

IS WORKAHOLISM ASSOCIATED WITH INFLAMMATORY RESPONSE? THE MODERATING ROLE OF WORK ENGAGEMENT

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The aim of this study was to investigate the association between two different forms of heavy work investment, namely workaholism and work engagement, and serum levels of the proinflammatory cytokine interleukin-17 (IL-17), a possible biomarker of stress. Given the different motivational underpinnings and outcomes of workaholism and work engagement and drawing on the allostatic load and the effort-recovery models, we hypothesized that workaholism is positively associated with IL-17, and that work engagement buffers this association. Workers in an Italian healthcare organization (88 females and 31 males) completed a self-report questionnaire, and then underwent blood sample collection. Data were analysed using moderated multiple regression. Results showed that workaholism was positively associated with IL-17, controlling for the effect of gender, age, and body mass index. Work engagement buffered this association, which was nonsignificant when work engagement was high. To reduce the risk of future health complaints, interventions should be aimed at preventing workaholism and promoting work engagement.

Key words: Workaholism; Work engagement; Interleukin-17; Biomarker; Stress; Moderation.

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Contemporary working conditions, characterized by global competitions, downsizing, smart working, and the growing pervasiveness of technology (e.g., smartphones, e-mail), stimulate employees to invest more and more time and effort in their work, even during off-work time, with negative consequences in terms of poor recovery and work-home interference (Breugh & Frye, 2008; Derks & Bakker, 2010; Molino, Cortese, & Ghislieri, 2019). Workaholism and work engagement are described in the literature as two different forms of heavy work investment (Snir & Harpaz, 2012; van Beek, Taris, Schaufeli, & Breninkmeijer, 2014). Although workaholics and engaged workers dedicate a lot of time and effort to their

work, their underlying motives are different (van Beek, Hu, Schaufeli, Taris, & Schreurs, 2012; van Beek, Taris, & Schaufeli, 2011). Furthermore, workaholism has mostly adverse consequences for the health of the workers (e.g., psychological and physical symptoms, sickness absences; Andreassen, Pallesen, & Torsheim, 2018; Matsudaira et al., 2013), whereas work engagement has more positive outcomes, in terms of well-being and life satisfaction (Schaufeli, Taris, & Van Rhenen, 2008; Shimazu, Schaufeli, Kamiyama, & Kawakami, 2015; Shimazu, Schaufeli, Kubota, & Kawakami, 2012). Therefore, in terms of prevention and health promotion, it is important to investigate factors that can buffer or strengthen the association between workaholism and impaired health.

Notably, it has been proposed that workaholism and work engagement can co-occur in the same individual, and that work engagement may buffer against the negative consequences of workaholism (Loscalzo & Giannini, 2017, 2019; van Beek et al., 2011). To date, only few studies examined this pattern of associations (Scafuri Kovalchuk et al., 2019; Spagnoli, Balducci, Scafuri Kovalchuk, Maiorano, & Buono, 2018; ten Brummelhuis, Rothbard, & Uhrich, 2017). Moreover, to the best of the authors' knowledge, no previous empirical research has explored the possible moderating role of work engagement in the relationship between workaholism and inflammatory mediators (e.g., proinflammatory cytokines), which may be considered as biomarkers of psychosocial stress (Hänzel, Hong, Cámara, & von Känel, 2010). To address this gap in the literature, in the present study we tested the hypothesis that workaholism is positively associated with the proinflammatory cytokine interleukin-17 (IL-17), and that work engagement buffers this association, which is expected to be attenuated when work engagement is high, and stronger when work engagement is low.

WORKAHOLISM AND WORK ENGAGEMENT

According to Schaufeli, Taris, and Bakker (2008, p. 204), workaholism is "the tendency to work excessively hard in a compulsive way." The core dimensions of the construct are working excessively (WE) and working compulsive (WC), and workaholism is characterized by high levels of both. Working excessively and working compulsive are the behavioural and the cognitive dimensions of workaholism, respectively (Schaufeli, Bakker, van der Heijden, & Prins, 2009). On the one hand, working excessively reflects the fact that workaholics tend to dedicate an extreme amount of time to their work, and to work beyond what is expected of them to attend organizational or economic requirements. On the other hand, working compulsively indicates that workaholics are obsessed with work, and they persistently think about their work even when they are involved in other activities (Schaufeli, Taris, & Bakker, 2008).

Work engagement is a "positive, fulfilling, work-related state of mind that is characterized by vigor, dedication, and absorption" (Schaufeli, Salanova, González-romá, & Bakker, 2002, p.74). Engaged employees are active and work hard (vigor), they are enthusiastic and proud about their job (dedication), and feel happily engrossed in it (absorption; De Carlo, Dal Corso, Falco, Girardi, & Piccirelli, 2016; Schaufeli, 2016). Interestingly, engaged workers persist in their work because they derive pleasure from it, whereas workaholics continue working because they feel they have not done enough (van Wijhe, Peeters, & Schaufeli, 2014). Moreover, engaged workers are characterized by harmonious passion and can decide to stop working when costs become too high (i.e., the person controls the activity). On the contrary, workaholics have an obsessive passion for their job, and they rigidly persist in their work activities even when they face relevant costs (i.e., the activity controls the person), with negative consequences in terms of inadequate time for recovery and poor interpersonal relationships (Gorgievski & Bakker, 2010; Vallerand et al., 2003).

Although some researchers suggested that workaholism may have also positive features (Baruch, 2011; Ng, Sorensen, & Feldman, 2007), previous studies showed workaholism to be mainly associated with negative outcomes, such as physical and psychological symptoms, work-family conflict, reduced job and life satisfaction, sleep problems, higher systolic blood pressure, cardiovascular risk, risk factors of metabolic syndrome, as well as sickness absences and sickness presenteeism (Andreassen, Hetland, Molde, & Pallesen, 2011; Balducci, Avanzi, & Fraccaroli, 2018; Falco et al., 2013; Girardi, Falco, Piccirelli, et al., 2015; Hakanen & Peeters, 2015; Kubota et al., 2010; Matsudaira et al., 2013; Salanova et al., 2016; Shimazu et al., 2015; Shimazu, Schaufeli, & Taris, 2010; ten Brummelhuis et al., 2017). Moreover, work engagement is mainly associated with positive outcomes, such as physical and mental health, organizational commitment, life satisfaction, work ability, as well as task and contextual performance (Airila et al., 2014; Christian, Garza, & Slaughter, 2011; Hakanen & Schaufeli, 2012; Halbesleben, 2010), even though past research also discussed possible dark sides of engagement (Bakker, Albrecht, & Leiter, 2011; see also Di Stefano & Gaudiino, 2019).

Interestingly, previous studies that considered at the same time both workaholism and work engagement showed that workaholism was related to negative outcomes over time, in terms of increased ill-health and decreased life satisfaction, whereas work engagement was related over time to decreased ill-health and to increased life satisfaction and job performance (Shimazu et al., 2015, 2012). Taken together, these results suggest that workaholism and work engagement represent a “bad” and a “good” kind of heavy work investment, respectively (Schaufeli, 2016).

INFLAMMATION AS A BIOMARKER OF WORKAHOLISM

When studying health outcomes of heavy work investment (i.e., workaholism and work engagement), most previous studies relied on self-reported measures of health complaints and psychophysical strain (with some exceptions; see for example Balducci et al., 2018; Eguchi et al., 2015; Salanova et al., 2016; ten Brummelhuis et al., 2017). Although self-report measures are useful indicators of how one person feels, it is extremely important to understand psycho-physiological mechanisms that can explain the relationship between workaholism, work engagement, and long-term consequences for the health of the workers (Falco, Dal Corso, Girardi, De Carlo, & Comar, 2018; ten Brummelhuis et al., 2017). Moreover, the combination of different measurement methods (i.e., self-report questionnaires and objective health indicators) may be useful to reduce common method bias (Podsakoff, MacKenzie, & Podsakoff, 2012) and to better understand the relationship between workaholism and impaired health (Clark, Michel, Zhdanova, Pui, & Baltes, 2016).

Recently, it has been proposed that inflammation may be considered as one of the mechanisms that link psychosocial stress and health risk (Rohleder, 2014). Indeed, previous research suggests that the continued exposure to stressful situations is associated with chronic low-grade inflammation, which, in turn, may lead to greater risk of developing diseases such as depression and cardiovascular disease (Endrighi, Hamer, & Steptoe, 2016; Gouin, Glaser, Malarkey, Beversdorf, & Kiecolt-Glaser, 2012; Magnusson Hanson et al., 2019; Pearson et al., 2003; Rohleder, 2014). Consistently, inflammation and several inflammatory mediators, such as pro/anti-inflammatory cytokines and acute phase proteins, may be considered as biomarkers of psychosocial stress, including work-related stress (Hänsel et al., 2010; Juster, McEwen, & Lupien, 2010; Marsland, Walsh, Lockwood, & John-Henderson, 2017).

In this study, we consider IL-17 as a biomarker of inflammation that can be associated with psychosocial stress and workaholism. IL-17 is a proinflammatory cytokine that is involved in both acute and chronic inflammation (Isailovic, Daigo, Mantovani, & Selmi, 2015; Miossec & Kolls, 2012; Sud et al., 2018). IL-17 is mainly produced by T helper 17 (Th17) cells and has pleiotropic effects on multiple cell types, increasing for example the production of proinflammatory cytokines from monocytes (e.g., interleukin-1, interleukin-6, tumor necrosis factor; Beringer, Noack, & Miossec, 2016; Miossec, Korn, & Kuchroo, 2009). Interestingly, previous research suggested IL-17 to be related with job demands and depression (Davami et al., 2016; Girardi, Falco, De Carlo, et al., 2015; Waisman, Hauptmann, & Regen, 2015), a disorder that can be associated with workaholism and work-related stress (Ganster & Rosen, 2013; Matsudaira et al., 2013; Nie & Sun, 2016).

The allostatic load (AL) model (Juster et al., 2010; see also Ganster & Rosen, 2013) and the effort-recovery model (E-R; Meijman & Mulder, 1998; see also Geurts & Sonnentag, 2006) provide a theoretical framework for understanding the role of IL-17, together with other proinflammatory cytokines and markers of inflammation (Hänsel et al., 2010), as a possible biomarker of psychosocial stress (including work-related stress) and workaholism. According to the AL model, the actual, prolonged, or anticipated exposure to job stressors (Cropley, Rydstedt, Devereux, & Middleton, 2015; Gaab, Rohleder, Nater, & Ehler, 2005) triggers an adaptation process in the individual, which involves the stimulation of primary mediators, such as stress hormones (e.g., cortisol) in conjunction with pro/anti-inflammatory cytokines (Juster et al., 2010; Slavich & Irwin, 2014). These physiological reactions are usually short-lived, but the repeated or chronic activation of primary mediators (e.g., following the repeated or chronic exposure to stressful situations; Gouin et al., 2012) may lead to subclinical perturbations in secondary mediators, which involve the metabolic (e.g., insulin, glucose), cardiovascular (e.g., blood pressure), and immune systems (e.g., C-reactive protein). Over time, this may lead to allostatic overload and psychological or physical diseases (e.g., depression or cardiovascular diseases; Ganster & Rosen, 2013; Juster et al., 2010; Miller & Blackwell, 2006; Miller & Raison, 2016; Pearson et al., 2003).

In line with the E-R model (Meijman & Mulder, 1998), recovery plays a central role in this process. If complete recovery occurs, the short-lived psycho-physiological activation that is inevitably associated with effort expenditures at work can be restored to baseline levels. However, incomplete recovery may result in a sustained psycho-physiological activation, with detrimental consequences for the health of the worker in the long run (Geurts & Sonnentag, 2006).

Interestingly, previous research has shown workaholism to be associated with poor recovery experiences (Molino, Cortese, & Ghislieri, 2018; van Wijhe, Peeters, Schaufeli, & Ouweneel, 2014). First, workaholics dedicate an excessive amount of time and effort to their work, and they continue working (e.g., in the evening, during weekend) to cope with their negative emotions and because they think they have not worked enough (van Wijhe, Peeters, & Schaufeli, 2014; van Wijhe et al., 2013). Moreover, workaholics incessantly think about work also during after-work hours (Scott, Moore, & Miceli, 1997) and find it difficult to mentally “switch off” from work (i.e., psychological detachment; Shimazu, De Jonge, Kubota, & Kawakami, 2014).

Given that workaholics invest more time and energies than others in their work, and, at the same time, they have less opportunity for recovery, we expect workaholism to be positively associated with IL-17, which was considered in this study as a biomarker of stress.

H1: Workaholism will be positively associated with IL-17.

THE MODERATING ROLE OF WORK ENGAGEMENT

Although previous research has shown workaholism to be mainly associated with negative outcomes for the individual and the organization (Matsudaira et al., 2013; Shimazu et al., 2015; see also Andreassen, 2014; Clark et al., 2016), some researchers suggested that workaholism may have also positive features (Baruch, 2011; Ng et al., 2007; Snir & Zohar, 2008). For example, Ng and colleagues claimed that workaholics enjoy the act of working, whereas Snir and Zohar found that workaholics experience higher levels of positive affect during work activity than during leisure activities, compared to nonworkaholics.

Spence and Robbins (1992) distinguished between workaholics who enjoy their work and workaholics who do not. In their seminal work, the three dimensions of work involvement, drive, and work enjoyment (i.e., the workaholic triad) were combined to identify different profiles of workers. Among these, workaholics are involved in their work, feel compelled to work because of an inner drive, and are low in work enjoyment, whereas work enthusiasts are high in work involvement and work enjoyment, but low in drive. Interestingly, enthusiastic workaholics combines features of both, given that they are involved in their work and feel driven to work, but they also enjoy their work.

Building on the concepts of workaholism and work engagement, van Beek and colleagues (2011) proposed a classification that resembles the one by Spence and Robbins (1992) in some respect. The authors distinguished between workaholic employees (workers who are workaholics and not engaged), engaged employees (workers who are engaged and nonworkaholics), engaged workaholics (workers who are both engaged and workaholics), and nonworkaholic/nonengaged workers (workers who are nonworkaholics and not engaged). Moreover, concerning the interplay between the two phenomena, van Beek et al. (2011) investigated whether work engagement can compensate the negative consequences of workaholism, and found that engaged workaholics dedicated most time to their work, but they also reported less burnout than workaholics employees. The authors concluded that work engagement may buffer against the negative consequences of workaholism.

More recently, Loscalzo and Giannini (2017, 2019) proposed that workaholism and work engagement are two relatively distinct phenomena that can co-occur in the same individual, and that three different types of heavy work investors may be identified by crossing the two constructs. These are disengaged workaholics (high levels of workaholism and low levels of work engagement), engaged workers (high levels of work engagement and low levels workaholism), and engaged workaholics (high levels of both workaholism and work engagement). Moreover, the authors suggested that disengaged workaholics should be conceived as the “real” or clinical workaholics whereas engaged workaholics should not, because their high levels of work engagement protect them against negative consequences.

Recent empirical studies provide support for the hypothesis that work engagement may buffer against the negative outcomes of workaholism. Spagnoli et al. (2018) found that work engagement moderated the association between workaholism and job-related negative affect among women, so that this association was significant when work engagement was low, but not significant when work engagement was high. In the study by Scafuri Kovalchuk et al. (2019) work engagement moderated the associations between workaholism on the one hand, and work-family conflict and emotional exhaustion on the other. Again, these associations were attenuated when work engagement was high. Ten Brummelhuis and colleagues (2017) investigated the association between workaholism, work engagement, subjective health complaints, and a biomarker of metabolic syndrome (i.e., a physiological health indicator), namely the risk factors for metabolic syndrome (RMS). Interestingly, the authors found that workaholism was positively associated with RMS, but only when work engagement was low.

Overall, based on the arguments previously described, we believe that work engagement may moderate the positive association between workaholism and IL-17, which is expected to be attenuated when work engagement is high, and stronger when work engagement is low.

H2: Work engagement will moderate the positive association between workaholism and IL-17.

Finally, it should be noted that demographic characteristics, such as gender, age, and body mass index (BMI), may influence circulating levels of proinflammatory cytokines. Previous research showed gender differences in sensitivity to glucocorticoid as well as in the production of proinflammatory cytokines in response to stressful events (Bourke, Harrell, & Neigh, 2012; Endrighi et al., 2016). Moreover, age and BMI are associated with chronic low-grade inflammation (Franceschi & Campisi, 2014; Gregor & Hotamisligil, 2011). For these reasons, we controlled for the effect of gender, age, and BMI in the following analyses.

METHOD

Participants and Procedure

The present study was carried out in an Italian public healthcare organization. Workers were informed in advance by the management and participated voluntarily in the investigation of work-related stress. Participants were healthcare professionals working the same day shift. First, workers underwent a clinical interview conducted by research team members. Individuals who reported mood or anxiety disorder, neuroendocrine diseases or drug abuse/dependence — according to Diagnostic and Statistical Manual of Mental Disorders – Fourth Edition, Text Revision (DSM-IV-TR; American Psychiatric Association, 2000) criteria — were excluded from the investigation. Then participants underwent a blood sample collection and completed a self-report questionnaire aimed at determining workaholism and work engagement.

The final study sample comprised 119 participants, of whom 73.9% were women, with a mean age of 45.2 years ($SD = 9.1$) and a mean BMI of 23.8 kg/m² ($SD = 3.3$ kg/m²). With respect to work position, 16% were head physicians, 63% were physicians or head nurses, 20.2% were nurses (one missing value, 0.8%). Most respondents had a permanent contract (95.8%) and were employed full-time (89.1%). Participants gave their written, informed consent, and the study was approved by the local ethics committee according to the recommendations of the declaration of Helsinki.

Measures

To determine workaholism and work engagement, the following self-report measures were administered.

Workaholism was measured with the Dutch Work Addiction Scale (DUWAS; Schaufeli, Taris, & Bakker, 2008) in the Italian adaptation (Kravina, Falco, Girardi, & De Carlo, 2010; see also Falco et al., 2012). The scale is composed of 10 items aimed at detecting the two dimensions of WE (six items; e.g., “I find myself continuing to work after my co-workers have called it quits”) and WC (four items; e.g., “I feel that there’s something inside me that drives me to work hard”). The six-point response scale ranged from 1 (*strongly disagree*) to 6 (*strongly agree*). In this study, WE and WC were strongly correlated ($r = 0.57, p < .001$). Given that workaholism reflects the tendency to work excessively hard in a compulsive way (Schaufeli, Bakker, van der Heijden, et al., 2009), an overall workaholism score was used in this study.

Work engagement was measured with the Utrecht Work Engagement Scale (UWES-9; Schaufeli, Bakker, & Salanova, 2006) in the Italian adaptation (Balducci, Fraccaroli, & Schaufeli, 2010). The scale comprises three subscales that reflect the dimensions of vigor (three items; e.g., “At my work, I feel bursting with energy”), dedication (three items; e.g., “I am enthusiastic about my job”), and absorption (three items; e.g., “I get carried away when I am working”). The six-point response scale ranged from 1 (*never*) to 6 (*always*). In this study, the three dimensions of work engagement were strongly correlated (correlations ranged from .51 to .75), and, in line with previous research (Balducci et al., 2010; Schaufeli et al., 2006), an overall score of work engagement was computed.

Biochemical assessments. Blood samples were collected in the morning (between 9:00 a.m. and 11:30 a.m.) using standard venepuncture technique, then sera were isolated and stored at -80°C until further analysis. Serum levels of IL-17 were measured employing the Bio-Plex Pro Human xMAP Assay (Bio-Rad Laboratories Srl, Milan, Italy) read on a Bio-Plex 200 instrument (Comar et al., 2014).

Data Analysis

The hypothesized relationships were tested using moderated multiple regressions analysis (Aiken & West, 1991) with R software (version 3.5.1; R Core Team, 2018). IL-17 was the dependent variable, whereas workaholism and work engagement were the independent and the moderating variables, respectively. The scores of both workaholism and work engagement were centered, and then cross-product of the centered variables was computed. Given that previous research has shown that demographic characteristics may be associated with proinflammatory cytokines and inflammation, the model was estimated controlling for the effects of gender, age, and BMI.

Confidence intervals (CI) based on the percentile bootstrap technique were also computed (Efron & Tibshirani, 1993). Briefly, 1,000 repeated random samples with replacement were drawn from the observed data set, and the statistics computed from the bootstrap samples were used to construct 95% CI. The main advantage of this approach is that these CI do not assume a normal sampling distribution (Falk, 2018; Liu, West, Levy, & Aiken, 2017). To interpret the nature of the moderating effect, the interaction was explored graphically, following the procedure outlined by Aiken and West (1991).

Prior to estimating the regression model, a confirmatory factor analysis (CFA) was carried out to investigate if two different forms of heavy work investment (i.e., workaholism and work engagement) could be identified. The CFA was carried out using the lavaan package (version 0.6-3; Rosseel, 2012) for R software. To evaluate the goodness-of-fit of the CFA models, the χ^2 was considered, as well as three additional fit indices, namely the root mean square error of approximation (RMSEA), the comparative fit index (CFI), and the standardized root mean square residual (SRMR). A model shows a good fit to data if χ^2 is nonsignificant. Moreover, values close to or smaller than .08 for RMSEA and SRMR, as well as values close to or greater than .90 for CFI, indicate an acceptable fit (Brown, 2015).

Finally, missing values were considered. Data were missing completely at random (Little's MCAR test $\chi^2 = 250.98$, $df = 221$, $p = .08$; Tabachnick & Fidell, 2013), and before analysing data missing values were estimated using the expectation-maximization algorithm (Cox, McIntosh, Reason, & Terenzi, 2014). Overall, 27 missing values (0.9%) were imputed.

RESULTS

First, the CFA showed a good fit to data: $\chi^2(4) = 6.55, p = .16$; RMSEA = .07; CFI = .99; SRMR = .05. In the model, workaholism and work engagement could be identified as distinct and uncorrelated forms of heavy work investment.

The results of the regression analysis are presented in Table 1. In the model, the predictors accounted for 12.6% of the variance in IL-17, $F(6, 112) = 2.68, p < .05$. Workaholism was positively associated with IL-17, controlling for the effect of demographic characteristics (i.e., gender, age, and BMI) and work engagement, $b = 10.16, p < .05$; 95% bootstrap CI [0.72, 19.57]. Therefore, our first hypothesis (H1) was supported.

TABLE 1
 Results from moderated multiple regression analyses ($N = 119$)

	<i>B</i>	<i>SE</i>	<i>t</i>
Intercept	58.34***	4.85	12.02
Gender ^a	-16.49	9.96	-1.65
Age	-0.87	0.47	-1.88
BMI	1.59	1.41	1.12
Workaholism	10.16*	4.69	2.17
Work engagement	-4.82	5.43	-0.89
Workaholism × work engagement	-14.16*	6.00	-2.36

Note. ^a0 = female, 1 = male; *SE* = standard error; BMI = body mass index.
 * $p < .05$. *** $p < .001$.

The interaction between workaholism and work engagement was significant, $b = -14.16, p < .05$; 95% bootstrap CI [-29.04, -2.14], and accounted for an additional 4.3% of the variance in IL-17 over demographics variables and the two types of heavy work investment, $F_{\text{change}}(1, 112) = 5.57, p < .05$. The simple slope analysis showed that the relationship between workaholism and IL-17 was positive and significant when work engagement was low, $b = 21.01, p < .01$; 95% bootstrap CI [7.25, 35.52], but not significant when work engagement was high. The interaction between workaholism and work engagement is presented graphically in Figure 1. Work engagement, therefore, buffered the association between workaholism and IL-17. Our second hypothesis (H2) was supported.

DISCUSSION

This study examined the association between two different forms of heavy work investment, namely workaholism and work engagement, and serum levels of the proinflammatory cytokine IL-17, a possible biomarker of stress. Building on the conceptualization of workaholism as a “bad” kind of heavy work investment (Schaufeli, 2016) and drawing on the AL model (Juster et al., 2010) and the E-R model (Meijman & Mulder, 1998), we hypothesized that workaholism is positively associated with IL-17. The second aim of this study was to investigate the moderating role of work engagement, a “good” kind of heavy work investment (Schaufeli, 2016), in the relationship between workaholism and IL-17.

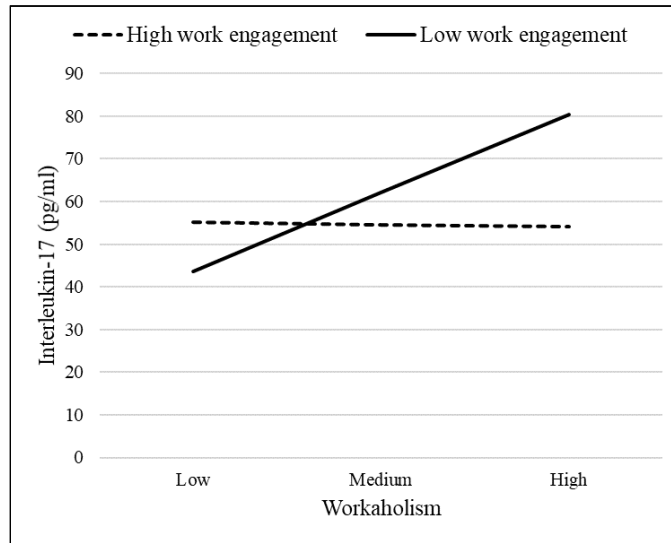


FIGURE 1
Interaction between workaholism and work engagement on IL-17.

More specifically, based on the seminal work of van Beek et al. (2011) and the more recent conceptualization of Loscalzo and Giannini (2017), we hypothesized that work engagement buffers the association between workaholism and IL-17, which is expected to be attenuated when work engagement is high, and stronger when work engagement is low.

The results of this study supported our predictions. First, the relationship between workaholism and IL-17 was positive and significant, after controlling for the effect of demographic characteristics such as gender, age, and BMI. Furthermore, work engagement buffered this association, which was positive and significant when work engagement was low, but not significant when work engagement was high. To the best of the authors' knowledge, this was the first study that investigated the possible moderating role of work engagement in the relationship between workaholism and inflammatory mediators (e.g., proinflammatory cytokines), whereas most previous studies relied on self-reported measures of health complaints and psychophysical strain (with some exceptions; see for example ten Brummelhuis et al., 2017). A strength of this approach is that the combination of different measurement methods may be useful to reduce common method bias due to negative affectivity, for example (Girardi, Falco, Dal Corso, Kravina, & De Carlo, 2011; Podsakoff et al., 2012). Moreover, although self-reported health complaints are useful indicators of how one person feels, the investigation of biomarkers may contribute to shed light on the psycho-physiological mechanisms that can explain the relationship between workaholism, work engagement, and long-term consequences for the health of the workers.

We believe that these findings provide a valuable contribution to the existing literature on workaholism and work engagement. First, our study suggests that workaholism is associated with a possible biomarker of stress, the proinflammatory cytokine IL-17. This is consistent with previous research that identified inflammation, in terms of increased proinflammatory activity, as one of the mechanisms that link psychosocial stress (including work-related stress) on the one hand, and physical or psychological diseases on the other (e.g., depression and cardiovascular disease; Endrighi et al., 2016; Ganster & Rosen, 2013; Gouin et al., 2012; Pearson et al., 2003; Rohleder, 2014). From a theoretical standpoint, the association between workaholism and markers of inflammation can be interpreted in the light of the AL model and the E-R

models (Juster et al., 2010; Meijman & Mulder, 1998). Indeed, effort expenditures at work are unavoidably associated with short-lived physiological reactions (e.g., the inflammatory response, among others), which may result in sustained psycho-physiological activation (e.g., chronic low-grade inflammation) in cases of prolonged exposure to job demands and incomplete recovery (Geurts & Sonnentag, 2006). Workaholics, given their strong urge to work hard, dedicate an excessive amount of time and effort to their work, even during off-work time, and find it difficult to mentally “switch off” from work (Schaufeli, Taris, & Van Rhenen, 2008; Scott et al., 1997). This may interfere with the recovery process, with detrimental consequences for the health of the worker in the long run (Ganster & Rosen, 2013). Overall, our findings are consistent with previous research that identified workaholism as a “bad” kind of heavy work investment (Schaufeli, 2016), with negative consequences for the individual both in the short term (e.g., daily exhaustion; Molino et al., 2018) and in the long term (e.g., psycho-physical strain and sickness absences; Matsu-daira et al., 2013; Shimazu et al., 2015).

Second, our results showed that work engagement buffers the association between workaholism and IL-17, which was not significant when work engagement was high. From an empirical point of view, these findings are in line with those of previous studies that investigated similar pattern of associations using self-reported measures (Scafuri Kovalchuk et al., 2019; Spagnoli et al., 2018) or objective indicators (i.e., biomarkers; ten Brummelhuis et al., 2017) to determine health and well-being. From a theoretical standpoint, our results may be explained in the light of the conservation of resources (COR; Hobfoll, 1989, 2001) theory. According to the COR theory, individuals try to acquire, retain, and protect resources, which may include energies (e.g., time, money, physical/psychological energy), conditions (e.g., tenure or occupational status), and personal characteristics (e.g., self-esteem). Stress may occur when resources are threatened with loss or actually lost, or when individuals do not gain adequate resources following relevant investment. Workaholics, who work excessively hard in a compulsive way, are likely to invest substantial time and effort (i.e., resources) in their work at the expense of recovery and private life, which results in resource loss and stress reactions (Bakker, Shimazu, Demerouti, Shimada, & Kawakami, 2013). On the contrary, work engagement is associated with more job and personal resources (Xanthopoulou, Bakker, Demerouti, & Schaufeli, 2009), and engaged workaholics have higher levels of resources compared to disengaged workaholics (ten Brummelhuis et al., 2017). In line with the COR theory, individuals with more resources (e.g., engaged workaholics) are less vulnerable to resource loss, compared to those with fewer resources (e.g., disengaged workaholics), because they are better able to deal with stressful situation (Hobfoll, 2001). In this perspective, engaged workaholics may use resources available to them (e.g., taking time off to recover, social support from supervisor or at home) to cope with primary stress reactions associated with resource loss (e.g., daily fatigue or daily exhaustion) and prevent loss spirals as well as more severe health complaints in the long run (ten Brummelhuis et al., 2017).

Finally, our findings are consistent with previous research that investigated the association between workaholism, work engagement, and objective health measures, including physiological indicators. Balducci et al. (2018) found that workaholism was positively associated with systolic blood pressure, whereas in the study by Salanova et al. (2016) workaholism was positively related to sleep problems and cardiovascular risk. Interestingly, Eguchi et al. (2015) found that individuals with moderate and high levels of work engagement at baseline had significantly lower odds ratios of having high levels of high-sensitivity C-reactive protein after one year. In the study by ten Brummelhuis et al. (2017) workaholism was positively associated with the risk factors for metabolic syndrome (i.e., a physiological health indicator), but only when work engagement was low. Taken together, these findings shed light on possible psycho-physiological mechanisms, such as for example inflammation (as in the case of the present work), that can

explain the relationship between workaholism, work engagement, and long-term consequences for the health of the workers. However, given the small number of studies available, caution is needed in drawing conclusions about the physiological processes underlying the association between heavy work investment and health, and more research is needed to replicate and expand these initial, albeit promising, findings.

Our study has some limitations. First, the study was carried in a single Italian public healthcare organization and involved a relatively small sample of healthcare professionals, which may limit the generalization of the results to other populations. Moreover, the cross-sectional research design did not allow for causal inferences. For example, although we assumed that workaholism may lead to psychophysical strain, it is also possible that employees with impaired health (i.e., with high levels of proinflammatory cytokines) may feel compelled to work long hours, to meet the deadlines or the expectations of others, such as supervisors or colleagues (i.e., they are exposed to higher job demands). This, in the long run, may lead to the onset of workaholism (Andreassen et al., 2017; Balducci et al., 2018). Therefore, future studies should be conducted across different organizations and cultural contexts and could use longitudinal or within-person research design. Finally, in this study we focused on a single biomarker, the proinflammatory cytokine IL-17. However, in terms of early diagnosis and prevention of future health consequences, it will be useful to identify a panel of possible biomarkers of workaholism and psychosocial stress (similarly to the composite AL index; Juster et al., 2010).

Finally, this study has several practical implications for practitioners. First, supervisors play a central role in primary prevention, especially in today's organizations, characterized by innovative dynamics, complexity, and change (Ivaldi & Scaratti, 2019; Scaratti & Ivaldi, 2015). They can adopt leadership styles (e.g., transformational leadership; Salanova, Lorente, Chambel, & Martínez, 2011) and provide workers with job resources (e.g., instrumental or emotional support; Barbieri, Amato, Passafaro, Dal Corso, & Picciau, 2014; Barbieri, Dal Corso, Di Sipio, De Carlo, & Benevene, 2016; Guidetti, Converso, Loera, & Viotti, 2018; Schaufeli, Bakker, & Van Rhenen, 2009) that foster work engagement. Moreover, organizations and supervisors should consider individual characteristics of employees, such as locomotion and proactivity (Falvo, Visintin, Capozza, Falco, & De Carlo, 2013), in designing work teams. Similarly, organizations should promote activities that favor recovery and reduce work-home interference (De Carlo, Girardi, Falco, Dal Corso, & Di Sipio, 2019; Geurts and Sonnentag, 2006). Concerning secondary prevention, interventions should be aimed at promoting personal resources (e.g., self-esteem; van Beek et al., 2012) in individuals at risk of workaholism (e.g., with high levels of perfectionism; Falco et al., 2017; Falco, Piccirilli, Girardi, Di Sipio, & De Carlo, 2014; Girardi, Falco, De Carlo, Dal Corso, & Benevene, 2018). Moreover, specific training programs could help workers to develop mindfulness (Magnano, Platania, Ramaci, Santisi, & Di Nuovo, 2017; Ramaci, Bellini, Presti, & Santisi, 2019), personal resources (e.g., emotional intelligence and courage; Magnano, Paolillo, Platania, & Santisi, 2017; Magnano, Santisi, & Platania, 2018; Platania, Castellano, Petralia, & Santisi, 2019) as well as skills (time management; Richardson & Rothstein, 2008) needed to cope effectively with job demands which, in the long run, may lead to the onset of workaholism (Andreassen et al., 2017). Finally, in terms of tertiary prevention, occupational physicians or psychologists/psychotherapists (Durand-Moreau, Deun, Lodde, & Dewitte, 2018) should be involved in the support, treatment, and rehabilitation of workaholics to prevent future diseases that may be associated with inflammation (e.g., depression or cardiovascular diseases; Miller & Raison, 2016; Pearson et al., 2003). At this stage, interventions may involve employee assistance programs (EAP; Robinson, 1997) as well as cognitive-behavioural interventions and cognitive-constructivist interventions (Burwell & Chen, 2002; Dal Corso, Floretta, Falco, Benevene, & De Carlo, 2013).

In conclusion, although workaholics usually work long hours, not all employees working long hours are necessarily addicted to work (Taris, Schaufeli, & Verhoeven, 2005; ten Brummelhuis et al., 2017). In this study, we found that workaholism, a “bad” kind of heavy work investment (Schaufeli, 2016), was positively associated with IL-17, a possible biomarker of stress. Moreover, work engagement, a “good” kind of heavy work investment, buffered this association, which was not significant when work engagement was high. Given that inflammation is considered as one of the mechanisms that link psychosocial stress and health risk (Rohleder, 2014), interventions should be aimed at preventing workaholism and promoting work engagement.

REFERENCES

- Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Newbury Park, CA: Sage.
- Airila, A., Hakanen, J. J., Schaufeli, W. B., Luukkonen, R., Punakallio, A., & Lusa, S. (2014). Are job and personal resources associated with work ability 10 years later? The mediating role of work engagement. *Work & Stress*, 28, 87-105.
doi:10.1080/02678373.2013.872208
- Andreassen, C. S. (2014). Workaholism: An overview and current status of the research. *Journal of Behavioral Addictions*, 3, 1-11.
doi:10.1556/JBA.2.2013.017
- Andreassen, C. S., Bakker, A. B., Bjorvatn, B., Moen, B. E., Magerøy, N., Shimazu, A., . . . Pallesen, S. (2017). Working conditions and individual differences are weakly associated with workaholism: A 2-3-year prospective study of shift-working nurses. *Frontiers in Psychology*, 8, 2045.
doi:10.3389/fpsyg.2017.02045
- Andreassen, C. S., Hetland, J., Molde, H., & Pallesen, S. (2011). ‘Workaholism’ and potential outcomes in well-being and health in a cross-occupational sample. *Stress and Health*, 27, 209-214.
doi:10.1002/smi.1366
- Andreassen, C. S., Pallesen, S., & Torsheim, T. (2018). Workaholism as a mediator between work-related stressors and health outcomes. *International Journal of Environmental Research and Public Health*, 15, 73.
doi:10.3390/ijerph15010073
- American Psychiatric Association. (2000). *Diagnostic and Statistical Manual of Mental Disorders – Fourth edition, Text Revision*. Washington, DC: American Psychiatric Association
- Bakker, A. B., Albrecht, S. L., & Leiter, M. P. (2011). Key questions regarding work engagement. *European Journal of Work and Organizational Psychology*, 20, 4-28.
doi:10.1080/1359432X.2010.485352
- Bakker, A. B., Shimazu, A., Demerouti, E., Shimada, K., & Kawakami, N. (2013). Work engagement versus workaholism: A test of the spillover-crossover model. *Journal of Managerial Psychology*, 29, 63-80.
doi:10.1108/JMP-05-2013-0148
- Balducci, C., Avanzi, L., & Fraccaroli, F. (2018). The individual “costs” of workaholism: An analysis based on multisource and prospective data. *Journal of Management*, 44, 2961-2986.
doi:10.1177/0149206316658348
- Balducci, C., Fraccaroli, F., & Schaufeli, W. B. (2010). Psychometric properties of the Italian version of the Utrecht Work Engagement Scale (UWES-9). *European Journal of Psychological Assessment*, 26, 143-149.
doi:10.1027/1015-5759/a000020
- Barbieri, B., Amato, C., Passafaro, P., Dal Corso, L., & Picciau, M. (2014). Social support, work engagement, and non-vocational outcomes in people with severe mental illness. *TPM – Testing, Psychometrics, Methodology in Applied Psychology*, 21, 181-196.
doi:10.4473/TPM21.2.5
- Barbieri, B., Dal Corso, L., Di Sipio, A., De Carlo, A., & Benevene, P. (2016). Small opportunities are often the beginning of great enterprises: The role of work engagement in support of people through the recovery process and in preventing relapse in drug and alcohol abuse. *Work*, 55, 373-383.
doi:10.3233/WOR-162411
- Baruch, Y. (2011). The positive wellbeing aspects of workaholism in cross cultural perspective: The choholism metaphor. *Career Development International*, 16, 572-591.
doi:10.1108/13620431111178335
- Beringer, A., Noack, M., & Miossec, P. (2016). IL-17 in chronic inflammation: From discovery to targeting. *Trends in Molecular Medicine*, 22, 230-241.
doi:10.1016/j.molmed.2016.01.001

- Bourke, C. H., Harrell, C. S., & Neigh, G. N. (2012). Stress-induced sex differences: Adaptations mediated by the glucocorticoid receptor. *Hormones and Behavior*, *62*, 210-218.
doi:10.1016/j.yhbeh.2012.02.024
- Breaugh, J. A., & Frye, N. K. (2008). Work-family conflict: The importance of family-friendly employment practices and family-supportive supervisors. *Journal of Business and Psychology*, *22*, 345-353.
doi:10.1007/s10869-008-9081-1
- Brown, T. A. (2015). *Confirmatory factor analysis for applied research* (2nd ed.). New York, NY: Guilford Press.
- Burwell, R., & Chen, C. P. (2002). Applying REBT to workaholic clients. *Counselling Psychology Quarterly*, *15*, 219-228.
doi:10.1080/09515070210143507
- Christian, M. S., Garza, A. S., & Slaughter, J. E. (2011). Work engagement: A quantitative review and test of its relations with task and contextual performance. *Personnel Psychology*, *64*, 89-136.
doi:10.1111/j.1744-6570.2010.01203.x
- Clark, M. A., Michel, J. S., Zhdanova, L., Pui, S. Y., & Baltes, B. B. (2016). All work and no play? A meta-analytic examination of the correlates and outcomes of workaholism. *Journal of Management*, *42*, 1836-1873.
doi:10.1177/0149206314522301
- Comar, M., Zanotta, N., Bonotti, A., Tognon, M., Negro, C., Cristaudo, A., & Bovenzi, M. (2014). Increased levels of C-C chemokine RANTES in asbestos exposed workers and in malignant mesothelioma patients from an hyperendemic area. *PLoS ONE*, *9*(8), e104848.
doi:10.1371/journal.pone.0104848
- Cox, B. E., McIntosh, K., Reason, R. D., & Terenzini, P. T. (2014). Working with missing data in higher education research: A primer and real-world example. *The Review of Higher Education*, *37*, 377-402.
doi:10.1353/rhe.2014.0026
- Cropley, M., Rydstedt, L. W., Devereux, J. J., & Middleton, B. (2015). The relationship between work-related rumination and evening and morning salivary cortisol secretion. *Stress and Health*, *31*, 150-157.
doi:10.1002/smi.2538
- Davami, M. H., Baharlou, R., Ahmadi Vasmehjani, A., Ghanizadeh, A., Keshtkar, M., Dezhkam, I., & Atashzar, M. R. (2016). Elevated IL-17 and TGF- β serum levels: A positive correlation between T-helper 17 cell-related pro-inflammatory responses with major depressive disorder. *Basic and Clinical Neuroscience*, *7*, 137-142.
doi:10.15412/J.BCN.03070207
- Dal Corso, L., Floretta, P., Falco, A., Benevene, P., & De Carlo, A. (2013). The repertory grid technique in a research-intervention on work-related stress. *TPM – Testing, Psychometrics, Methodology in Applied Psychology*, *20*, 155-168.
doi:10.4473/TPM20.2.4
- De Carlo, N. A., Dal Corso, L., Falco, A., Girardi, D., & Piccirelli, A. (2016). “To be rather than to seem”: The impact of supervisor’s and personal responsibility on work engagement, job performance, and job satisfaction in a positive healthcare organization. *TPM – Testing, Psychometrics, Methodology in Applied Psychology*, *23*, 561-580.
doi:10.4473/TPM23.4.9
- De Carlo, A., Girardi, D., Falco, A., Dal Corso, L., & Di Sipio, A. (2019). When does work interfere with teachers’ private life? An application of the Job Demands-Resources model. *Frontiers in Psychology*, *10*, 1121.
doi:10.3389/fpsyg.2019.01121
- Derks, D., & Bakker, A. B. (2010). The impact of e-mail communication on organizational life. *Cyberpsychology: Journal of Psychosocial Research on Cyberspace*, *4*(1), 4.
Retrieved from <https://cyberpsychology.eu/article/view/4233>
- Di Stefano, G., & Gaudiino, M. (2019). Workaholism and work engagement: How are they similar? How are they different? A systematic review and meta-analysis. *European Journal of Work and Organizational Psychology*, *28*, 329-347.
doi:10.1080/1359432X.2019.1590337
- Durand-Moreau, Q., Deun, C. L., Lodde, B., & Dewitte, J.-D. (2018). The framework of clinical occupational medicine to provide new insight for workaholism. *Industrial Health*, *56*, 441-451.
doi:10.2486/indhealth.2018-0021
- Efron, B., & Tibshirani, R. J. (1993). *An introduction to the bootstrap*. Boca Raton, FL: Chapman & Hall.
- Eguchi, H., Shimazu, A., Kawakami, N., Inoue, A., Nakata, A., & Tsutsumi, A. (2015). Work engagement and high-sensitivity C-reactive protein levels among Japanese workers: A 1-year prospective cohort study. *International Archives of Occupational and Environmental Health*, *88*, 651-658.
doi:10.1007/s00420-014-0995-9
- Endrighi, R., Hamer, M., & Steptoe, A. (2016). Post-menopausal women exhibit greater Interleukin-6 responses to mental stress than older men. *Annals of Behavioral Medicine*, *50*, 564-571.
doi:10.1007/s12160-016-9783-y

- Falco, A., Dal Corso, L., Girardi, D., De Carlo, A., Barbieri, B., Boatto, T., & Schaufeli, W. B. (2017). Why is perfectionism a risk factor for workaholism? The mediating role of irrational beliefs at work. *TPM – Testing, Psychometrics, Methodology in Applied Psychology*, *24*, 583-600. doi:10.4473/TPM24.4.8
- Falco, A., Dal Corso, L., Girardi, D., De Carlo, A., & Comar, M. (2018). The moderating role of job resources in the relationship between job demands and interleukin-6 in an Italian healthcare organization. *Research in Nursing & Health*, *41*, 39-48. doi:10.1002/nur.21844
- Falco, A., Girardi, D., Parmiani, G., Bortolato, S., Piccirelli, A., Bartolucci, G. B., & De Carlo, N. A. (2013). Presenteismo e salute dei lavoratori: Effetti di mediazione sullo strain psico-fisico in un'indagine longitudinale [Presenteeism and workers' health: Effects of mediation on psycho-physical stress in a longitudinal study]. *Giornale Italiano di Medicina del Lavoro ed Ergonomia*, *35*(3), 138-150.
- Falco, A., Kravina, L., Girardi, D., Dal Corso, L., Di Sipio, A., & De Carlo, N. A. (2012). The convergence between self and observer ratings of workaholism: A comparison between couples. *TPM – Testing, Psychometrics, Methodology in Applied Psychology*, *19*, 311-324. doi:10.4473/TPM19.4.5
- Falco, A., Piccirelli, A., Girardi, D., Di Sipio, A., & De Carlo, N. A. (2014). "The best or nothing": The mediating role of workaholism in the relationship between perfectionism and burnout. *TPM – Testing, Psychometrics, Methodology in Applied Psychology*, *21*, 213-232. doi:10.4473/TPM21.2.7
- Falk, C. F. (2018). Are robust standard errors the best approach for interval estimation with nonnormal data in structural equation modeling? *Structural Equation Modeling: A Multidisciplinary Journal*, *25*, 244-266. doi:10.1080/10705511.2017.1367254
- Falvo, R., Visintin, E. P., Capozza, D., Falco, A., & De Carlo, A. (2013). The relationships among workaholism, proactivity, and locomotion in a work setting. *Social Behavior and Personality: An International Journal*, *41*, 1557-1569. doi:10.2224/sbp.2013.41.9.1557
- Franceschi, C., & Campisi, J. (2014). Chronic inflammation (inflammaging) and its potential contribution to age-associated diseases. *The Journals of Gerontology: Series A*, *69*, S4-S9. doi:10.1093/gerona/glu057
- Gaab, J., Rohleder, N., Nater, U. M., & Ehlert, U. (2005). Psychological determinants of the cortisol stress response: The role of anticipatory cognitive appraisal. *Psychoneuroendocrinology*, *30*, 599-610. doi:10.1016/j.psyneuen.2005.02.001
- Ganster, D. C., & Rosen, C. C. (2013). Work stress and employee health: A multidisciplinary review. *Journal of Management*, *39*, 1085-1122. doi:10.1177/0149206313475815
- Geurts, S. A. E., & 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*, 482-492. doi:10.5271/sjweh.1053
- Girardi, D., Falco, A., Dal Corso, L., Kravina, L., & De Carlo, A. (2011). Interpersonal conflict and perceived work stress: The role of negative affectivity. *TPM – Testing, Psychometrics, Methodology in Applied Psychology*, *18*, 257-273. doi:10.4473/TPM.18.4.5
- Girardi, D., Falco, A., De Carlo, A., Benevene, P., Comar, M., Tongiorgi, E., & Bartolucci, G. B. (2015). The mediating role of interpersonal conflict at work in the relationship between negative affectivity and biomarkers of stress. *Journal of Behavioral Medicine*, *38*, 922-931. doi:10.1007/s10865-015-9658-x
- Girardi, D., Falco, A., De Carlo, A., Dal Corso, L., & Benevene, P. (2018). Perfectionism and workaholism in managers: The moderating role of workload. *TPM – Testing, Psychometrics, Methodology in Applied Psychology*, *25*, 571-588. doi:10.4473/TPM25.4.7
- Girardi, D., Falco, A., Piccirelli, A., Dal Corso, L., Bortolato, S., & De Carlo, A. (2015). Perfectionism and presenteeism among managers of a service organization: The mediating role of workaholism. *TPM – Testing, Psychometrics, Methodology in Applied Psychology*, *22*, 507-521. doi:10.4473/TPM22.4.5
- Gorgievski, M. J., & Bakker, A. B. (2010). Passion for work: Work engagement versus workaholism. In S. L. Albrecht (Ed.), *The handbook of employee engagement: Perspectives, issues, research and practice* (pp. 264-271). Cheltenham, UK: Edward Elgar.
- Gouin, J.-P., Glaser, R., Malarkey, W. B., Beversdorf, D., & Kiecolt-Glaser, J. (2012). Chronic stress, daily stressors, and circulating inflammatory markers. *Health Psychology*, *31*, 264-268. doi:10.1037/a0025536

- Gregor, M. F., & Hotamisligil, G. S. (2011). Inflammatory mechanisms in obesity. *Annual Review of Immunology*, 29, 415-445.
doi:10.1146/annurev-immunol-031210-101322
- Guidetti, G., Converso, D., Loera, B., & Viotti, S. (2018). Concerns about change and employee wellbeing: The moderating role of social support. *Journal of Workplace Learning*, 30, 216-228.
doi:10.1108/JWL-09-2017-0083
- Hakanen, J. J., & Peeters, M. C. W. (2015). How do work engagement, workaholism, and the work-to-family interface affect each other? A 7-year follow-up study: *Journal of Occupational and Environmental Medicine*, 57, 601-609.
doi:10.1097/JOM.0000000000000457
- Hakanen, J. J., & Schaufeli, W. B. (2012). Do burnout and work engagement predict depressive symptoms and life satisfaction? A three-wave seven-year prospective study. *Journal of Affective Disorders*, 141, 415-424.
doi:10.1016/j.jad.2012.02.043
- Halbesleben, J. R. B. (2010). A meta-analysis of work engagement: Relationships with burnout, demands, resources, and consequences. In A. B. Bakker & M. P. Leiter (Eds.), *Work engagement: A handbook of essential theory and research* (pp. 102-117). New York, NY: Psychology Press.
- Hänsel, A., Hong, S., Cámara, R. J. A., & von Känel, R. (2010). Inflammation as a psychophysiological biomarker in chronic psychosocial stress. *Neuroscience and Biobehavioral Reviews*, 35, 115-121.
doi:10.1016/j.neubiorev.2009.12.012
- Hobfoll, S. E. (1989). Conservation of resources: A new attempt at conceptualizing stress. *American Psychologist*, 44, 513-524.
doi:10.1037/0003-066X.44.3.513
- Hobfoll, S. E. (2001). The influence of culture, community, and the nested-self in the stress process: Advancing conservation of resources theory. *Applied Psychology*, 50, 337-421.
doi:10.1111/1464-0597.00062
- Isailovic, N., Daigo, K., Mantovani, A., & Selmi, C. (2015). Interleukin-17 and innate immunity in infections and chronic inflammation. *Journal of Autoimmunity*, 60, 1-11.
doi:10.1016/j.jaut.2015.04.006
- Ivaldi, S., & Scaratti, G. (2019). Coworking hybrid activities between plural objects and sharing thickness. *TPM – Testing, Psychometrics, Methodology in Applied Psychology*, 26, 121-147.
doi:10.4473/TPM26.1.7
- Juster, R.-P., McEwen, B. S., & Lupien, S. J. (2010). Allostatic load biomarkers of chronic stress and impact on health and cognition. *Neuroscience & Biobehavioral Reviews*, 35, 2-16.
doi:10.1016/j.neubiorev.2009.10.002
- Kravina, L., Falco, A., Girardi, D., & De Carlo, N. A. (2010). Workaholism among management and workers in an Italian cooperative enterprise. *TPM – Testing, Psychometrics, Methodology in Applied Psychology*, 17, 201-216.
doi:10.4473/TPM.17.4.2
- Kubota, K., Shimazu, A., Kawakami, N., Takahashi, M., Nakata, A., & Schaufeli, W. B. (2010). Association between workaholism and sleep problems among hospital nurses. *Industrial Health*, 48, 864-871.
doi:10.2486/indhealth.MS1139
- Liu, Y., West, S. G., Levy, R., & Aiken, L. S. (2017). Tests of simple slopes in multiple regression models with an interaction: Comparison of four approaches. *Multivariate Behavioral Research*, 52, 445-464.
doi:10.1080/00273171.2017.1309261
- Loscalzo, Y., & Giannini, M. (2017). Clinical conceptualization of workaholism: A comprehensive model. *Organizational Psychology Review*, 7(4), 306-329. doi:10.1177/2041386617734299
- Loscalzo, Y., & Giannini, M. (2019). What type of worker are you? Work-related Inventory (WI-10): A comprehensive instrument for the measurement of workaholism. *Work*, 62, 383-392.
doi:10.3233/WOR-192875
- Magnano, P., Paolillo, A., Platania, S., & Santisi, G. (2017). Courage as a potential mediator between personality and coping. *Personality and Individual Differences*, 111, 13-18.
doi:10.1016/j.paid.2017.01.047
- Magnano, P., Platania, S., Ramaci, T., Santisi, G., & Di Nuovo, S. (2017). Validation of the Italian version of the Mindfulness Organizing Scale (MOS) in organizational contexts. *TPM – Testing, Psychometrics, Methodology in Applied Psychology*, 24, 45-64.
doi:10.4473/TPM24.1.3
- Magnano, P., Santisi, G., & Platania, S. (2018). Emotional intelligence as mediator between burnout and organisational outcomes. *International Journal of Work Organisation and Emotion*, 8, 305-320.
doi:10.1504/IJWOE.2017.089295
- Magnusson Hanson, L. L., Virtanen, M., Rod, N. H., Steptoe, A., Head, J., Batty, G., . . . Westerlund, H. (2019). Does inflammation provide a link between psychosocial work characteristics and diabetes? Analysis of the role of interleukin-6 and C-reactive protein in the Whitehall II cohort study. *Brain, Behavior, and Immunity*, 78, 153-160.
doi:10.1016/j.bbi.2019.01.017

- Marsland, A. L., Walsh, C., Lockwood, K., & John-Henderson, N. A. (2017). The effects of acute psychological stress on circulating and stimulated inflammatory markers: A systematic review and meta-analysis. *Brain, Behavior, and Immunity*, *64*, 208-219.
doi:10.1016/j.bbi.2017.01.011
- Matsudaira, K., Shimazu, A., Fujii, T., Kubota, K., Sawada, T., Kikuchi, N., & Takahashi, M. (2013). Workaholism as a risk factor for depressive mood, disabling back pain, and sickness absence. *PLoS ONE*, *8*, e75140.
doi:10.1371/journal.pone.0075140
- Meijman, T. F., & Mulder, G. (1998). Psychological aspects of workload. In P. J. Drenth, H. Thierry, & C. J. de Wolff (Eds.), *Handbook of work and organizational psychology* (pp. 5-33). Hove, UK: Psychology Press.
- Miller, G. E., & Blackwell, E. (2006). Turning up the heat: Inflammation as a mechanism linking chronic stress, depression, and heart disease. *Current Directions in Psychological Science*, *15*, 269-272.
doi:10.1111/j.1467-8721.2006.00450.x
- Miller, A. H., & Raison, C. L. (2016). The role of inflammation in depression: From evolutionary imperative to modern treatment target. *Nature Reviews Immunology*, *16*, 22-34.
doi:10.1038/nri.2015.5
- Miossec, P., & Kolls, J. K. (2012). Targeting IL-17 and TH17 cells in chronic inflammation. *Nature Reviews Drug Discovery*, *11*, 763-776.
doi:10.1038/nrd3794
- Miossec, P., Korn, T., & Kuchroo, V. K. (2009). Interleukin-17 and Type 17 Helper T Cells. *New England Journal of Medicine*, *361*, 888-898.
doi:10.1056/NEJMra0707449
- Molino, M., Cortese, C. G., & Ghislieri, C. (2018). Daily effect of recovery on exhaustion: A cross-level interaction effect of workaholism. *International Journal of Environmental Research and Public Health*, *15*, 1920.
doi:10.3390/ijerph15091920
- Molino, M., Cortese, C. G., & Ghislieri, C. (2019). Unsustainable working conditions: The association of destructive leadership, use of technology, and workload with workaholism and exhaustion. *Sustainability*, *11*, 446.
doi:10.3390/sul1020446
- Ng, T. W. H., Sorensen, K. L., & Feldman, D. C. (2007). Dimensions, antecedents, and consequences of workaholism: A conceptual integration and extension. *Journal of Organizational Behavior*, *28*, 111-136.
doi:10.1002/job.424
- Nie, Y., & Sun, H. (2016). Why do workaholics experience depression? A study with Chinese University teachers. *Journal of Health Psychology*, *21*, 2339-2346.
doi:10.1177/1359105315576350
- Pearson, T. A., Mensah, G. A., Alexander, R. W., Anderson, J. L., Cannon, R. O., Criqui, M., . . . Vinicor, F. (2003). Markers of inflammation and cardiovascular disease. Application to clinical and public health practice: A statement for healthcare professionals from the Centers for Disease Control and Prevention and the American Heart Association. *Circulation*, *107*, 499-511.
doi:10.1161/01.CIR.0000052939.59093.45
- Platania, S., Castellano, S., Petralia, M. C., & Santisi, G. (2019). L'effetto mediatore dell'impatto della qualità della vita nella relazione tra qualità di vita professionale e stress percepito dei caregiver formali [The mediating effect of the impact of quality of life on the relationship between professional quality of life and perceived stress of formal caregivers]. *Psicologia della Salute*, *1*, 64-83.
doi:10.3280/PDS2019-001004
- Podsakoff, P. M., MacKenzie, S. B., & Podsakoff, N. P. (2012). Sources of method bias in social science research and recommendations on how to control it. *Annual Review of Psychology*, *63*, 539-569.
doi:10.1146/annurev-psych-120710-100452
- R Core Team (2018). *R: A language and environment for statistical computing* [Computer software]. Vienna, Austria: R Foundation for Statistical Computing.
- Ramaci, T., Bellini, D., Presti, G., & Santisi, G. (2019). Psychological flexibility and mindfulness as predictors of individual outcomes in hospital health workers. *Frontiers in Psychology*. Advance online publication.
doi:10.3389/fpsyg.2019.01302
- Richardson, K. M., & Rothstein, H. R. (2008). Effects of occupational stress management intervention programs: A meta-analysis. *Journal of Occupational Health Psychology*, *13*, 69-93.
doi:10.1037/1076-8998.13.1.69
- Robinson, B. E. (1997). Work addiction: Implications for EAP counseling and research. *Employee Assistance Quarterly*, *12*, 1-13.
doi:10.1300/J022v12n04_01

- Rohleder, N. (2014). Stimulation of systemic low-grade inflammation by psychosocial stress. *Psychosomatic Medicine*, 76, 181-189.
doi:10.1097/PSY.0000000000000049
- Rosseel, Y. (2012). lavaan: An R package for structural equation modeling. *Journal of Statistical Software*, 48, 1-36.
doi:10.18637/jss.v048.i02
- Salanova, M., López-González, A. A., Llorens, S., del Líbano, M., Vicente-Herrero, M. T., & Tomás-Salvá, M. (2016). Your work may be killing you! Workaholism, sleep problems and cardiovascular risk. *Work & Stress*, 30, 228-242.
doi:10.1080/02678373.2016.1203373
- Salanova, M., Lorente, L., Chambel, M. J., & Martínez, I. M. (2011). Linking transformational leadership to nurses' extra-role performance: The mediating role of self-efficacy and work engagement. *Journal of Advanced Nursing*, 67, 2256-2266.
doi:10.1111/j.1365-2648.2011.05652.x
- Scafuri Kovalchuk, L., Buono, C., Ingusci, E., Maiorano, F., De Carlo, E., Madaro, A., & Spagnoli, P. (2019). Can work engagement be a resource for reducing workaholism's undesirable outcomes? A multiple mediating model including moderated mediation analysis. *International Journal of Environmental Research and Public Health*, 16, 1402.
doi:10.3390/ijerph16081402
- Scaratti, G., Ivaldi, S. (2015). Manager on the ground. A practice based approach for developing management education: Lessons from complex and innovative organizations. *BPA Applied Psychology Bulletin*, 63(272), 42-57.
- Schaufeli, W. B. (2016). Heavy work investment, personality and organizational climate. *Journal of Managerial Psychology*, 31, 1057-1073.
doi:10.1108/JMP-07-2015-0259
- Schaufeli, W. B., Bakker, A. B., & Salanova, M. (2006). The measurement of work engagement with a short questionnaire: A cross-national study. *Educational and Psychological Measurement*, 66, 701-716.
doi:10.1177/0013164405282471
- Schaufeli, W. B., Bakker, A. B., van der Heijden, F. M. M. A., & Prins, J. T. (2009). Workaholism among medical residents: It is the combination of working excessively and compulsively that counts. *International Journal of Stress Management*, 16, 249-272.
doi:10.1037/a0017537
- Schaufeli, W. B., Bakker, A. B., & Van Rhenen, W. (2009). How changes in job demands and resources predict burnout, work engagement, and sickness absenteeism. *Journal of Organizational Behavior*, 30, 893-917.
doi:10.1002/job.595
- Schaufeli, W. B., Salanova, M., González-romá, V., & Bakker, A. B. (2002). The measurement of engagement and burnout: A two sample confirmatory factor analytic approach. *Journal of Happiness Studies*, 3, 71-92.
doi:10.1023/A:1015630930326
- Schaufeli, W. B., Taris, T. W., & Bakker, A. B. (2008). It takes two to tango: Workaholism is working excessively and working compulsively. In R. J. Burke & C. L. Cooper (Eds.), *The long work hours culture: Causes, consequences and choices* (pp. 203-225). Bingley, UK: Emerald.
- Schaufeli, W. B., Taris, T. W., & Van Rhenen, W. (2008). Workaholism, burnout, and work engagement: Three of a kind or three different kinds of employee well-being? *Applied Psychology*, 57, 173-203.
doi:10.1111/j.1464-0597.2007.00285.x
- Scott, K. S., Moore, K. S., & Miceli, M. P. (1997). An exploration of the meaning and consequences of workaholism. *Human Relations*, 50, 287-314.
doi:10.1023/A:1016986307298
- Shimazu, A., De Jonge, J., Kubota, K., & Kawakami, N. (2014). Psychological detachment from work during off-job time: Predictive role of work and non-work factors in Japanese employees. *Industrial Health*, 52, 141-146.
doi:10.2486/indhealth.2013-0210
- Shimazu, A., Schaufeli, W. B., Kamiyama, K., & Kawakami, N. (2015). Workaholism vs. work engagement: The two different predictors of future well-being and performance. *International Journal of Behavioral Medicine*, 22, 18-23.
doi:10.1007/s12529-014-9410-x
- Shimazu, A., Schaufeli, W. B., Kubota, K., & Kawakami, N. (2012). Do workaholism and work engagement predict employee well-being and performance in opposite directions? *Industrial Health*, 50, 316-321.
doi:10.2486/indhealth.MS1355
- Shimazu, A., Schaufeli, W. B., & Taris, T. W. (2010). How does workaholism affect worker health and performance? The mediating role of coping. *International Journal of Behavioral Medicine*, 17, 154-160.
doi:10.1007/s12529-010-9077-x

- Slavich, G. M., & Irwin, M. R. (2014). From stress to inflammation and major depressive disorder: A social signal transduction theory of depression. *Psychological Bulletin*, *140*, 774-815.
doi:10.1037/a0035302
- Snir, R., & Harpaz, I. (2012). Beyond workaholism: Towards a general model of heavy work investment. *Human Resource Management Review*, *22*, 232-243.
doi:10.1016/j.hrmr.2011.11.011
- Snir, R., & Zohar, D. (2008). Workaholism as discretionary time investment at work: An experience-sampling study. *Applied Psychology*, *57*, 109-127.
doi:10.1111/j.1464-0597.2006.00270.x
- Spagnoli, P., Balducci, C., Scafuri Kovalchuk, L., Maiorano, F., & Buono, C. (2018). Are engaged workaholics protected against job-related negative affect and anxiety before sleep? A study of the moderating role of gender. *International Journal of Environmental Research and Public Health*, *15*(9), 1996.
doi:10.3390/ijerph15091996
- Spence, J. T., & Robbins, A. S. (1992). Workaholism: Definition, measurement, and preliminary results. *Journal of Personality Assessment*, *58*, 160-178.
doi:10.1207/s15327752jpa5801_15
- Sud, V., Abboud, A., Tohme, S., Vodovotz, Y., Simmons, R. L., & Tsung, A. (2018). IL-17A – A regulator in acute inflammation: Insights from in vitro, in vivo and in silico studies. *Cytokine*. Advance online publication.
doi:10.1016/j.cyto.2018.03.030
- Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics* (6th ed.). Boston, MA: Pearson Education.
- Taris, T. W., Schaufeli, W. B., & Verhoeven, L. C. (2005). Workaholism in the Netherlands: Measurement and implications for job strain and work-nonwork conflict. *Applied Psychology: An International Review*, *54*, 37-60.
doi:10.1111/j.1464-0597.2005.00195.x
- ten Brummelhuis, L. L., Rothbard, N. P., & Uhrich, B. (2017). Beyond nine to five: Is working to excess bad for health? *Academy of Management Discoveries*, *3*, 262-283.
doi:10.5465/amd.2015.0115
- Vallerand, R. J., Blanchard, C., Mageau, G. A., Koestner, R., Ratelle, C., Leonard, M., . . . Marsolais, J. (2003). Les passions de l'Âme: On obsessive and harmonious passion. *Journal of Personality and Social Psychology*, *85*, 756-767.
doi:10.1037/0022-3514.85.4.756
- van Beek, I., Hu, Q., Schaufeli, W. B., Taris, T. W., & Schreurs, B. H. J. (2012). For fun, love, or money: What drives workaholic, engaged, and burned-out employees at work? *Applied Psychology*, *61*, 30-55.
doi:10.1111/j.1464-0597.2011.00454.x
- van Beek, I., Taris, T. W., & Schaufeli, W. B. (2011). Workaholic and work engaged employees: Dead ringers or worlds apart? *Journal of Occupational Health Psychology*, *16*, 468-482.
doi:10.1037/a0024392
- van Beek, I., Taris, T. W., Schaufeli, W. B., & Brenninkmeijer, V. (2014). Heavy work investment: Its motivational make-up and outcomes. *Journal of Managerial Psychology*, *29*, 46-62.
doi:10.1108/JMP-06-2013-0166
- van Wijhe, C. I., Peeters, M. C. W., & Schaufeli, W. B. (2014). Enough is enough: Cognitive antecedents of workaholism and its aftermath. *Human Resource Management*, *53*, 157-177.
doi:10.1002/hrm.21573
- van Wijhe, C. I., Peeters, M. C. W., Schaufeli, W. B., & Ouweneel, E. (2013). Rise and shine: Recovery experiences of workaholic and nonworkaholic employees. *European Journal of Work and Organizational Psychology*, *22*, 476-489.
doi:10.1080/1359432X.2012.663527
- Waisman, A., Hauptmann, J., & Regen, T. (2015). The role of IL-17 in CNS diseases. *Acta Neuropathologica*, *129*, 625-637.
doi:10.1007/s00401-015-1402-7
- Xanthopoulou, D., Bakker, A. B., Demerouti, E., & Schaufeli, W. B. (2009). Reciprocal relationships between job resources, personal resources, and work engagement. *Journal of Vocational Behavior*, *74*, 235-244.
doi:10.1016/j.jvb.2008.11.003