leisure-time physical activity, participants were instructed to also include active commuting in their answers. Thus, participants first reported the number of days per week they engaged in these activities (from 0 to 7 days) and then indicated the average duration (in minutes) for the days they engaged in these activities. Multiplication of frequency and duration scores resulted in an estimate of weekly hours invested in moderate physical activity and VPA. Summing up these two scores resulted in a total MVPA index. Evidence for the validity of the IPAQ has been shown in adult samples (Craig et al., 2003; Mäder, Martin, Schutz, & Marti, 2006).

Assessment of burnout symptoms. To assess burnout symptoms, the participants filled in the 14-item Shirom–Melamed Burnout Measure (SMBM; Melamed et al., 1999). The SMBM consists of three subscales labeled Physical Fatigue (e.g., "I feel physically exhausted."), Emotional Exhaustion (e.g., "I feel fed-up."), and Cognitive Weariness. Responses on the SMBM are given on a 7-point scale, ranging from 1 (*almost never*) to 7 (*almost always*), with higher scores reflecting a higher degree of self-rated burnout. We calculated a mean score across all 14 items to obtain an overall burnout index. Prior research suggests that the SMBM has good psychometric properties (Sassi & Neveu, 2010) and that scores of ≥4.40 can be considered as clinically relevant (Lundgren-Nilsson, Jonsdottir, Pallant, & Ahlborg, 2012).

Statistical Analyses

First, we calculated descriptive statistics (*M, SD*, range) to describe the main study variables. Second, we calculated a series of analyses of variance and Pearson product–moment correlations to examine how potential confounders (see Table 1 for an overview) are associated with participants' occupational stress, physical activity, and burnout levels. Third, we run Pearson product–moment correlations to test bivariate relationships between the predictor (occupational stress), moderator (physical activity), and outcome variables (burnout symptoms). Next, we computed a series of hierarchical (four-stage) regression analyses to find out the extent to which occupational stress and physical activity interact in the prediction of burnout symptoms. We performed six separate analyses for the JDC and ERI models (and the different indices). We first (Step 1) controlled for all demographic and social background variables (if they were found to be bivariately associated with participants' burnout symptoms), and then entered occupational stress (Step 2), physical activity (Step 3), and the interaction between occupational stress and physical activity in the regression equation (Step 4). To examine how physical activity and control/reward interact in the moderation of the relationship between demands/effort and burnout symptoms, we calculated two separate hierarchical (five-stage) regression analyses. We first controlled for sociodemographic background variables (Step 1), and then introduced demands/effort (Step 2), physical activity and control/demand (Step 3), the two-way interactions between demands and control (or effort and reward) and demands and physical activity (or effort and physical activity; Step 4), and finally the three-way interactions between demands, control, and physical activity (or effort, rewards, and physical activity) in the regression equation. We centered occupational stress, physical activity, and burnout symptoms before we calculated the (two-way and three-way) interaction terms. In the Results section, we display the following statistical coefficients: (a) the multiple correlation coefficient squared R^2 for the entire model after the final step, (b) the stepwise changes in R^2, and (c) the standardized regression weights (β) for each predictor variable (for the final model). To facilitate interpretation of the direction of the relationships, we plotted significant interaction effects. Moreover, we tested simple slope analyses in case of significant interactions. In simple slope analyses, we defined low and high physical activity levels as 1 *SD* below versus above the mean. Across all analyses, we set the α level at $p < .05$. We performed all statistical analyses with SPSS (Version 24, IBM Corporation, Armonk, NY) for Apple Mac.

Results

Descriptive Statistics

Descriptive statistics for all study variables are presented in Table 1. In the present sample, 48 (15.5%) participants had a JDC ratio of ≥1.0, whereas three participants (0.9%) reported an ERI ratio of ≥1.0. In total, 98 participants (31.7%) did not meet physical activity recommendations (www.cdc.gov/physicalactivity/basics/index.htm), because they did not engage in sufficient amounts of VPA (≥75 min/week) and/or MVPA (≥150 min/week). Finally, 17 participants (5.5%) reported clinically relevant burnout symptoms (scores on the SMBM = ≥4.40).

Bivariate Associations Between Occupational Stress, Physical Activity, and Burnout

Table 2 shows that both types of occupational stress (ERI and JDC ratios, logarithm of the ratios, subtraction scores) were positively correlated with each other. Moreover, higher occupational stress levels were moderately and positively associated with participants' burnout symptoms. Positive correlations were also found between effort/demands and burnout symptoms, whereas a negative association occurred between reward/control and burnout symptoms. Finally, weak-to-moderate (negative) correlations were found between participants' leisure-time physical activity, their perceived occupational stress, and burnout symptoms, indicating

Table 2
Summary of Intercorrelations for Scores on the Main Study Variables

Main study variables	1	2	3	4	5	6	7	8	9	10	11
1. Effort	—										
2. Reward	−.27**	—									
3. Effort–reward imbalance ratio	.90**	−.62**	—								
4. Logarithm of effort–reward imbalance ratio	.94**	−.54**	.97**	—							
5. Effort–reward subtraction	.87**	−.71**	.98**	.96**	—						
6. Job demands	.65**	−.26**	.63**	.64**	.61**	—					
7. Job control	.24**	.19*	.16*	.16*	.07	.18*	—				
8. Job demands–control ratio	.42**	.35**	.49**	.47**	.49**	.76**	−.49**	—			
9. Logarithm of job demands–control ratio	.43**	−.34**	.47**	.47**	.49**	.78**	−.46**	.98**	—		
10. Job demands–control subtraction	.38**	−.35**	.44**	.43**	.46**	.71**	−.57**	.98**	.98**	—	
11. Moderate-to-vigorous physical activity (min/week)	−.18**	.17**	−.20**	−.20*	−.22**	−.06	.07	−.12*	−.12*	−.12*	—
12. Burnout symptoms	.34**	−.42**	.42**	.40**	.46**	.27**	−.24**	.38**	.39**	.40**	−.34**

* $p < .01$. ** $p < .001$.

that more physical activity is associated with lower occupational stress levels and burnout symptoms. No significant correlations were found between physical activity and job demands and job control.

Physical Activity as a Moderator of the Stress–Burnout Relationship

The results of the hierarchical regression analyses are summarized in Table 3 (two-way interaction models) and Table 4 (three-way interaction models). In all models, age, relationship status, and the use of psychotropic medication significantly explained burnout symptoms. As reported previously, fewer burnout symptoms were reported if participants were older, were in a relationship, or did not use psychotropic medication. Beyond these social and demographic influences, as shown in Table 3, the JDC and ERI ratios explained significant variance in participants' burnout symptoms. Further, physical activity was able to explain additional variance in the outcome variable. Finally, two significant interaction effects between occupational stress and physical activity were observed in the fourth step. As illustrated in Figure 1, plotting the interactions revealed that if participants experienced low occupational stress, the relationship between physical activity and burnout was weak, whereas if participants experienced higher occupational stress levels, those with lower leisure-time physical activity had significantly higher burnout scores than their more active counterparts. The two-way interaction between stress and physical activity occurred independently of whether the JDC or the ERI model was used to operationalize occupational stress.

Simple slope analyses further showed that the slope was significant among participants with low (JDC ratio: $\beta = .40$, $p < .001$; ERI ratio: $\beta = .52$, $p < .001$) and high (JDC ratio: $\beta = .16$, $p < .05$; ERI ratio: $\beta = .19$, $p < .01$) physical activity levels. In other words, increased stress was associated with higher burnout symptoms in both groups. However, the association was stronger among participants with low physical activity levels.

As shown in Table 3, a similar pattern of results occurred if the alternative occupational stress measures (logarithm of the JDC/ERI ratio, subtraction scores) were used. Again, the interaction term was significant across all analyses and pointed in the same direction. For the logarithmic scores, the simple slope analyses confirmed that an increasing slope existed both in participants with low (JDC ratio: $\beta = .40$, $p < .001$; ERI ratio: $\beta = .51$, $p < .001$) and high (JDC ratio: $\beta = .17$, $p < .05$; ERI ratio: $\beta = .19$, $p < .01$) physical activity levels. A similar pattern was found for the subtraction scores, with slopes for participants with low physical activity being $\beta = .40$, $p < .001$ (JDC) and $\beta = .56$, $p < .001$ (ERI) and for counterparts with high physical activity levels being $\beta = .17$, $p < .05$ (JDC) and $\beta = .19$, $p < .01$ (ERI).

Physical Activity, Control, and Reward as Simultaneous Moderators of the Relationship Between Effort/Demands and Burnout

Table 4 shows that after controlling for social and demographic background (Step 1), in both models, effort and demands were significantly (and positively) associated with burnout symptoms (Step 2). By contrast, physical activity, reward, and control were all significantly (and negatively) associated with burnout symptoms (Step 3). In Step 4, only the interactions between effort and physical activity and demands and physical activity were significant. In the fifth step, no significant three-way interactions were identified. The interaction effects pointed in the same direction, as highlighted in Figure 1.

Simple slope analyses further showed that the slope was significant among participants with low physical activity, independent of whether demand or effort was used as the independent variable (demands: $\beta = .29$, $p < .001$; effort: $\beta = .46$, $p < .001$). Among participants with high physical activity levels, the slope was either nonsignificant (demands: $\beta = .14$, $p =$ ns) or considerably lower (effort: $\beta = .17$, $p < .05$).

Discussion

Theoretical Implications

The key finding of the present study is that among employees with high stress levels, those who engage in more leisure-time

Table 3
Hierarchical Multiple Regression Analyses (Two-Way Models) Predicting Burnout Symptoms With Occupational Stress and Physical Activity

	Effort–reward imbalance ratio		Logarithm of effort–reward imbalance ratio		Effort–reward subtraction	
Predictors	ΔR^2	β	ΔR^2	β	ΔR^2	β
Step 1	.104***		.104***		.104***	
Age		−.30***		−.30***		−.29***
Relationship status		−.10*		−.11*		−.10*
Children at home		−.02		−.03		−.03
Use of psychotropic medication		−.10*		−.10*		−.10*
Step 2	.201***		.173***		.216***	
Occupational stress		.36***		.35***		−.38
Step 3	.076***		.083***		.071***	
Physical activity		−.32***		−.32***		−.31***
Step 4	.021**		.022**		.026***	
Occupational Stress × Physical Activity		−.15***		−.15**		−.17***
Total R^2	.401***		.382***		.417***	

	Job demands–control imbalance ratio		Logarithm of job demands–control imbalance ratio		Job demands–control subtraction	
Predictors	ΔR^2	β	ΔR^2	β	ΔR^2	β
Step 1	.104***		.104***		.104***	
Age		−.21***		−.21***		−.21***
Relationship status		−.08***		−.08***		−.08***
Children at home		−.02		−.02		−.02
Use of psychotropic medication		−.13**		−.13**		−.13**
Step 2	.106***		.104***		.108***	
Occupational stress		.28***		.28***		.28***
Step 3	.097***		.098***		.095***	
Physical activity		−.32***		−.32***		−.31***
Step 4	.012*		.012*		.011*	
Occupational Stress × Physical Activity		−.11*		−.11*		−.11*
Total R^2	.318***		.318***		.317***	

Note. Regression weights are presented as they are after the final step. Based on analyses of variance and Pearson product–moment correlations, significant relationships with burnout were observed for the following social and demographic background variables: First, compared with participants living with a partner ($M = 2.31$, $SD = .95$), single respondents reported higher burnout scores ($M = 2.72$, $SD = 1.07$), $F(1, 307) = 10.19$, $p = .002$, $\eta^2 = .032$. Second, compared with participants with children ($M = 2.23$, $SD = .89$), those without children had higher burnout scores ($M = 2.53$, $SD = 1.04$), $F(1, 307) = 6.30$, $p = .011$, $\eta^2 = .021$. Third, participants using psychotropic medication reported higher burnout scores ($M = 3.77$, $SD = .71$) than participants not using psychotropic medication ($M = 2.40$, $SD = .99$), $F(1, 307) = 7.74$, $p = .006$, $\eta^2 = .025$. Finally, age, $r(307) = -.28$, $p < .001$, and years on job, $r(307) = -.27$, $p < .001$, were negatively correlated with self-reported burnout symptoms, highlighting that older and professionally more experienced participants reported lower burnout scores. As these two variables are confounded with each other, $r = .95$, $p < .001$, only age is used as a covariate in the hierarchical regression analyses (described in more details below). By contrast, the following social and demographic background variables were not associated with burnout: sex, $F(1, 307) = .42$, $p = .517$, education, $F(1, 307) = .49$, $p = .744$, employment, $F(1, 307) = 1.33$, $p = .250$, caregiving, $F(1, 307) = .85$, $p = .356$, nocturnal shift work, $F(1, 307) = .48$, $p = .487$, smoking, $F(1, 307) = .17$, $p = .680$, height, $r(307) = .062$, $p = .275$, weight, $r(307) = .00$, $p = .968$, and body mass index, $r(307) = -.05$, $p = .411$. Accordingly, they were not considered in the regression models.
* $p < .05$. ** $p < .01$. *** $p < .001$.

physical activity report lower burnout symptoms than their less active counterparts. This finding suggests that physical activity could be more than a simple pastime; it could also have the potential to help people to cope successfully with the stress experienced at work.

These findings are important for a number of reasons. First, burnout due to occupational stress is a common experience for many employees in Western societies (Norlund et al., 2010). However, it is noteworthy that in the present sample, the number of employees with clinically relevant burnout symptoms was lower (5.5%) compared with a sample of Swedish health-care workers (15.8%; Gerber, Jonsdottir, et al., 2014). Although speculative, we assume that the recruitment of participants via university students might have entailed a selection bias in the sense that students more often contacted healthy people and that healthy people were more willing to complete the online survey. Although we acknowledge that the nonrepresentative nature of our data may limit the generalizability of the findings, we also believe that detecting stress-buffering effects was more difficult in our sample due to limited variance in the health outcome. Second, burnout symptoms are relatively stable across time (Lindwall, Gerber, Jonsdottir, Börjesson, & Ahlborg, 2014) and in the long term negatively impact cognitive performance (Sandström, Rhodin, Lundberg, Olsson, & Nyberg, 2005). We therefore claim that preventive measures (e.g., improving recovery processes) are paramount to guard employees against negative consequences of burnout (Toppinen-Tanner, Ahola, Koskinen, & Väänänen, 2009). Finally, our findings emphasize the importance of physical activity promotion as part

Table 4
Hierarchical Multiple Regression Analyses (Three-Way Models) Predicting Burnout Symptoms With Occupational Stress and Physical Activity

	Effort–reward			Job demands–control	
Predictors	ΔR^2	β	Predictors	ΔR^2	β
Step 1	.104***		Step 1	.104***	
Age		−.28***	Age		−.22***
Relationship status		−.12*	Relationship status		−.08
Children at home		−.03	Children at home		−.02
Use of psychotropic medication		−.10	Use of psychotropic medication		−.12*
Step 2	.148***		Step 2	.062***	
Effort		.24***	Demands		.27***
Step 3	.140***		Step 3	.142***	
Physical activity		−.28***	Physical activity		−.30***
Reward		−.24***	Control		−.15**
Step 4	.016*		Step 4	.014*	
Effort × Physical Activity		−.14**	Demands × Physical Activity		−.10*
Effort × Reward		.03	Demands × Reward		.04
Step 5	.004		Step 5	.003	
Effort × Reward × Physical Activity		.07	Demands × Control × Physical Activity		−.07
Total R^2	.412***		Total R^2	.324***	

Note. Regression weights are presented as they are after the final step.
* $p < .05$. ** $p < .01$. *** $p < .001$.

of workplace health initiatives (Malik, Blake, & Suggs, 2014). Whereas regular physical activity contributes to increased cardiovascular fitness and improved cardiovascular health (Kaminsky et al., 2013), exposure to chronic occupational stress entails the risk of reduced physical activity levels (Fransson et al., 2012).

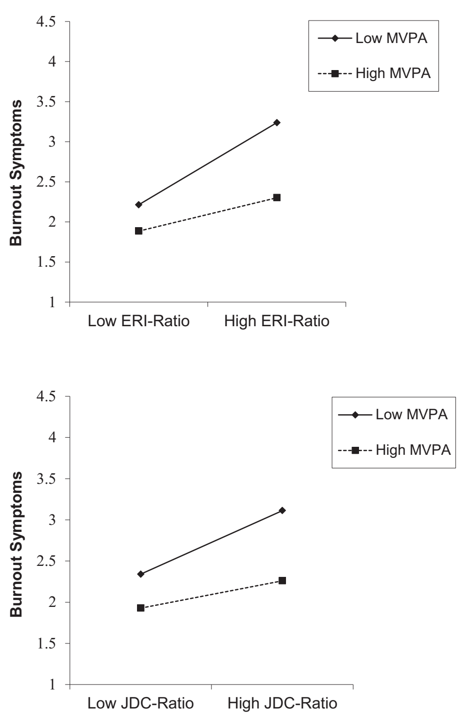

Figure 1. Two-way interaction between occupational stress and moderate-to-vigorous physical activity (MVPA) on burnout symptoms, after controlling for age, relationship status, children at home, and use of psychotropic medication. ERI = effort–reward imbalance; JDC = job demands–control.

The analysis of bivariate correlations shows that participants who engaged in more leisure-time physical activity reported lower occupational stress and fewer burnout symptoms. This corroborates the findings of previous studies within working populations (Jonsdottir, Rödjer, Hadzibajramovic, Börjesson, & Ahlborg, 2010; Schmidt et al., 2016; Wunsch & Gerber, 2017). Several mechanisms may explain these relationships. For instance, researchers have argued that physical activity contributes to more efficient recovery (Sonnentag & Jelden, 2009). This notion is supported by the fact that physical activity is associated with better sleep (Farnsworth, Kim, & Kang, 2015) and fewer dysfunctional sleep-related cognitions such as rumination about unresolved problems (Brand et al., 2010). Furthermore, previous research also showed that physically active people tend to be more mentally tough (Gerber et al., 2012), and mental toughness was found to be a stress-resilience resource in previous studies (Gerber et al., 2015). Moreover, researchers found that regular physical activity is associated with higher serotonin levels (Salmon, 2001), which are typically low among people with mental disorders (Young, 2007).

In the introduction, we formulated two hypotheses, and we will now address and discuss them separately. Hypotheses 1a and 1b were supported, corroborating the notion that leisure-time physical activity moderates the positive relationship between occupational stress and symptoms of mental ill-health (Gerber & Pühse, 2009). Importantly, the findings were independent of whether we used the ERI/JDC ratios, the logarithm of the ratios, or the subtraction scores. This is important, as scholars have argued that using different measures may explain some of the inconsistencies in the literature (de Mello Alves et al., 2015). From a theoretical perspective, our findings support the notion that if individuals are exposed to high levels of occupational stress, those who are physically active report fewer burnout symptoms. This implies that it is particularly important to maintain a physically active lifestyle if one is exposed to high stress levels. However, research shows that increasing stress levels are often associated with decreasing physical activity levels (Stults-Kolehmainen & Sinha, 2014). Thus, one major challenge is to find ways to enable highly stressed participants to stay physically active, for instance by fostering behavioral skills (Nigg, 2013). Although not specifically tested in our study, both psychological and biological factors can be used to explain a physical activity-based stress-buffering effect. For instance, regular physical activity has proven to be associated with increased social support (Kouvonen et al., 2012) or favorable cognitive mind-sets such as optimism and self-efficacy (Neissaar & Raudsepp, 2011), resources which may all have a favorable impact on stress-related appraisal processes (Lazarus & Folkman, 1984). Regular physical activity was also associated with decreased sleep disturbances among people with high stress levels (Gerber, Brand, et al., 2014). This is important because a close relationship exists between poor sleep and burnout symptoms (Söderström, Jeding, Ekstedt, Perski, & Åkerstedt, 2012). Moreover, experimental research has shown that regular physical activity is associated with a reduced physiological stress response when individuals are exposed to laboratory stressors (Gerber, Ludyga, et al., 2017; Klaperski, von Dawans, Heinrichs, & Fuchs, 2014; Mücke, Ludyga, Colledge, & Gerber, 2018). Recent studies have also shown that physical exercise training leads to a blunted stress reactivity if participants have to cope with real-life stress situations (von Haaren et al., 2016). Finally, Schmidt et al. (2016) argued that regular physical activity and high fitness levels are associated with a more efficient transfer of glucose from the blood into the cells. As glucose has been described as a self-control resource (Hagger & Chatzisarantis, 2013), the supposition is that physical activity can facilitate coping in stressful situations with high self-control demands.

Hypotheses 2a and 2b were not supported. Although it has been argued that job control and reward might function as a resource that may buffer some of the negative consequences of high job demands or effort (Meier et al., 2008), no significant two-way interactions were found between these variables. Despite this, our data suggest that there is a direct association with burnout symptoms, showing that independent of job demands and effort, higher levels of job control and reward are associated with fewer burnout symptoms. Finally, although a joint (stress-buffering) effect has been described previously between physical activity, hardiness, and social support (Kobasa et al., 1982, 1985), no such relationship was found in the present study. However, the findings are difficult to compare because Kobasa et al. operationalized stress via critical life events, whereas we specifically focused on occupational stress.

Strengths and Limitations

The major strength of the present study is that it expands upon previous research, as few studies have used contemporary and internationally accepted occupational stress theories when examining the role of leisure-time physical activity as a stress buffer. This study fills an important void in the extant literature through its focus on the JDC and ERI models. Another strength is that the study population consists of a relatively diverse sample of workers, including participants with varied educational backgrounds and both female and male employees.

Nevertheless, some limitations preclude an overgeneralization of the findings. First, in the present sample, most participants had relatively high levels of education, which makes it difficult to generalize our results to groups with lower socioeconomic status or working in lower status professions. In the present sample, however, no significant bivariate associations were found between educational background and the predictor or outcome variables. We therefore believe that educational background did not have a major influence on the findings. Second, the response rate was quite low, and we presume that self-selection may have contributed to an underrepresentation of mental health symptoms in the present sample compared with the general population. Nevertheless, stress-buffering effects associated with increased physical activity were demonstrated in other occupational samples, in which more workers were willing to participate in the study (Gerber, Jonsdottir, et al., 2014; Gerber et al., 2010). Third, the cross-sectional nature of this study precludes a causal interpretation of both main and interaction effects. For instance, previous research has suggested that the relationship between occupational stress and burnout is more likely to be reciprocal than unilateral (De Lange, Taris, Kompier, Houtman, & Bongers, 2004). We therefore claim that more longitudinal studies are needed to find out whether physical activity moderates the relationship between occupational stress and burnout over time, after controlling for baseline burnout levels. Fourth, all data were derived from subjective self-report instruments, and the emphasis was on mental health symptoms, whereas other physical health outcomes were not considered. One could therefore argue that the stress-buffering effect of physical activity is due to shared method variance. However, it should be noted that stress-buffer effects were shown in previous studies, in which researchers used objective indicators to assess physical fitness and/or health (Gerber et al., 2016; Gerber, Endes, et al., 2017; Schmidt et al., 2016). Fifth, our instrument used to assess physical activity assessed only leisure-time physical activity, and consequently, work-related physical activity is not reported. In future studies, it would be worthwhile to consider both types of physical activity, to examine how both types of physical activity interact. For instance, in a recent study with Danish blue-collar workers, Hallmann, Birk Jørgensen, and Holtermann (2017) reported that the beneficial effect of leisure-time physical activity on nocturnal heart rate and heart rate variability indices diminished after controlling for occupational physical activity.

Conclusions and Practical Implications

Low levels of leisure-time physical activity are associated with more burnout symptoms and more perceived occupational stress. Most importantly, the relationship between physical activity and burnout symptoms is especially strong among participants who perceive high occupational stress. Despite the limitations of our study, our findings seem to indicate that leisure-time physical activity could be more than a trivial pastime. Rather, we cautiously suggest that participation in regular physical activity can make a relevant contribution to a thriving workforce that feels better able to handle occupational stress. Thus, beyond primary prevention efforts to make work less stressful, our findings indicate that promotion of physically active lifestyles should become a central target for corporate health managers. For example, organizations could ensure a protected time of at least 20 min per day for employees to engage in physical activity. They could also sponsor sports equipment or a physical fitness room or promote active commuting. Finally, this could be linked to a system of incentives such as vouchers, friendly competitions, or small prizes.

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