



Revista de Psicología del Trabajo y de las Organizaciones

ISSN: 1576-5962

ISSN: 2174-0534

Colegio Oficial de la Psicología de Madrid

Fodor, Daniel P; Pohrt, Anne; Gekeler, Babette S.; Knoll, Nina; Heuse, Silke  
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Revista de Psicología del Trabajo y de las Organizaciones, vol. 36, no. 3, 2020, pp. 223-229  
Colegio Oficial de la Psicología de Madrid

DOI: <https://doi.org/10.5093/jwop2020a21>

Available in: <http://www.redalyc.org/articulo.oa?id=231365058005>

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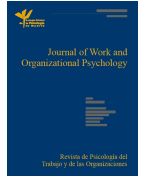
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# Journal of Work and Organizational Psychology

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## Intensity Matters: The Role of Physical Activity in the Job Demands-Resources Model

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### ARTICLE INFO

#### Article history:

Received 5 January 2019  
Accepted 20 August 2020  
Available online 22 October 2020

#### Keywords:

Burnout  
Job stress  
Physical exercise  
Occupational health  
Health behavior

#### Palabras clave:

Agotamiento emocional  
Estrés del puesto de trabajo  
Ejercicio físico  
Salud ocupacional  
Comportamiento saludable

### ABSTRACT

Research indicates that physical activity is associated with lower perceived job stress and burnout. Recent literature shows that regular vigorous-intensity aerobic physical activity (VPA) may have beneficial effects going well beyond those of regular moderate-intensity aerobic physical activity (MPA). However, research investigating the competing roles of VPA and MPA in the context of deleterious job conditions is scarce. Using data from an online-study with 847 employees, we tested if VPA and MPA relate to lower symptoms of burnout and whether they moderate the relationship of job demands and burnout. Results point towards a negative main effect between MPA and burnout whereas no main effect has been found between VPA and burnout. However, results indicate that VPA moderates the deleterious relationship of high job demands and burnout. Findings suggest that employees may benefit from MPA independently from level of job demand whereas VPA may additionally help coping with high job demands.

### La intensidad importa: el papel de la actividad física en el modelo de exigencias-recursos del puesto de trabajo

### RESUMEN

La investigación indica que la actividad física se asocia con una menor percepción de estrés y agotamiento emocional. La literatura reciente muestra que la actividad física aeróbica habitual de intensidad vigorosa (AFV) puede tener efectos provechosos que pueden ir bastante más allá que los de la actividad física aeróbica habitual de intensidad moderada (AFM). No obstante, hay pocos estudios que investiguen los papeles enfrentados de la AFV y la AFM en condiciones de trabajo adversas. A partir de los datos de un estudio online realizado con 847 empleados pusimos a prueba si la AFV y la AFM tienen relación con síntomas menores de agotamiento emocional y si modulan la relación de las exigencias del puesto de trabajo y el agotamiento laboral. Los resultados señalan un efecto principal negativo entre la AFM y el agotamiento emocional, pero ninguno entre este y la AFV. Sin embargo, los resultados indican que la AFV modera la relación nociva de las exigencias elevadas del puesto de trabajo con el agotamiento emocional. Los hallazgos indican que los empleados pueden sacar provecho de la AFM con independencia del nivel de exigencia del puesto mientras que la AFV puede además ayudar a manejar un elevado nivel de exigencia.

Literature suggests that regular physical activity facilitates the prevention of burnout (Gerber et al., 2015; Toker & Biron, 2012; Yang et al., 2010). However, it remains inconclusive (1) whether regular physical activity alleviates symptoms of burnout directly or indirectly through buffering the impact of typical causes, i.e. job demands, and (2) if these potential interactions depend on the intensity level of physical activity. This study examines distinct effects of MPA as well as VPA as potential resources in the relationship between a broad range of occupational risk factors for job stress, i.e., job demands, and burnout.

In Germany, around 10% of men and 11% of women in the working population suffer from burnout (Rose et al., 2016). There was a tremendous rise in the number of diagnosed burnout cases between 2004 and 2012 (Federal Chamber of Psychotherapists, 2012). Although prevalence rates decreased in the meanwhile, increasing age of employees still seems to be a risk factor for burnout (DAK, 2019). Established concepts of burnout such as the Maslach Burnout Inventory (MBI) consider emotional exhaustion as a pivotal element of burnout, representing the stress component (Maslach et al., 2001). A second core element of burnout is the use of cognitive

Cite this article as: Fodor, D. P., Pohrt, A., Gekeler, B. S., Knoll, N., & Heuse, S. (2020). Intensity matters: The role of physical activity in the Job Demands-Resources model. *Journal of Work and Organizational Psychology*, 36(3), 223-229. <https://doi.org/10.5093/jwop2020a21>

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distancing: individuals develop indifferent or even cynical attitudes towards their job when experiencing unfavorable job conditions over time. This is referred to as cynicism. Additionally, a third element is reduced professional efficacy, meaning a reduced ability to perform according to demands posed by the job.

Etiologically, burnout symptoms are the result of chronic job stress conditions (Schaufeli et al., 2009) and internationally present (Schaufeli, 2018). As a framework model of job stress, the JD-R model (Demerouti et al., 2001) has been applied to a wide range of different job types (e.g., dentists, teachers, ambulance officers, or customer services employees), showing as main effects that the prevalence of high job demands (e.g., workload, time pressure, emotional demands) and low or inappropriate job resources (e.g., job control, social support, supervisory) have the potential to evoke stress (Bakker & Demerouti, 2017; Bakker et al., 2003; Bakker et al., 2007; Hakanen et al., 2005; Lesener et al., 2019; Lewig et al., 2007). Additionally, the JD-R model's "buffer hypothesis" suggests that job resources moderate the deleterious relationship of job demands and stress or exhaustion, respectively (Bakker & Demerouti, 2007). Long-term effects of an imbalance between job demands and job resources imply the potential to exhaust employees' mental resources resulting in a state of exhaustion, i.e., symptoms of burnout (Bakker & Demerouti, 2007; Dicke et al., 2018; Toker & Biron, 2012).

Often, opportunities to change the prevailing job conditions, i.e., reducing job demands or increasing job resources, are limited due to the nature of the specific job type. However, besides occupational factors, also health-related behaviors such as physical activity have been shown to relate to lower levels of job stress and reduced mental health problems such as burnout (Lindwall et al., 2014; Toker & Biron, 2012; Yang et al., 2010). This literature points to a main effect of moderate-to-vigorous physical activity on perceived stress and burnout.

For overall health benefits, a few years ago, and still valid, the World Health Organization (WHO, 2010) recommended healthy adults aged 18–64 to do at least 75 minutes of VPA, or at least 150 minutes of MPA throughout the week, or an equivalent combination of both activities (WHO, 2010). On an absolute scale, MPA refers to a three- to six-fold and VPA to a six-fold and above increase in intensity of the resting state. Widely used self-report scales, such as the Godin and Shephard Leisure-Time Physical Activity Questionnaire (GSLTPAQ) (Godin, 2011), define MPA as physical activities which take effort but are not exhausting (e.g., fast walking, easy bicycling, easy swimming) and VPA as physical activities during which the heart beats rapidly (e.g., running, jogging, soccer).

There are consistent findings on benefits of physical activity on mental and physical health (Stubbs et al., 2018) as well as the idea of domain- (White et al., 2017) and intensity-specificity (Currier et al., 2020). Health benefits of MPA and VPA are most often examined as one factor (moderate-to-vigorous physical activity) by combining the duration or frequency of each of the two intensity levels. Indeed, similar effects of MPA and VPA have been found, such as lower symptoms of depression (Pavey et al., 2013). Literature investigating the effects of different intensity levels of physical activity on depression shows that even a low dose of physical activity may be protective against stress-related mental health disorder (Teychenne et al., 2008). However, also different effects of MPA and VPA on stress and stress-related mental health have been reported in the literature. An increase in VPA has been shown to additionally reduce perceived stress and increase mental health in individuals who already meet the WHO requirements of MPA (Gerber et al., 2014). Moreover, regular VPA has been shown to effectively improve physical fitness, which is associated with reduced stress reactivity (Martikainen et al., 2013; Rimmelmeier et al., 2009; Zschucke et al., 2015). Recent literature also suggests that employees who are engaging in higher levels of physical activity are less likely to suffer from mental health problems under the same job stress conditions (Gerber et al., 2015). A possible explanation of the benefit of VPA is that it might be preventive in helping to manage upcoming stressors at work: some research has shown that physical fitness, as a consequence of regular

VPA, enhances cognitive performance such as memory (Erickson et al., 2011; Hötting et al., 2012). Especially under high job demands, sustained cognitive skills are needed to achieve work goals and avoid performance drops (Schaufeli & Taris, 2014). In contrast, cognitive impairment may lead to inadequate coping with job demands which, in turn, is more likely to result in a state of exhaustion, i.e., burnout. Accordingly, it seems likely that regular VPA reduces perceived job demands rather than job stress, the latter being a consequence of chronically high job demands and inappropriate job resources. Thus, VPA may alleviate burnout symptoms through buffering prevailing job demands.

This study aims to test the specific role of MPA and VPA in the context of job stress, looking at competing effects of MPA and VPA. In line with the JD-R main effect assumption (Bakker & Demerouti, 2017), we assume that employees reporting high job demands are more likely to perceive symptoms of burnout (hypothesis 1a), whereas those reporting high job resources are more likely to perceive less symptoms of burnout (hypothesis 1b). In line with the JD-R buffer hypothesis, in hypothesis 2 we assume that job resources are able to buffer detrimental effects of job demands on symptoms of burnout. Our sample consists of employees from different vocational fields with different risk factors for job stress. Therefore, we used a broad range of job demands and job resources, whose impact on job stress and burnout have been confirmed in different JD-R studies. This approach has already been used before (Schaufeli, 2015).

In line with known main effects of physical activity in the context of job stress (Lindwall et al., 2014; Toker & Biron, 2012; Yang et al., 2010), we propose that both, MPA and VPA are resources that relate to lower symptoms of burnout. Therefore, in our hypothesis 3a, we predict that engaging in higher MPA relates to lower symptoms of burnout, independent of prevailing job demands and job resources; in hypothesis 3b, we predict that engaging in higher VPA relates to lower symptoms of burnout, independent of prevailing job demands and job resources.

Moreover, in line with the buffer hypothesis of the JD-R model (Demerouti et al., 2001) and in accordance with previous findings regarding the competing role of MPA and VPA (Gerber et al., 2014), we assume that only VPA is able to buffer detrimental effects of job demands. Accordingly, in our hypothesis 4a we predict that the relationship of job demands and burnout is not buffered by MPA, whereas in hypothesis 4b we assume an interaction in that the relationship between job demands and burnout is weaker when employees engage in VPA, independent of prevailing job resources.

## Method

### Participants and Procedure

Inclusion criteria of the present study was at least a part-time employment with a 20-hour average working week as well as reporting no physical constraints (e.g., an injury) that prevented participants from being physically active over the last four weeks. Participants were invited through the Socio-Scientific Panel1; 1,361 employees in Germany following the invitation for study participation of which  $N = 847$  met the inclusion criteria. In the invitation email employees were informed about the study's aim and procedure, followed by an internet link leading to the questionnaire. The study was approved by the ethics commission of *Deutsche Gesellschaft für Psychologie e.V.* (DGPs).

Background information of the remaining  $N = 847$  employees are depicted in Table 1. The sample characteristics did not represent the general working population in Germany: the proportion of women as well as the average education level is higher in our sample. Furthermore, the sample's distribution over the vocational fields did not represent the working population. Nevertheless, the sample repre-

**Table 1.** Sample Characteristics, Germany 2014 (*N* = 847)

Variable	%	Mean ( <i>SD</i> ), Range
Age, years		41.30 (10.86), 22–72
Sex		
Women	59.9	
Men	40.1	
Education level		
Elementary school	0.7	
Vocational school	14.2	
High school	17.5	
University degree (Ba/Ma)	56.4	
PhD	11.2	
Average working hours per week		41.63 (11.01), 20–85
Vocational field <sup>1</sup>		
Medical/Health sector	11.6	
Service/consulting industry	10.4	
Social care services	9.5	
Production industry	8.7	
Administration/public services	8.5	

Note. <sup>1</sup>Only the five largest vocational fields of the sample are shown; the remaining 51.3 percent are spread over many various sectors.

sents a broad range of different working adults across various occupational fields in Germany.

## Measures

If not otherwise stated, items were answered on 5-point Likert scales either ranging from *never/very rarely* (1) to *very often/always* (5) or from *completely disagree* (1) to *completely agree* (5) and were all framed to the previous four weeks.

**Occupational risk factors.** In order to cover a broad range of risk factors for job stress, the mean value of items from the following scales was used to represent job demands: the five-item ‘time pressure’ scale (e.g., ‘How often did you work under time pressure?’) was retrieved from a validated instrument for stress-related job analysis (*Instrument zur Stressbezogenen Tätigkeitsanalyse*; ISTA) (Semmer et al., 1999). Further job demand scales were retrieved from the German version of the Copenhagen Psychosocial Questionnaire (COPSOQ) (Nübling et al., 2005): emotional demands (three items; e.g., ‘Have you been emotionally involved in your work?’), work-home conflict (five items; e.g., ‘The demands at work interfered with my private and family life’), role conflicts (four items; e.g., ‘Did you receive contradictory requests at work?’), and job insecurity (four items; e.g., ‘Did you worry about getting unemployed?’). Similarly, the mean value of items representing a broad range of factors that have been shown to protect against job stress before were used to depict ‘job resources’ factor. These items were retrieved from the following five scales: the two five-item decision latitude scales (e.g., ‘How much influence did you have on the type of work that was assigned to you?’) and time control (e.g., ‘How much were you able to determine your pace of work on your own?’) were retrieved from the ISTA (Semmer et al., 1999). The response format of two items of the time control scale was a 6-point Likert scale ranging from *not at all* (1) to *more than one hour* (6) and *less than five minutes a day* (1) to *more than two hours a day* (6), respectively. These items were transformed into 5-point scales (see Semmer et al., 1999). Three further four-item scales were retrieved from the German version of the COPSOQ (Nübling et al., 2005): social support (e.g., ‘How often did you receive help from your colleagues?’), development opportunities (e.g., ‘Did you have the opportunity to learn new things at work?’), and role clarity (e.g., ‘Did you know exactly your area of responsibility?’). Results of an exploratory factor

analysis including all items of the 10 scales with a fixed number of 2 factors and a varimax rotation corresponded to the classification described above with one exception: none of the four job insecurity items loaded on any of the two factors. Feelings of job insecurity may occur independently from other risk factors for job stress. However, the job insecurity scale was excluded from the job demands factor. Accordingly, job demands comprised 17 items (Cronbach’s  $\alpha = .91$ ) whereas job resources consisted of 22 items (Cronbach’s  $\alpha = .87$ ).

**Physical activity.** For MPA and VPA, each of two open response items were used: ‘How many times have you been physically active on average per week within the last 4 weeks?’ (frequency) and ‘How many minutes have you been physically active on average per week within the last 4 weeks?’ (duration). This assessment is an adaption of the widely used and validated GSLTPAQ (Godin, 2011). In the original scale, participants were asked to indicate the average minutes spent per session of any specific physical activity. This would have been more difficult to estimate for a time span of 4 weeks. Beforehand, a definition and some examples were given for all three different levels of physical activity (e.g., for VPA: ‘rapid heartbeat because of swimming, running, cycling’). Furthermore, participants were instructed to count in only activities that were executed for at least 10 minutes at a stretch. The duration items (minutes per week) were used as core outcome values whereas frequency items were used to control for plausible values.

**Burnout.** Two subscales from the German short version of the MBI were used (Büssing & Glaser, 1998): both emotional exhaustion (Cronbach’s  $\alpha = .90$ ) and cynicism (Cronbach’s  $\alpha = .89$ ) consist of 5 items and range from *never* (1) to *very often* (6). Combined, for the two scales Cronbach’s  $\alpha$  was .91. Means, standard errors, and correlations of all variables are provided in Table 2. The third subscale of the MBI, professional inefficacy, was not assessed since it is a consequence of lacking job resources rather than emerging from high job demands such as emotional exhaustion and cynicism (see Maslach et al., 2001). Correspondingly, only emotional exhaustion and cynicism were relevant for our hypotheses.

## Statistical Analyses

Hypotheses were tested within one hierarchical multiple linear regression analysis predicting burnout from job demands, job resources, MPA, and VPA and their two-way interactions. Prior

**Table 2.** Means, Standard Deviations and Correlations for All Study Variables, Germany 2014 ( $N = 847$ )

Variable	<i>M</i>	<i>SD</i>	$\alpha$	1	2	3	4	5	6
1. JD	2.90	0.74	.91						
2. JR	3.69	0.57	.87	-.32**					
3. MPA	87.15	109.17	--	.01	.07				
4. VPA	57.96	76.61	--	-.06	.07*	.31**			
5. Burnout	3.10	1.12	.91	.56**	-.61**	-.06	-.08*		
6. Sex <sup>1</sup>	1.40	0.49	--	-.05	.03	-.05	.07*	-.03	
7. Age	41.30	10.86	--	-.02	.15**	.06	-.08*	-.14**	.11**

Note. JD = job demands; JR = job resources; MPA = minutes of moderate physical activity per week; VPA = minutes of moderate physical activity per week; 11 = male, 2 = female.

\* $p < .05$ , \*\* $p < .01$

to analysis, the physical activity measures MPA and VPA were log-transformed due to their skewed distribution after detecting univariate outliers and winsorizing MPA and VPA data. Moreover, all variables were mean centered prior to calculating the interaction terms. No multivariate outliers were detected for the interacting variables. As of here the term 'effect' is used in order to express the expected direction. It should be noted that all analyses were run with cross-sectional data. Thus, we were testing relationships between study variables and not whether causal links exist.

After entering two covariates, sex and age, in the first step, the main effects of job demands and job resources were tested in the second, testing hypotheses 1a and 1b. In the third step, main effects of MPA and VPA were included in the model, testing the main effect hypotheses 3a and 3b. In the fourth and final step, two-way interactions were entered: the buffering hypothesis 2 of the JD-R model was tested as the interaction term of job demands and job resources. Similarly, the buffering hypotheses 4a and 4b of physical activity were tested with the interaction terms of job demands and MPA as well as job demands and VPA, respectively. In this final step, also two-way interactions of job resources and both MPA and VPA as well as of MPA and VPA were included. For each step,  $R^2$  change will indicate whether main effects or interaction effects additionally add to the likelihood of perceiving symptoms of burnout.  $R^2$  values are corrected for model overfit using Browne's shrinkage formula (Yin & Fan, 2001).

Providing a significant moderation, the conditional effect of job demands on burnout was analyzed for low and high values of job resources, VPA, respectively, with simple slope analyses (Aiken & West, 1991). All statistical analyses were run with SPSS 21.

## Results

### Main Effects and Interaction Effect of Job Demands and Job Resources on Burnout

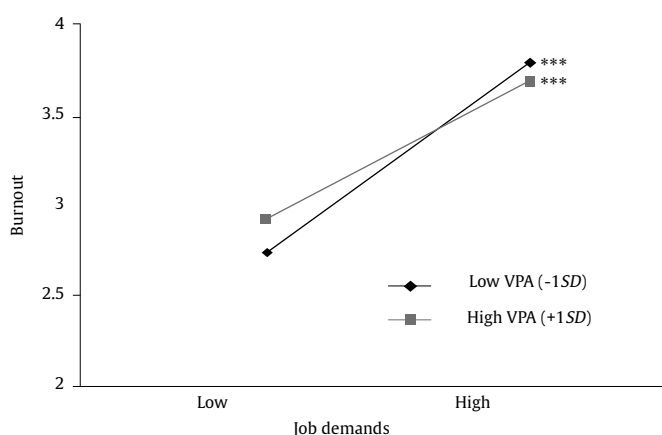
Step 2 of Table 3 depicts the main effects of job demands and job resources on burnout in the final model 5. After entering these two factors in step 2, in line with hypothesis 1a, job demands highly related with burnout ( $\beta = .40$ ,  $p < .001$ ), whereas in line with hypothesis 1b job resources negatively related with burnout even stronger ( $\beta = -.47$ ,  $p < .001$ ). With  $\Delta R^2 = .50$  ( $p < .001$ ), the main effects of job demands and job resources on burnout were very large. However, in contrast to hypothesis 2 the interaction term of job demands and job resources did not significantly relate with burnout ( $\beta = -.02$ ,  $ns$ ; see Table 3, step 4).

### Main Effects of MPA and VPA on Burnout

To test the main effect hypotheses of physical activity, in step 3 of the hierarchical regression analysis MPA and VPA were entered into the model. In this model 3, in line with hypothesis 3a, only MPA was significantly associated with burnout ( $\beta = -.08$ ,  $p < .01$ ). In contrast

to our hypothesis 3b, VPA did not relate to burnout symptoms ( $\beta = -.02$ ,  $ns$ ). The  $\Delta R^2$  of physical activity was significant but fairly small ( $\Delta R^2 = .01$ ,  $p < .05$ ).

Moderation Effect of VPA on the relationship between job demands and burnout buffer hypotheses 4a and 4b were tested by the interaction effects of job demands and MPA or VPA on burnout, respectively. Therefore, two-way interactions of the study variables were tested in the final step 4 of the regression (see Table 3). In line with hypothesis 4a, the interaction term of job demands and MPA did not reach significance ( $b = -.01$ ,  $ns$ ). In line with hypothesis 4b, the interaction term of job demands and VPA was the only significant two-way interaction with a negative effect on burnout ( $\beta = -.07$ ,  $p < .05$ ). However, the interaction effects did not explain additional significant outcome variance in the model ( $\Delta R^2 = .01$ ,  $ns$ ). Simple slope analysis revealed that job demands significantly related to burnout in participants with lower levels of VPA ( $-1SD$ ), and still, but slightly lower in participants with high values of VPA ( $+1SD$ ) (see Figure 1).



**Figure 1.** Moderation Effect of VPA on the Relationship of Job Demands and Burnout at two Levels of the Moderator (one standard deviation below and above the mean), Germany 2014.

\*\*\* $p < .001$ .

## Discussion

To our knowledge this is the first study that tests competing effects of MPA and VPA and, moreover, discriminates between main and moderating effects of MPA and VPA in addition to job demands and job resources on burnout. Findings showed known JD-R main effects of job demands and job resources on symptoms of burnout in line with our first hypotheses, but in contrast to our second hypothesis they failed to approve the JD-R buffer hypothesis. Testing MPA and VPA competing as additional resource, results also point to specific associations between MPA and VPA with burnout. In line with hypothesis 3a, MPA was found to directly relate with lower symptoms of burnout. In contrast to hypothesis 3b, no association was found between VPA and burnout. Nevertheless, in line with hypotheses 4a and 4b our results point to a potential moderating effect of VPA on the relations-



**Table 3.** Multiple Linear Regression Model on Burnout with Predictor Job Demands, JobResources, MPA, VPA and two-way Interactions between These Factors. Controlled for Sex and Age, Germany 2014

Step	Predictors	<i>B</i> ( <i>SE</i> )	$\beta$	<i>R</i> <sup>2</sup> change
1	Sex	0.02 (0.06)	.01	
	Age	-0.01 (0.01)	-.05	.02**
2	Job demands (JD)	0.60 (0.04)	.40**	
	Job resources (JR)	-0.93 (0.05)	-.47**	.50**
3	MPA	-0.10 (0.05)	-.08**	
	VPA	0.03 (0.03)	.02	.01*
4	JD x JR	-0.02 (0.06)	-.01	
	JD x MPA	-0.01 (0.05)	-.01	
	JD x VPA	-0.10 (0.05)	-.07*	
	JR x MPA	-0.01 (0.06)	-.01	
	JR x VPA	-0.09 (0.06)	-.05	
	MPA x VPA	-0.01 (0.03)	-.01	< .01
	<i>R</i> <sup>2</sup>		.54**	-

Note. *B*s, *SE*s, and  $\beta$ s of the final model 4 are depicted.

\**p* < .05, \*\**p* < .01.

hip between job demands and symptoms of burnout, rather than of MPA. Thus, there may be a distinct association of physical activity and job stress depending on the type of physical activity individuals are engaging in: MPA, which refer to activities that take effort but are not exhausting such as easy bicycling, or VPA, which refer to activities during which the heart beats rapidly such as running. Our study covers a range of individuals that do not perform any MPA or VPA at all (26.1% no MPA, 40.5% no VPA, 21.0% neither) up to individuals that meet or even surpass the recommended levels of at least 150 minutes of MPA, 75 minutes of VPA or a combination of both (19% for MPA, 28.9% for VPA 47.8% combined). Despite effects being fairly small, presented results largely support our assumptions.

Employees engaging in regular MPA reported less symptoms of burnout. In line with previous work, this finding shows that symptoms of burnout are lower when exercising regularly (Lindwall et al., 2014). Nevertheless, no direct relationship was found between VPA and burnout. This contrasts previous research which found that VPA has effects on mental health beyond MPA (Gerber et al., 2014). MPA seems to be used as a resource against stress-related mental health problems alongside other resources that are provided at the workplace. It is conceivable that MPA may act as a recovery method against symptoms of burnout which is independent from job conditions. Recovery is a process in which employees spend leisure-time to recover from energy depletion due to work-related activities (Geurts & Sonnentag, 2006). According to the “inverted-U hypothesis”, MPA provides the optimal stimulus for positive affective changes (Berger & Motl, 2000).

However, when job resources failed at buffering job demands, our results show that VPA buffered the relationship between job demands and burnout. Additionally, the relationship between job demands and burnout was weaker when employees performed high amounts of VPA. This association is fairly small in the present study. However, notably, even when employees performed high amounts of VPA per week, the relationship between job demands and burnout remained highly significant. Yet our findings showed that only for those employees performing very high amounts of VPA job demands would not significantly relate with burnout symptoms. Very high amounts of VPA seemed to have acted as a coping resource that may help against prevailing job demands and thus might indirectly protect against symptoms of burnout. This finding contributes to the understanding why VPA may protect against burnout beyond MPA.

The finding that job demands related with lower symptoms of burnout when engaging in high amounts of VPA accords neurobiological findings: especially high-intensity exercise has been shown to increase the hippocampal volume and the levels of the brain-derived neurotrophic factor (BDNF), a growth factor that might act

as a mediator of neurogenesis (Erickson et al., 2011). In contrast, deleterious stress and stress-related mood disorders have been shown to negatively affect the hippocampal volume and BDNF levels (Duman & Monteggia, 2006). The hippocampus plays an important role for cognitive functioning, e.g., memory (van Praag et al., 2014). Fulfilling work goals requires energy, especially under high job demands. As employees engaging in regular VPA are likely to have better cognitive skills, they may cope with high job demands more effectively and thus be less likely to blunder into the deleterious spiral of job demands and energy depletion. Furthermore, the hippocampus inhibits the activity of the hypothalamic-pituitary-adrenal (HPA) axis. Accordingly, regular exercise may protect against stress by inhibiting the HPA axis more effectively through better hippocampal functioning. This is in line with research showing attenuated HPA reactivity to stressors in highly trained athletes (Rimmele et al., 2009).

### Limitations and Future Directions

Our study design was cross-sectional so that we were unable to test direction and causality in the relationship between physical activity, job demands, and burnout. Thus, the possibility that employees with already existing burnout symptoms perceived higher job demands and spent less time on physical activity cannot be ruled out. Furthermore, job stress has been shown to be a risk factor for leisure-time physical inactivity before (Fransson et al., 2012). Future research should investigate long-term influences of MPA and VPA on job demands and burnout. Here, other possible mechanisms such as the mediation of the relationship of job demands and burnout by VPA should be tested as well. A further limitation results from the use of the GSLTPAQ scale, which only takes leisure-time physical activity into account and does not differentiate between leisure-time and occupational physical activity. Leisure-time physical activity has been shown to decrease long-term sickness absence while for occupational physical activity the opposite effect has been found (Holtermann et al., 2012). It is likely that leisure-time physical activity and occupational activity as well have different effects on burnout. Thus, a differentiation may have shed additional light into the moderating role of VPA and MPA on the relationship of job stress and burnout.

In addition, we exclusively used self-report data to test our hypotheses. Objective measurements, i.e., the use of accelerometers to determine the amount and intensity of physical activity should be considered in future research in order to confirm our findings.

Moreover, participants did not represent the general working population of Germany. Thus, findings of our study are restricted to the

specific characteristics of our sample with an increased proportion of higher levels of education as well as more women than in the working population of Germany. Generalizability is also limited as our sample may be biased: it is conceivable that individuals who are exercising regularly are more likely to suffer from injuries which was one of the exclusion criteria. Furthermore, individuals particularly interested and engaging in physical activity might have participated in the study more likely than others. Accordingly, results of this study must be replicated with more representative samples in future research in order to test if these different associations of MPA and VPA within job stress can be confirmed in those samples.

Participants reported a wide range of working hours per week. This might have consequences for their leisure time and opportunities to perform physical activity. Future research should consider this, evaluating the effects of physical activity as a coping strategy in the burnout prevention.

Furthermore, participants came from a wide range of vocational fields. The distribution of sectors was not representative for the working population in Germany. Nevertheless, it offered testing our assumptions across different industries, including a broad range of well-known risk factors. However, in accordance with the JD-R model, it is conceivable that the job demands and job resources under study may differently interact with MPA and VPA depending on the field. Therefore, future research may test the effect of MPA and VPA on specific job demands in specific vocational fields.

Besides work, there are several potential confounding factors that were not obtained in this study. For instance, children at home or caregiving further limits the time being able to engage in physical activities regularly. Thus, in future research such factors should be additionally considered.

Future research should also use intervention studies with different intensity-levels and different qualities of physical activity to examine the dose-response effect of various physical activities on job demands and burnout. Finally, the integration of cognitive performance tasks in a longitudinal intervention study would help to validate our assumption that VPA reduces job demands through cognitive enhancement.

## Practical Implication

The current study confirms that reducing job demands and enhancing job resources at work are valuable intervention strategies to protect employees against stress-related mental health problems. Accordingly, it is first and foremost the employer's responsibility to avoid mental hazards at the workplace in order to prevent the likelihood of stress-related mental health issues such as burnout. In many countries, this obligation to carry out psychological risk assessments is consistently enshrined in the labour protection law. However, this paper argues that regular physical activity may also help employees to protect themselves against stress-related mental health problems such as burnout. Associations found between physical activity and job stress variables are too small to draw final conclusions. Nevertheless, results point to the possibility that encouraging employees to engage in regular MPA may additionally reduce symptoms of burnout. As MPA seems likely to help recovering from work-related stress, employees should be encouraged to perform regular MPA, independently of the prevailing job characteristics. Additionally, engaging in regular VPA may help protecting against burnout particularly when employees' job demands are high.

## Conclusion

Our findings show distinct effects of MPA and VPA on burnout symptoms; whereas regular MPA is able to directly reduce burnout

symptoms, VPA buffers detrimental effects of job demands on burnout symptoms. Findings can be used to develop new stress management strategies in the operational health management. Occupational offers and programs can enrich possibilities to enact either MPA as a preventive strategy or VPA as a coping strategy in case of high job demands.

## Conflict of Interest

The authors of this article declare no conflict of interest.

## Acknowledgement

The authors would like to thank Dr. Dominik Leiner for his support in making the Socio-Scientific Panel accessible for recruitment of study participants. Furthermore, we would like to thank all the study participants for their contribution.

## Note

The Socio-Scientific Panel (<https://www.soscisurvey.de/panel/>) is an open scientific questionnaire panel of 90,317 individuals in Germany (as of January 2015). According to our aimed sample size of  $N = 800$  and in consideration of the anticipated response rate, an invitation email was sent to a larger number of individuals via the panel.

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