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# The daily costs of workaholism: A within-individual investigation on blood pressure, emotional exhaustion, and sleep disturbances

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## Author Note

We have no known conflict of interest to disclose.

The study hypotheses and procedures were preregistered prior to data collection at the Open Science Framework (OSF) repository, as publicly available from: https://osf.io/h9zvq.

All data, code, and materials are publicly available at the OSF repository accessible from: https://osf.io/awbxj.

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## Abstract

Workaholism literature has been so far focused on individual differences in workaholic tendencies, considering the construct as a stable individual trait, and highlighting its health and well-being consequences. Only recently, research has started inspecting the daily dynamics and potential consequences of state workaholism. In this preregistered study, we aimed at systematically investigating the within-individual fluctuations in workaholism levels and their potential short-term and delayed psychophysiological responses as captured by ambulatory assessment integrating subjective and objective data. Using an intensive longitudinal design over 10 workdays with 114 workers from various occupations (2,534 measurement occasions), we found higher systolic and diastolic blood pressure, emotional exhaustion, and sleep disturbances in workdays characterized by higher-than-usual workaholism symptoms. Moreover, the reactivity to state workaholism, as indexed by afternoon blood pressure, was found as a mediator of the subsequent prolonged activation indexed by bedtime blood pressure. Finally, we found evidence of a buffering effect of evening psychological detachment on the relationship between state workaholism and sleep disturbances. Overall, our results support the conceptualization of workaholism as a multilevel phenomenon that acts as an internal job-related demand by showing the typical strain reactions triggered by well characterized external demands. This study contributes to the literature by highlighting that transient workaholism symptoms can result in significant short-term stress responses at different levels, providing new, robust, and multi-source evidence that underlies the importance of effectively preventing and managing dysfunctional work investment since its early manifestation.

**Keywords:** State workaholism; Blood pressure; Burnout; Sleep quality; Ambulatory assessment

## Introduction

Over the last 10-to-15 years, an increasing body of research has addressed the phenomenon of workaholism, a dysfunctional form of heavy work investment characterized by an obsession with work and a tendency to work far beyond than required (Clark et al., 2016; Oates, 1971; Schaufeli et al., 2008; Scott et al., 1997). Such an increasing interest is linked to the raising awareness on the well-being implications of work intensification (e.g., Green et al., 2022; Kremer et al., 2021), the contemporary long work-hour culture (see Pfeffer, 2018; Reid & Ramarajan, 2016), and the commonly reported difficulties in disconnecting from work. For example, research has documented the occurrence of 'overwork-related disorders', identifying physical and mental conditions such as heart diseases, burnout, and depression (Lin et al., 2017; Pega et al., 2021; Takahashi, 2019). Being characterized by obsessive overwork (Schaufeli et al., 2008), workaholism is likely to play a major role in the pathogenesis of these conditions. As such, it is a non-ignorable issue of modern working life.

Workaholism research has been so far dominated by static cross-sectional designs, in line with the common construct conceptualization as a stable tendency (Andreassen, Schaufeli, et al., 2018; Clark et al., 2016). Yet, despite shedding light on the enduring precursors and consequences of *trait workaholism,* cross-sectional research falls short in detailing how workaholic tendencies exert their health impairment effects over time, particularly in the short-term. Moreover, while recent meta-analyses highlight only small amounts of workaholism variability predicted by stable personality traits (Clark et al., 2016; Kun et al., 2021), even personality has been shown to substantially vary within individuals (Fleeson & Jayawickreme, 2015; N. P. Podsakoff et al., 2019). Investigating how workaholism symptoms can fluctuate over time opens the way to a more fine-grained understanding of its nature, antecedents, and consequences, with the ultimate goal of designing effective prevention measures (Cossin et al., 2021).

This study aimed at investigating the within-individual fluctuations in daily workaholic cognition and behavior and their short-term effects on worker health and well-being. To this end, we conducted an ambulatory assessment over 10 workdays focusing the potential health impairment processes set in motion by the daily experience of *state workaholism* (i.e., symptoms of compulsive overwork). Specifically, we investigated whether state workaholism could predict short-term concurrent and prolonged straining responses, namely higher blood pressure, emotional exhaustion, and sleep disturbances. Compared to the few previous attempts to investigate workaholism dynamically (e.g., Clark et al., 2021; Sawhney et al., 2022), our study stands out for its in-depth focus on short-term straining effects, its multimethod approach, and the use of an intensive longitudinal design that temporally separates the core study variables. Additionally, we explored the hypothesis that evening psychological detachment – as promoted by recovery activities that individuals may undertake, and organizations might incentivize – buffers some of the short-term strain correlates of workaholism.

*Workaholism as an internal job-related demand*

Within the array of definitions of workaholism (for a review, see Clark et al., 2016), most scholars agree that 'compulsive overwork' is at the core of the phenomenon. The first term indicates preoccupation about work coupled with loss of self-control over work-related behavior. Consistently, the second term highlights that such compulsive thoughts manifest as excessively long working hours and high work-related effort at the expenses of other activities. Additionally, workaholics tend to experience significant withdrawal symptoms when they are impeded to work, resulting in negative feelings such as angry, irritability, anxiety, and guilt (Andreassen et al., 2012; Atroszko et al., 2019; Clark et al., 2020; Schaufeli et al., 2008). Even during work – when one may think that workaholics should be relieved from such feelings (see Ng et al., 2007) – higher negative affect has been found in individuals with stronger workaholic tendencies (Menghini et al., 2023). In line with addiction theories (Robinson & Berridge, 2003), such a profile is compatible with the idea that workaholism can fuel a dysphoric state gradually coloring any aspect of workaholics' life.

Increasing evidence indicates that workaholism is predictive of several forms of job strain (e.g., Andreassen, Pallesen, et al., 2018; Balducci et al., 2018; Huyghebaert et al., 2018; Salanova et al., 2016), with similar effect sizes than those shown by external job demands (for a meta-analysis, see Clark et al., 2016). As such, we contend that workaholism can be thought of as an internal demand or stressor, a pressure that individuals put on themselves in relation to work conditional to their values and needs (see MacKay & Cooper, 1987). Building from this perspective, we argue that workaholism symptoms can result in a progressive series of strain outcomes similar to what previously has been reported for external job demands (e.g., Ilies et al., 2010, 2016; Pindek et al., 2019).

Particularly, workaholism might contribute to allostatic load, the cumulative 'wear and tear' of the body originating from repeated stressful exposures. According to the allostatic load model (McEwen, 2004, 2006), the chronicity of initially adaptive physiological changes (e.g., spikes in blood pressure) can result in more stable modifications of the body's biological set points (e.g., chronically increased blood pressure) for better anticipating environmental demands. However, this allostatic adaptation comes with the cost of possibly leading to tertiary disease endpoints (Ganster & Rosen, 2013; Ilies et al., 2016; Mauss et al., 2015; McEwen, 2006), some of which have been found related to workaholic tendencies (e.g., Balducci et al., 2018; Salanova et al., 2016; van Beek et al., 2011). In contrast, due to the dominant trait-level focus of workaholism research, less evidence is available on the relationships between workaholism and primary allostatic load mediators, the proximal short-term indicators of the stress response. Investigating such relationships would help in 'closing the circle' on the potential health impairment effects of workaholism, demonstrating whether it can set in motion allostatic load processes since their early manifestations up to the stable endpoints highlighted by previous literature.

### *State vs. trait workaholism*

To investigate its short-term straining effects, we conceptualized workaholism as a multilevel construct exhibiting both stable between-individual differences (trait workaholism) and within-individual fluctuations over time (state workaholism). In applied psychology, the conceptualization of state-trait continua has been widely applied to both stress-related (e.g., job demands and recovery) and motivational constructs (e.g., work engagement) (Bakker, 2014; Sonnentag et al., 2017). Particularly, as noted by Clark et al. (2021), the conceptualization of state workaholism is in line with the whole trait theory of personality (Fleeson & Jayawickreme, 2015; Jayawickreme et al., 2019), according to which individuals are not only characterized by time-invariant trait levels (personality traits) but also experience considerable variation over a distribution of time-varying state levels (personality states). While individuals differ in terms of central tendency and variability of such distributions, even those with low trait levels can sometimes experience high levels of the corresponding state, and vice versa (see also Horstmann & Ziegler, 2020). According to Fleeson (2017), a personality state is causally determined by, and should reflect the same content domain of, the corresponding trait. Therefore, investigating the state component of a multilevel phenomenon is useful to better characterize the whole phenomenon. For example, a similar approach has been used in clinical psychology, where the daily fluctuations in psychopathological (e.g., obsessive-compulsive disorder) symptoms have been investigated to better characterize their everyday functioning, predictors, and short-term outcomes in both clinical and non-clinical samples (e.g., Cox et al., 2023; Macatee et al., 2013).

Such perspectives open the way to the possibility of identifying transient antecedents and consequences of constructs typically regarded as dispositional or with a strong temporal stability. It is the case of workaholism, which is commonly conceptualized as a “stable tendency” (Andreassen, 2014, p. 2) or “an individual difference characteristic” (Bakker et al., 2009, p. 24), despite some evidence suggesting that it can be boosted by certain work-related conditions (e.g., Keller et al., 2016; Mazzetti et al., 2014, 2016). Following Balducci et al. (2021) and the widely supported Schaufeli et al. (2008)’s bidimensional model of workaholism (see Clark et al., 2016), we define *state workaholism* as the daily level of an individual’s work-related obsessions and tendency to work excessively. That is, workdays characterized by higher state workaholism imply the experience of stronger workaholism symptoms (i.e., workaholic cognitions and behaviors) compared to one's usual level.

Our conceptualization is also consistent with addiction research, where the temporal fluctuations in addictive cognitions and/or behaviors such as daily alcohol use, weekly smartphone addiction, and day-to-day "gambling urge" have been investigated in samples with varying severity of trait-level addiction (e.g., Z. Hu & Xiang, 2024; Lau-Barraco & Linden-Carmichael, 2019; Mereish et al., 2018; Yi et al., 2023). Particularly, the role of habit formation in drug addiction has been recently questioned by more consistent evidence supporting a goal-oriented nature of addictive behaviors, implying that they can temporally fluctuate conditional to internal states and environmental factors (e.g., to cope with negative affect and psychosocial stressors) both in the initial and in the later stages of addiction (Hogarth, 2020, 2022). While the accumulation of addictive behaviors would result in more stable individual differences (e.g., addicts vs. non-addicts), such fluctuations can be experienced by addicts as well, possibly "driving goal-directed drug seeking above already elevated baselines" (Hogarth, 2020, p. 721). Coming back to workaholism, this is compatible with the idea that both work addicts and individuals with lower trait workaholism can experience workaholism symptoms above and below their average workaholism level, without necessarily becoming addicted or moving back to a less problematic work investment. Importantly, to ensure consistency with Schaufeli et al. (2008)'s definition and content correspondence across levels, we considered the co-occurrence of both working compulsively and working excessively as a necessary condition to experience workaholism symptoms (see also Atroszko, 2024; Clark et al., 2016).

A few recent studies supported this or similar conceptualizations. Clark et al. (2021) investigated the daily fluctuations in work-related compulsive feelings, thoughts, and behaviors in a sample of 121 U.S. employees over 10 workdays, reporting substantial within-individual variation (intraclass correlation coefficient, ICC = .53) and strong correlation with trait workaholism ($r$ = .57). Additionally, their state-level measure was significantly and positively related to daily fluctuations in self-reported fatigue and spouse's ratings of stress crossover and relationship tension. Consistently, substantial within-individual fluctuations in state workaholism were reported by three further studies (Balducci et al., 2022; Sawhney et al., 2022; Xu et al., 2021) that showed concurrent relationships with worse strain outcomes (i.e., higher blood pressure, emotional exhaustion, and work-family conflict). Starting from this sparse evidence, and responding to specific calls for person-centric studies on workaholism (Clark et al., 2016), we offer here an original, comprehensive, and robust investigation of its potential short-term costs.

## *Study hypotheses*

### *State workaholism and blood pressure*

In line with the allostatic load model (McEwen, 2004, 2006), we focused on early-manifested signs (primary mediators) of psychophysiological dysregulation, namely systolic and diastolic blood pressure reactivity. Increased blood pressure has been highlighted as "one of the mechanisms through which work-related factors increase risk of cardiovascular disease" (Steptoe & Willemsen, 2004, p. 915). It is among the most studied indices of sympathetically-driven arousal triggered by acute stress responses, with chronically elevated resting blood pressure being considered a secondary allostatic load mediator (Ilies et al., 2016; Logan & Barksdale, 2008; Mauss et al., 2015). A number of studies have found that within-individual fluctuations in several stressors, including work-related ones such as task demands and workload (e.g., Ilies et al., 2010; Kamarck et al., 2002, 2005), predict parallel fluctuations in blood pressure levels. Therefore, in line with our general hypothesis that workaholism is functionally equivalent to external stressors or demands, we expected similar elevation in blood pressure levels in those workdays characterized by higher-than-usual workaholism symptoms.

A concurrent within-individual relationship between state workaholism and end-of-the-day blood pressure has been recently highlighted by Balducci et al. (2021) based on a sample of 61 workers monitored once per day over 10 working days. Here, we aimed at strengthening these preliminary findings with a new and larger sample, while additionally considering the prolonged activation effects that workaholism symptoms might exert on blood pressure over time. That is, in addition to analyze the concurrent relationship between state workaholism and blood pressure (acute reactivity responses), we also explored its prolonged psychophysiological effects at bedtime (delayed/prolonged responses).

Prolonged activation may be an additional and understudied crucial mechanism underlying the health impairment effects of workaholism. According to the perseverative cognition hypothesis (Brosschot et al., 2006, 2010), the pathogenic nature of stress is primarily explained by its duration (i.e., total amount of physiological activation over time, either before or after stressful exposures) rather than its magnitude (i.e., reactivity) (Brosschot et al., 2005; Pieper & Brosschot, 2005). In line with the allostatic load model, such a prolonged activation experienced in stressor-free conditions (e.g., after work) is thought to be the main mediator of the ‘wear and tear’ effect of stress on the human body, and the primary mechanism though which stress causes illness. Importantly, prolonged activation is considered the result of perseverative cognitions, “the repeated or chronic activation of the cognitive representations of one or more psychological stressors” (Brosschot et al., 2006, p. 114). These may take the form of lasting worries and ruminative thoughts related to one or more stressful experiences, in addition to unconscious perseverative cognition that might prolong physiological activation even during sleep (Brosschot et al., 2010, 2018).

Workaholics frequently, persistently, and obsessively think about work even during leisure time (Oates, 1971; Schaufeli et al., 2008; Scott et al., 1997), with findings suggesting that maladaptive work-related rumination is common in individuals high on the trait (Kun et al., 2020; Wojdylo et al., 2013). Additionally, workaholism implies overworking, which on its own can prolong psychophysiological activation outside the working time. Thus, we integrated our focus on psychophysiological reactivity and primary allostatic load mediators with more recent perspectives on the critical role of prolonged activation, hypothesizing that:

*Hypothesis 1: Higher daily levels of state workaholism predict higher systolic and diastolic blood pressure at the end of the workday (H1a) and at bedtime (H1b).*

*State workaholism and emotional exhaustion*

In addition to investigating psychophysiological responses, we focused on emotional exhaustion and sleep disturbances as two important and widely investigated short-term strain indicators. The former is the core and early-manifested dimension of burnout (Kristensen et al., 2005; Maslach et al., 2001; Maslach & Jackson, 1981), characterized by lack of energy, irritability, frustration, and a general feeling that emotional resources are 'used up' (Maslach & Jackson, 1984; Maslach & Leiter, 2016). Past research reported consistent relationships between workaholism and emotional exhaustion both cross-sectionally (e.g., Gillet et al., 2022; Schaufeli, Bakker, et al., 2009; Schaufeli, Shimazu, et al., 2009; van Beek et al., 2011) and longitudinally (e.g., Hakanen et al., 2018; Innanen et al., 2014), with meta-analytical correlations up to $\rho = .42$ (Clark et al., 2016).

Such relationships may be explained by the workaholics' tendency to not only devote a great amount of time to work, beyond what is reasonably expected of them, but also expend higher physical and mental energy (Snir & Harpaz, 2012). Indeed, recovery theory (see Geurts & Sonnentag, 2006; Meijman & Mulder, 1998) suggests that high effort at work and prolonged work-related activation are psychologically costly and can impair unwinding processes at the end of the workday. Slow unwinding refers to an increased need for rest and recovery, operationalizable through subjective strain indicators of fatigue and exhaustion (Geurts & Sonnentag, 2006). The allostatic load model would lead to similar conclusions, given that primary stress mediators do not only include physiological changes, but also a number of negative affective states connected to emotional exhaustion, such as anger and irritability (see Ganster & Rosen, 2013). Thus, workdays characterized by higher workaholism symptoms might imply higher effort as the result of taking on additional tasks and commitments, carrying out multitasking, and possibly suppressing recovery experiences (e.g., lunch and coffee breaks). In turn, this might lead, as an after-effect, to higher levels of emotional exhaustion at bedtime.

In line with this interpretation, Xu et al. (2021) surveyed 119 employees over 10 workdays, finding support for the homology of the relationship between workaholism and emotional exhaustion across the within- and the between-individual levels (see Chen et al., 2005). Similar results were also reported for evening fatigue in another diary study by Clark et al. (2021). The present study moves a step further by introducing temporal separation between predictor and response variable to investigate whether state workaholism may indeed initiate the exhaustion process at the day level, as part of a more articulated impact on health and well-being:

*Hypothesis 2: Higher daily levels of state workaholism predict higher levels of emotional exhaustion at bedtime.*

*State workaholism and sleep disturbances*

Whereas emotional exhaustion has been widely studied in relation to job stressors, sleep is a more widely defined construct potentially affected by a multitude of biological and psychosocial factors (Grandner, 2017). Sleep is the most crucial recovery process and a vital component of overall health and well-being (Buysse, 2014; Hale et al., 2020), with sleep disturbances having a powerful influence on the risk of developing somatic and psychological diseases (Irwin, 2015; Ramar et al., 2021; Watson et al., 2015). Both perceived and objective sleep disturbances, such as difficulties in falling and/or staying asleep, are highly prevalent in the working population (Léger et al., 2008; Yong et al., 2017), and poor sleep quality has been consistently associated with job demands and other stressful work characteristics (Léger et al., 2008; Linton et al., 2015; Van Laethem et al., 2013).

Similarly, workaholism has been found to be related to poor sleep quality (Kubota et al., 2014; Salanova et al., 2016; Spagnoli et al., 2019), subjective sleep problems (Caesens et al., 2014), and insomnia symptoms (Andreassen, Pallesen, et al., 2018). For instance, Salanova et al.

(2016) surveyed 537 hospital employees, observing significantly higher sleep disturbances, shorter sleep duration, and higher diurnal sleepiness in individuals with higher workaholic tendencies. Moreover, they found higher cardiovascular risk in workaholics, with sleep problems fully mediating this relationship. Here, building on such between-individual evidence, we investigated the within-individual relationship between workaholism and sleep disturbances, which has not been considered so far. Building again on recovery theory (Geurts & Sonnentag, 2006; Sonnentag & Fritz, 2015), according to which sleep disturbances may be further consequences of particularly demanding workdays and the resulting impaired unwinding, and considering that perseverative cognitions are predicted to trigger prolonged activation even during sleep (Brosschot et al., 2006, 2010), we expected that:

*Hypothesis 3: Higher daily levels of state workaholism predict higher sleep disturbances as rated the following morning.*

*Psychological detachment as a moderator of state workaholism*

Finally, we investigated the potential within-individual moderating role of recovery experiences, and particularly psychological detachment, in the dynamic relationships between state workaholism and the investigated outcomes. Psychological detachment can be defined as the subjective perception of being away from work, implying to psychologically 'let go' work-related thoughts and activities (e.g., by being mentally absorbed by other domains such as leisure, social, and/or family activities), and mainly occurring physically and/or temporally outside the work context (Sonnentag & Fritz, 2007, 2015). In this sense, it might be viewed as the opposite of the perseverative cognitions described above. Robust evidence enucleates the role of psychological detachment in stressor-strain relationships, considering it as a vital factor for maintaining well-being and work engagement (Sonnentag et al., 2022). Specifically, the stressor-detachment model (Sonnentag & Fritz, 2015) posits that psychological detachment acts both as a core moderator and as a core mediator of job stressors: it is expected to attenuate their straining effects (i.e., predicting worse outcomes when simultaneously experiencing high effort and low detachment) while at the same time explaining them (i.e., predicting that stressors increase strain by reducing detachment experiences).

Here, we focused on the potential moderating role of day-to-day fluctuations in psychological detachment. Previous cross-sectional studies reported lower recovery experiences (Huyghebaert et al., 2018; van Wijhe et al., 2013) and weaker well-being effects of recovery (Bakker et al., 2013; Molino et al., 2018) in individuals with higher workaholic tendencies. In contrast, to our knowledge no previous studies have directly investigated whether recovery experiences, and particularly psychological detachment, may attenuate the straining effects of workaholism. Testing such moderation is particularly important since psychological detachment from work is the target of several stress prevention and management interventions (e.g., 'disconnection' policies, mindfulness practices), most of which can be relatively easily undertaken by individuals and promoted by organizations (Quick et al., 2013). In line with the idea that workaholism acts as an internal daily stressor, we predicted that experiencing higher-than-usual psychological detachment after work (i.e., in the evening) can buffer the within-individual relationships between workaholism and each investigated outcome:

*Hypothesis 4: Higher evening levels of psychological detachment predict weakened within-individual relationships between state workaholism and bedtime blood pressure levels (H4a), bedtime emotional exhaustion (H4b), and next-morning ratings of sleep disturbances (H4c).*

All study hypotheses and procedures were pre-registered prior to data collection, as publicly available from: https://osf.io/h9zvq.

## Method

### *Participants*

The study involved a heterogeneous sample of Italian workers recruited within the private network of the authors and their collaborators (i.e., 15 undergraduate students recruited approximately 8-10 participants each as part of their final thesis) and based on snowball sampling. To increase variability in workaholism levels, recruitment prioritized, but was not limited to, full-time office workers with some managerial status/responsibilities within their organization (e.g., employers, managers, self-employed) as workaholism was found to be more prevalent for these roles (Clark et al., 2016; Taris et al., 2012). None of the recruited participants was a shift worker, and none of them worked for less than five days per week (i.e., Monday to Friday). Participation was confidential and voluntary, although incentivized by personalized feedback reports at the end of the study. All participants signed an informed consent before starting the study, which was approved by the Bioethics Committee of the University of Bologna (protocol 113559).

From a total of 140 recruited participants, six were excluded due to missing responses to the preliminary questionnaire or all daily surveys. Moreover, as we pre-registered, we excluded further 21 participants with less than three complete days of assessment. Thus, the considered sample consisted of 114 working adults (51.8% women; mean age ± SD = 42.12 ± 12.61 years; BMI = 23.91 ± 3.53 kg $m^{-2}$). Most participants had a university degree (60.5%) and were employed in the private sector (79.8%). The most represented occupational groups based on the International Standard Classification of Occupations (ISCO-08) were business and administration professionals (13.2%) and associate professionals (15.8%), legal/social/cultural professionals (10.5%), and science/engineering professionals (10.5%). Most participants were employees (50%), whereas 46.5% reported working as employers, self-employers, or managers, and the remaining 3.5% worked on a temporary contract. On average, participants reported working 41.22 ± 9.76 hours per week. 46.5% of the sample reported being in a romantic relationship, 50.9% to have children, and 64.1% to live with their partner and/or children. 27.2% were smokers.

Eight participants (three women; age = 56.00 ± 5.53 years; BMI = 26.49 ± 3.79 kg $m^{-2}$) reported suffering from cardiovascular dysfunctions (e.g., hypertension, ischemia) or taking cardiovascular medications (e.g., diuretics, beta blockers, antihypertensive) and were selectively excluded from the analyses of blood pressure (N = 106), in line with our pre-registration.

*Procedure*

Participants were asked to provide an e-mail address to be possibly synchronized with a mobile app on their smartphone. Then, they were provided with the link to a preliminary questionnaire, and they were invited to a 30-minute preparatory meeting involving instructions and training, delivery of blood pressure monitors, and practice trials.

Starting from the following Monday afternoon, participants received up to three e-mails per day linking to short online questionnaires (referred as 'diaries' from here on). The diary protocol (Figure 1) consisted of five consecutive workdays over two consecutive weeks. At the end of the first week, participants were asked to freely choose whether continuing over the second one or rather quitting the study. The first diary (scheduled at 3:00 PM, available up to 7:30 PM) was responded at the end of the working day and included a measure of state workaholism. The second diary (scheduled at 9:30 PM, available up to 6:00 AM) was responded at bedtime and included measures of emotional exhaustion and psychological detachment. Finally, a third diary was scheduled each morning (i.e., 8:30, available up to 10:30 AM) from Tuesday to Saturday, including a measure of sleep disturbances referred to the previous night. A reminder was scheduled after two hours in all cases of uninitiated or unfinished responses.

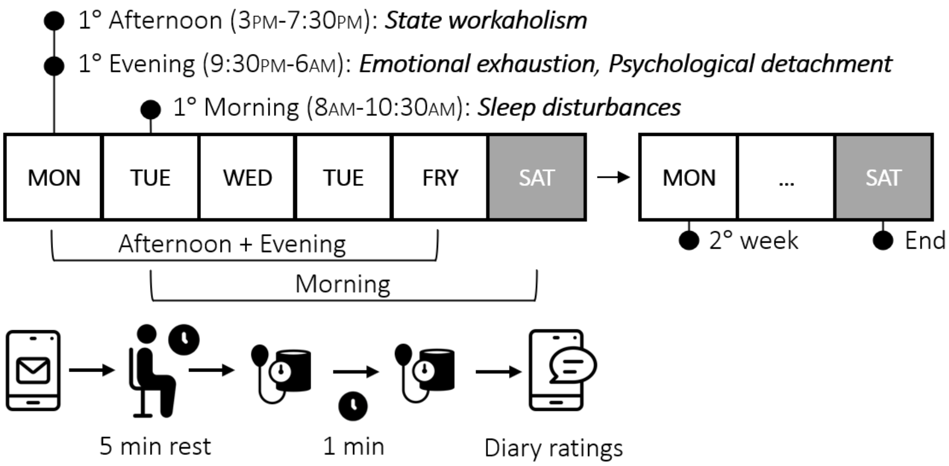


**Figure 1.** Daily diary protocol at the daily (above) and data entry level. Icons created by Those Icons at https://flaticon.com/.

For a better survey experience, participants were suggested to answer diaries using their smartphone. Each diary was only initiated if participants answered affirmatively to a first item asking whether they had actually worked on that day. Then, afternoon and evening data entries started with two self-measured blood pressure recordings (see details below), followed by the rating of the diary scales and a number of multi-choice items accounting for potential time-varying confounding factors (i.e., recording location, moderate/vigorous physical activity, coffee, nicotine, and meals consumed over the last 30 minutes, nonwork-related hassles). At the end of the protocol, participants returned the blood pressure monitor and received their report. On average, filling the diaries required 4.02 ± 3.51 minutes. All measures were implemented, scheduled, and delivered using Qualtrics (Qualtrics Experience Management, Provo, UT, USA).

### *Measures*

#### *Preliminary questionnaire*

The preliminary questionnaire included measures of participants' demographics (e.g., gender), occupational indicators (e.g., job position), further potential time-invariant confounding variables (i.e., BMI, smoking status, number of children, living with children), and exclusion criteria (e.g., cardiovascular disease/medication), in addition to a set of scales that were not considered for the present study.

#### *Daily diaries*

Among the measures collected with daily diaries, we considered afternoon ratings of state workaholism, evening ratings of emotional exhaustion and psychological detachment, and morning ratings of sleep disturbances, all measured with visual analogue scales from 1 (*Completely disagree*) to 7 (*Completely agree*). In addition, we considered a set of single-item measures accounting for confounding factors such as behaviors potentially influencing blood pressure levels (e.g., smoking, physical activity). Diary scales are fully reported in the Supplementary Materials.

*State workaholism* was measured at the end of the workday with six items from the Dutch Work Addiction Scale (DUWAS) (Balducci et al., 2017; Schaufeli, Shimazu, et al., 2009) adapted to reflect the daily experience of working compulsively (e.g., “Today, I felt that there was something inside me that drove me to work hard”) and working excessively (e.g., “Today, I found myself continuing to work after my coworkers had called it quits”), similar to Balducci et al. (2021). Level-specific reliability indices (Geldhof et al., 2014) were satisfactory at both levels (ω-within = .81, ω-between = .94). We tested our hypotheses focusing on the scale total score (i.e., mean of all item scores), consistently with the DUWAS conceptualization (Schaufeli et al., 2008) and in line with recent studies based on a bifactor model (Gillet et al., 2022; Huyghebaert-Zouaghi et al., 2021) showing higher predictive value for the global factor and little added value for the two subdimensions in predicting well-being measures. The total score was then included in the analyses reported below both as the individual average score over the 10 workdays (i.e., person means representing the trait component) and as the day-to-day deviations from ones’ average (i.e., person-mean-centered scores representing the state component).

*Emotional exhaustion* was measured at bedtime with four items from the Copenhagen Burnout Inventory (Avanzi et al., 2013; Kristensen et al., 2005), adapted to reflect the momentary experience of emotional exhaustion (e.g., “At this moment, I feel emotionally exhausted”). Following the removal of one item (i.e., “At this moment, I feel tired”) associated with decreased reliability and fit of the measurement model (see **Supplementary Materials**), we achieved satisfactory level-specific reliability (ω-within = .76, ω-between = .93).

*Psychological detachment* was measured at bedtime with three items (e.g., “This evening, I forgot about work”) from the Recovery Experience Questionnaire (Sonnentag & Fritz, 2007; Zito et al., 2013) (ω-within = .90, ω-between = .98).

*Sleep disturbances* were measured the next morning with four sleep-related items from the Mini Sleep Questionnaire (Natale et al., 2014) rephrased to be referred to the last night (e.g., “Last night, I had difficulties to fall asleep”) (ω-within = .74, ω-between = .87).

*Blood pressure*

Systolic and diastolic blood pressure were self-measured by participants immediately before each diary entry, using the Pic Solution SmartRAPID blood pressure monitor (PSSR, Pikdare, Casnate con Bernate, Italy). Self-measured blood pressure monitoring is recognized as a valid and useful approach for out-of-office blood pressure measurement (Shimbo et al., 2020). The PSSR is a wrist-worn digital oscillometer that has passed the European Society of Hypertension (ESH) International Protocol for the validation of blood pressure measurement devices (O'Brien et al., 2002; Trust Dabl®Educational, 2013), with previous models from the same company (i.e., Pic Indolor Travel Check) showing satisfactory accuracy against gold-standard monitors (Germano et al., 2009) and being recommended by the ESH, the International Society of Hypertension, and the World Hypertension League (STRIDE BP, 2009).

In compliance with ESH guidelines (Stergiou et al., 2021), two consecutive measurements were recorded at each diary entry, with at least five resting-state minutes prior to the first one and one minute between the first and the second one (see **Figure 1**). Following the same guidelines, we instructed participants to record blood pressure on their non-dominant wrist while sitting comfortably with uncrossed legs, flat feet on the floor, their back gently against the chair, placing their elbow on a table with the hand on the chest to keep the device at the heart level (see **Supplementary Materials**). A practice trial was conducted during the preparatory meeting and feedback were given to correct any deviation from the protocol. Participants were instructed to avoid, if possible, consuming caffeine or nicotine, practicing physical activity, having a meal, or taking a bath/shower over the 30 minutes prior each measurement. During the recording, they were instructed to avoid moving, talking, or using electronic devices (see Kallioinen et al., 2017). For each time point, systolic and diastolic blood pressure (mmHg) were computed as the average between the two corresponding measurements. However, the first measurement was discarded in all cases showing an absolute difference higher than 10 mmHg (19.1%).

*Data analysis*

Data were analyzed with R 4.3.1 (R Core Team, 2023) and particularly the *lme4* (Bates et al., 2014) and the *lavaan* R packages (Rosseel, 2012). Prior to analyzing the data, we implemented several pre-processing steps to recode variables and filter double and inaccurate measurements (see Supplementary Materials). Then, multilevel confirmatory factor analysis (MCFA) was conducted following Kim et al., (2016) to assess the measurement model of each diary scale. Particularly, the conceptualization of workaholism as a multilevel construct was evaluated by fitting two increasingly constrained models: a first model with the same latent structure across levels (corresponding to configural invariance across individuals) and a second model with both the same structure and equal factor loadings (metric invariance) (Jak et al., 2021; Jak & Jorgensen, 2017; Stapleton et al., 2016). Model fit was evaluated in terms of root mean square error of approximation (RMSEA), comparative fit index (CFI), level-specific standardized root mean squared residual (SRMR) (see Hsu et al., 2015), and information criteria. We considered RMSEA < .06, CFI > .95, and SRMR < .08 as indicative of good fit (L. T. Hu & Bentler, 1999).

The study hypotheses were then tested using multilevel linear regression fitted with the restricted maximum likelihood estimator (REML). For each outcome (i.e., afternoon and evening blood pressure, emotional exhaustion, and sleep disturbances), we fitted four nested models: a null model (M0) with only fixed and random intercept; a baseline model (M1) also including trait-level workaholism (i.e., between-individual component operationalized as the individual average score over the 10 workdays), psychological detachment, and a number of control variables; a model (M2) where we added state workaholism at the within-individual level (Hypotheses 1-3); and a final model (M3) including its within-individual interaction with psychological detachment (Hypothesis 4). Figure 2 summarizes the study hypotheses, variables, and relationships included in our regression models clarifying the corresponding time points and levels of analysis.

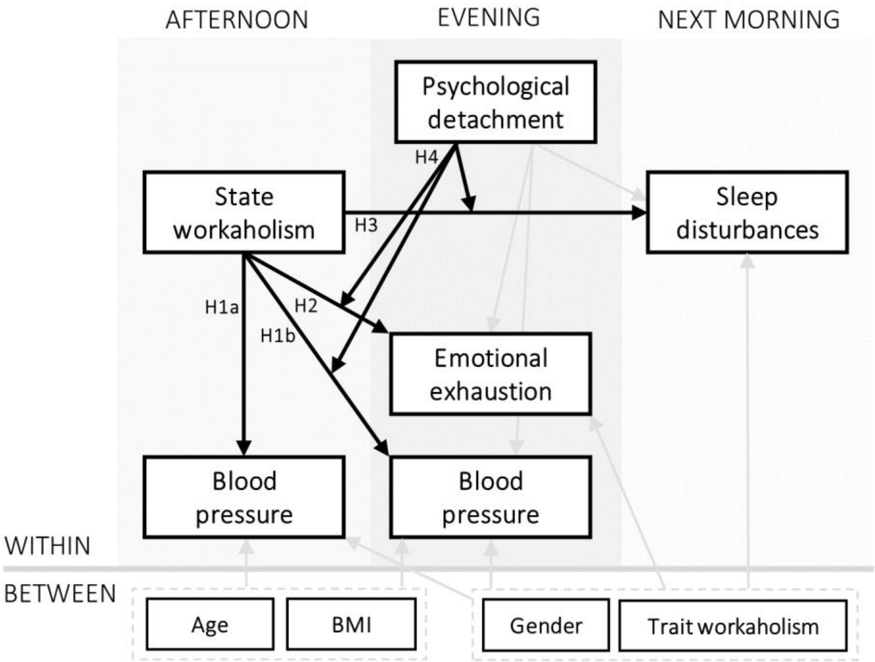


Figure 2. Conceptual model, hypotheses, and selected control variables.

Particularly, control variables in models M1-M3 were selected in line with the hierarchical iterative control (HIC) approach (Spector, 2021) by only retaining plausible 'common drivers' (i.e., not potential mediators) of strain and workaholism that were substantially related to each outcome. Specifically, gender was selected for all strain indicators, whereas age and BMI were only selected for blood pressure indicators (for details, see Supplementary Materials). In contrast, further control variables that were not substantially related to any outcome (e.g., time, evening physical activity, job position) were included as subsequent robustness checks, consistently with the HIC approach. All level-1 predictors (i.e., state workaholism and psychological detachment) were person-mean centered, whereas level-2 quantitative predictors (i.e., trait workaholism, age, and BMI) were grand-mean centered in the listwise deleted dataset before fitting any model. Of note, psychological detachment and its interaction with state workaholism were not considered to predict afternoon blood pressure since the latter variable was recorded before any evening detachment experience could take place.

Finally, model selection was implemented by comparing nested models based on their relative strength of evidence, as indicated by the Akaike weight (Aw) (Wagenmakers & Farrell, 2004), in addition to the likelihood ratio test (conducted by refitting models using maximum likelihood with a significance level set to $p < .05$). For each outcome, we selected the model showing the strongest evidence and a significantly higher likelihood than more parsimonious models. Parameters estimates from the selected model were then evaluated and reported with their bootstrapped 95% confidence intervals.

### *Data, materials, and code*

All data, data analysis code, and research materials are available at the Open Science Framework (OSF) repository and can be accessed from: https://osf.io/awbxj.

## Results

A total of 2,534 diary entries were obtained over 958 days (i.e., total number of sampled workdays where at least one of the three diaries was completed by a given participant). 83 participants (72.8%) completed the two-week protocol, whereas 31 participants (27.2%) dropped out at the end of the first week, implying a lower number of responses (level-1 sample size) for the latter participants (mean = 14.10) than the former (mean = 25.27). On average, participants responded to 22.23 ± 6.09 diaries (response rate: 86.9 ± 12.8%). The subsample of 106 participants included in blood pressure analyses provided a total of 898 daily observations, with an average of 22.26 ± 5.98 completed diary entries (response rate: 86.1 ± 13%).

### *Measurement models and descriptives*

Table 1 shows the MCFA fit for state workaholism items, using maximum likelihood with robust test statistics (MLR) on the full sample of available responses (i.e., 914 observations from 135 participants). Although one-factor solutions fitted the data approximately well, a better fit was shown by two-factor solutions (i.e., working excessively and compulsively), with configural invariance performing better than metric invariance. However, based on modification indices, the relaxation of the equality constraint for the first item (“Today, I seemed to be in a hurry and racing against the clock”) substantially improved the fit, highlighting the two-factor model with partial metric invariance as the most accurate solution (see Byrne et al., 1989). In the selected model, standardized loadings ranged from .54 to .97 (see **Figure 3**), with ICCs of .69 (0.05) and .65 (.05) for working excessively and working compulsively, respectively. Yet, despite the better fit of two-factor solutions, very strong correlations were estimated between the two dimensions at both levels (*r-between* = .86, *r-within* = .95), indicating poor scale ability to discriminate the two dimensions especially at the within-individual level. These results, together with the acceptable fit shown by one-factor solutions, further justify our focus on the total score of the scale.

**Table 1**. Fit indices of the multilevel CFA models specified for workaholism items.

| Model | N. param. | $\chi^2$ (df) | RMSEA | CFI | SRMR-W | SRMR-B | AIC weight | BIC weight |
|---|---|---|---|---|---|---|---|---|
| One-factor configural | 30 | 63.67 (18) | .063 | .962 | .029 | .053 | < .001 | < .001 |
| One-factor metric | 25 | 80.64 (23) | .062 | .953 | .031 | .064 | < .001 | .005 |
| One-factor scalar | 19 | 1645.20 (29) | .210 | .323 | .115 | .287 | < .001 | < .001 |
| Two-factor configural | 32 | 45.11 (16) | .054 | .975 | .027 | .042 | .881 | .004 |
| Two-factor metric | 28 | 59.15 (20) | .055 | .967 | .029 | .074 | .005 | .331 |
| Two-factor partial metric | 29 | 52.61 (19) | .053 | .971 | .028 | .055 | .114 | .660 |
| Two-factor scalar | 22 | 988.19 (26) | .186 | .521 | .093 | .197 | < .001 | < .001 |

*Notes.* df, degrees of freedom associated with the $\chi^2$ statistic; RMSEA, root mean square error of approximation; CFI, comparative fit index; SRMR-W, root mean squared residual within individual; SRMR-B, SRMR between individuals; AIC, Akaike Information Criterion; BIC, Bayesian Information Criterion. All models were fitted with the MLR robust estimator and evaluated by considering the robust $\chi^2$, RMSEA, and CFI indices on the full sample of available responses to afternoon diaries (914 observations from 135 participants).

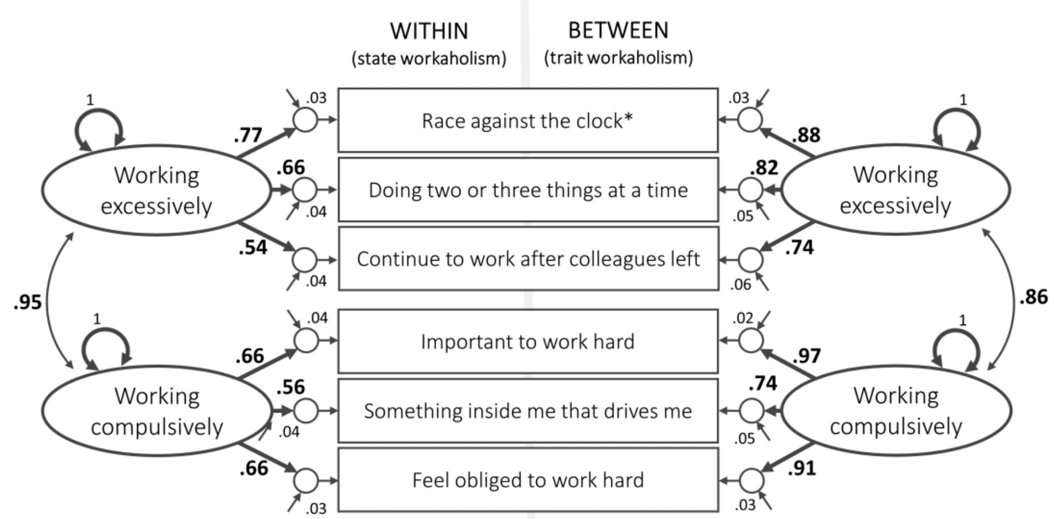


Figure 3. Completely standardized solutions at the within (right) and between (left) level from the multilevel CFA models selected for state workaholism items. *Item whose unstandardized loadings were not constrained to be equal across levels.

Acceptable fit was also found for the one-factor MCFA models assuming cross-level invariance for emotional exhaustion ($\chi^2(2)$ = 6.81, RMSEA = .056, CFI = .994, SRMR-within = .015, SRMR-between = .021), sleep disturbances ($\chi^2(7)$ = 30.63, RMSEA = .069, CFI = .965, SRMR-within = .027, SRMR-between = .081), and psychological detachment ($\chi^2(2)$ = 0.77, RMSEA < .001, CFI = 1.00, SRMR-within = .002, SRMR-between = .002). Moreover, we found satisfactory fit ($\chi^2(17)$ = 29.66, RMSEA = .030, CFI = .995, SRMR-within = .034, SRMR-between = .037) for the model assuming the distinctiveness between emotional exhaustion and psychological detachment (i.e., measured at the same time point), whereas the corresponding one-factor model was rejected.

Table 2 shows the descriptive statistics and correlations from the included participants considered in the following analyses. All time-varying variables showed substantial variation at both levels, with higher between-individual variability for workaholism, blood pressure, and emotional exhaustion, and higher within-individual variation for psychological detachment and sleep disturbances. Daily fluctuations in workaholism symptoms were significantly although weakly correlated with fluctuations in afternoon blood pressure, emotional exhaustion, and sleep disturbances, whereas trait workaholism moderately correlated with trait-level emotional exhaustion and sleep disturbances. Systolic and diastolic blood pressure were mutually correlated at both levels, showing significant and positive level-2 relationships with emotional exhaustion, age, and BMI.

**Table 2**. Descriptive statistics and correlations between the considered variables.

| Measure | No. obs. | Mean (SD) | ICC | Pearson's correlations 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Workaholism (1-7) | 847 | 3.43 (1.54) | .61 | | $.14^{***}$ | $.14^{***}$ | .04 | .08 | $.18^{***}$ | $-.08^{*}$ | $.13^{**}$ |
| 2. Afternoon SBP (mmHg) | 843 | 122.18 (19.56) | .70 | .12 | | $.46^{***}$ | $.18^{***}$ | $.12^{**}$ | .05 | -.02 | $.09^{*}$ |
| 3. Afternoon DBP (mmHg) | 843 | 78.17 (14.60) | .61 | .13 | $.83^{***}$ | | $.10^{*}$ | $.12^{**}$ | .08 | -.02 | .06 |
| 4. Evening SBP (mmHg) | 841 | 115.58 (18.22) | .69 | .11 | $.90^{***}$ | $.77^{***}$ | | $.56^{***}$ | .06 | $-.10^{*}$ | .03 |
| 5. Evening DBP (mmHg) | 841 | 72.96 (14.26) | .64 | .04 | $.77^{***}$ | $.86^{***}$ | $.87^{***}$ | | $.08^{*}$ | -.03 | $.09^{*}$ |
| 6. Exhaustion (1-7) | 841 | 3.24 (1.57) | .56 | $.49^{***}$ | $.24^{*}$ | $.22^{*}$ | .21 | .17 | | $-.13^{***}$ | $.09^{*}$ |
| 7. Detachment (1-7) | 841 | 4.38 (1.85) | .35 | -.14 | -.01 | -.05 | -.07 | -.08 | -.13 | | -.06 |
| 8. Sleep disturbances (1-7) | 842 | 2.57 (1.40) | .39 | $.43^{***}$ | .09 | .15 | .12 | .13 | $.47^{***}$ | -.16 | |
| 9. Age (years) | 114 | 42.12 (12.61) | | -.14 | $.35^{***}$ | $.35^{***}$ | $.34^{***}$ | $.38^{***}$ | -.05 | .06 | .02 |
| 10. BMI (kg $m^{-2}$) | 114 | 23.91 (3.53) | | .06 | $.33^{***}$ | $.33^{***}$ | $.40^{***}$ | $.40^{***}$ | .06 | .07 | -.03 |

*Notes.* SD, standard deviation; ICC, intraclass correlation coefficient; SBP, systolic blood pressure; DBP, diastolic blood pressure; BMI, body mass index. Correlations at the within level are shown above the main diagonal, whereas correlations at the between level are shown below the main diagonal. Each correlation was computed considering all completed responses (720 observations from 114 participants), and two-tail significance levels were Benjamini-Hochberg-corrected. *, p < .05; ** p < .01; *** p < .001. Age and BMI correlated at $r$ = .22*.

### *State workaholism and blood pressure*

Multilevel modeling was used to predict blood pressure by the considered predictors, including gender, age, and BMI as level-2 covariates. The inclusion of state workaholism in the baseline models predicting afternoon blood pressure (model **M2**) implied stronger evidence and significant likelihood ratio test (systolic: Aw = .99, $\chi^2(1) = 15.07$, p < .001; diastolic: Aw = .99, $\chi^2(1) = 13.84$, $p < .001$), showing higher systolic ($b$ = 1.56 (0.40) mmHg, 95% CI [0.78, 2.37] mmHg) and diastolic blood pressure ($b$ = 1.39 (0.35) mmHg, 95% CI [0.62, 1.97] mmHg) in those days characterized by higher-than-usual workaholism symptoms (see **Table 3**). In contrast, the inclusion of state workaholism (model **M2**) was not associated with stronger evidence or significant likelihood ratio test compared to the baseline models **M1** predicting evening systolic (Aw = .33, $\chi^2(1) = 0.58$ , $p$ = .44) and diastolic blood pressure (Aw = .68, $\chi^2(1) = 3.81$ , $p$ = .05), and the same was found for its interaction (model **M3**) with psychological detachment (systolic: Aw = .11, $\chi^2(1) = 0.65$ , $p$ = .42; diastolic: Aw = .14, $\chi^2(1)$ 0.01 , $p$ = .99), as shown in **Table 4**.

Table 3. Multilevel regression models predicting afternoon blood pressure.

| | Systolic blood pressure (mmHg) | | | | Diastolic blood pressure (mmHg) | | | |
|---|---|---|---|---|---|---|---|---|
| | M1 (baseline) | | M2 (main effect) | | M1 (baseline) | | M2 (main effect) | |
| *Predictors* | *b (SE)* | *CI* | *b (SE)* | *CI* | *b (SE)* | *CI* | *b (SE)* | *CI* |
| **Level 2 (between):** | | | | | | | | |
| Intercept | **118.25 (1.97)** | **114.44, 122.00** | **118.25 (1.97)** | **114.27, 122.17** | **77.32 (1.46)** | **74.45, 80.20** | **77.32 (1.46)** | **74.34, 80.04** |
| Gender [men] | 5.39 (2.92) | -0.45, 11.10 | 5.39 (2.92) | -0.36, 11.10 | -0.38 (2.17) | -4.65, 3.88 | -0.30 (2.17) | -4.30, 4.08 |
| Age (years) | **0.41 (0.12)** | **0.18, 0.66** | **0.41 (0.12)** | **0.18, 0.65** | **0.28 (0.09)** | **0.10, 0.45** | **0.28 (0.09)** | **0.10, 0.46** |
| BMI (kg $m^{-2}$) | **1.10 (0.43)** | **0.24, 1.94** | **1.10 (0.43)** | **0.25, 1.96** | **0.96 (0.32)** | **0.33, 1.61** | **0.96 (0.32)** | **0.33, 1.59** |
| Trait workaholism (1-7) | 1.33 (1.14) | -0.94, 3.57 | 1.33 (1.14) | -0.89, 3.57 | 1.11 (0.85) | -0.55, 2.78 | 1.11 (0.85) | -0.60, 2.77 |
| **Level 1 (within):** | | | | | | | | |
| State workaholism (1-7) | | | **1.56 (0.40)** | **0.76, 2.35** | | | **1.39 (0.35)** | **0.62, 1.97** |
| **Random effects:** | | | | | | | | |
| $\tau_{00}^2$ | 195.27 | | 195.55 | | 104.48 | | 104.66 | |
| $\sigma^2$ | 108.96 | | 106.74 | | 82.14 | | 90.61 | |

*Notes.* BMI, body mass index; SE = standard error; CI = non-parametric bootstrap confidence intervals. Level-2 continuous predictors were grand-mean-centered, whereas level-1 continuous predictors were person-mean-centered before fitting the models. Bold type highlights cases where 95% CI excluded zero. The models were fitted on 787 observations from the 106 participants meeting blood pressure inclusion criteria.

### *State workaholism, emotional exhaustion, and sleep disturbances*

Table 5 shows the models predicting evening ratings of emotional exhaustion and next morning ratings of sleep disturbances. Participants' gender was selected as a level-2 covariate for both outcomes (see Supplementary materials). For emotional exhaustion, the model M2 including its within-individual relationship with state workaholism was selected as the best model (Aw = .99, $\chi^2(1) = 21.51$ , $p < .001$), predicting higher exhaustion at the end of workdays with higher workaholism symptoms ($b = 0.19$ (0.04), 95% CI [0.11  0.27]). In contrast, the interactive model M3 showed neither stronger evidence (Aw = .06) nor significant likelihood ratio ($\chi^2(1) = 1.62$, $p$ = .20) compared to the other models.

**Table 4**. Multilevel regression models predicting evening blood pressure.

| | Systolic blood pressure (mmHg) | | | | | | Diastolic blood pressure (mmHg) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M1 (baseline) | | M2 (main effect) | | M3 (interaction) | | M1 (baseline) | | M2 (main effect) | | M3 (interaction) | |
| *Predictors* | *b (SE)* | *CI* | *b (SE)* | *CI* | *b (SE)* | *CI* | *b (SE)* | *CI* | *b (SE)* | *CI* | *b (SE)* | *CI* |
| **Level 2 (between):** | | | | | | | | | | | | |
| Intercept | **113.08 (1.87)** | **109.37, 116.72** | **113.08 (1.87)** | **109.41, 116.75** | **113.11 (1.86)** | **109.46, 116.77** | **72.72 (1.45)** | **69.92, 75.51** | **72.72 (1.45)** | **69.90, 75.53** | **72.72 (1.45)** | **69.92, 75.52** |
| Gender [men] | 2.48 (2.76) | -2.94, 7.90 | 2.48 (2.76) | -3.07, 7.87 | 2.48 (2.76) | -2.95, 7.97 | -1.31 (2.15) | -5.50, 2.78 | -1.31 (2.15) | -5.47, 2.97 | -1.31 (2.15) | -5.57, 2.86 |
| Age (years) | **0.33 (0.11)** | **0.11, 0.56** | **0.33 (0.11)** | **0.11, 0.56** | **0.33 (0.11)** | **0.10, 0.55** | **0.27 (0.09)** | **0.10, 0.45** | **0.27 (0.09)** | **0.09, 0.44** | **0.27 (0.09)** | **0.09, 0.45** |
| BMI (kg $m^{-2}$) | **1.40 (0.41)** | **0.60, 2.21** | **1.40 (0.41)** | **0.62, 2.21** | **1.40 (0.41)** | **0.60, 2.21** | **1.16 (0.32)** | **0.53, 1.77** | **1.16 (0.32)** | **0.54, 1.77** | **1.16 (0.32)** | **0.53, 1.78** |
| Trait workahol. (1-7) | 1.34 (1.06) | -0.72, 3.40 | 1.34 (1.06) | -0.75, 3.40 | 1.35 (1.06) | -0.71, 3.44 | 0.46 (0.83) | -1.15, 2.13 | 0.46 (0.83) | -1.14, 2.07 | 0.46 (0.83) | -1.16, 2.10 |
| **Level 1 (within):** | | | | | | | | | | | | |
| Detachment (1-7) | **-0.82 (0.26)** | **-1.34, -0.29** | **-0.81 (0.27)** | **-1.33, -0.28** | **-0.80 (0.27)** | **-1.31, -0.28** | -0.23 (0.23) | -0.68, 0.22 | -0.18 (0.23) | -0.63, 0.27 | -0.18 (0.23) | -0.63, 0.27 |
| State workahol. (1-7) | | | 0.31 (0.40) | -0.48, 1.12 | 0.31 (0.40) | -0.48, 1.08 | | | 0.67 (0.34) | -0.01, 1.35 | 0.67 (0.35) | -0.01, 1.35 |
| State workaholism × Detachment | | | | | 0.24 (0.30) | -0.37, 0.82 | | | | | 0.01 (0.26) | -0.50, 0.51 |
| **Random Effects** | | | | | | | | | | | | |
| $\tau_{00}^2$ | 173.03 | | 173.02 | | 172.72 | | 102.38 | | 102.42 | | 102.43 | |
| $\sigma^2$ | 96.62 | | 96.69 | | 96.77 | | 71.29 | | 70.97 | | 71.08 | |

*Notes*. BMI = body mass index; SE = standard error; CI = non-parametric bootstrap confidence intervals. Level-2 continuous predictors were grand-mean-centered, whereas level-1 continuous predictors were person-mean-centered before fitting the models. Bold type highlights cases where 95% CI excluded zero. The models were fitted on 721 complete from the 106 participants meeting blood pressure inclusion criteria.

Consistently, model **M2** predicting sleep disturbances by daily fluctuations in workaholism symptoms showed stronger evidence and significantly higher likelihood than the corresponding baseline model **M1** (Aw = . 55, $\chi^2(1) = 6.84$, $p = .01$), with more sleep disturbances following higher-than-usual workaholism levels ($b = 0.11$ (0.04) , 95% CI [0.03, 0.20]). However, sleep disturbances were also predicted by the within-individual interaction (model **M3**) between state workaholism and psychological detachment (Aw = .19, $\chi^2(1) = 5.31$, $p = .02$), such that the former predicted more sleep disturbances only in those days characterized by lower-than-usual evening experiences of psychological detachment ($b = -0.07$ (0.03), 95% CI [-0.14, -0.01]), as shown in **Figure 4**.

*Exploratory mediation analyses*

In light of the within-individual relationships found between state workaholism and afternoon blood pressure (see **Table 3**), with the latter being significantly related to evening blood pressure at the same level (see **Table 2**), we further explored the prolonged activation correlates of workaholism by using the *mediation* R package (see Tingley et al., 2014).[1] The estimated coefficients and their 95% CI based on quasi-Bayesian approximation with 10,000 Montecarlo draws indicated a significant indirect relationship between state workaholism and evening systolic blood pressure through afternoon systolic blood pressure ($b = 0.20$ mmHg, 95% CI [0.06, 0.38] mmHg), whereas the corresponding direct relationship was not significant ($b = 0.11$ mmHg, 95% CI [-0.68, 0.89] mmHg). Similar results were found for diastolic blood pressure (indirect relationship: $b = 0.17$ mmHg, 95% CI [0.04, 0.33] mmHg; direct relationship: $b = 0.52$ mmHg, 95% CI [-0.17, 1.21] mmHg).

[1] The possibility of exploratorily testing such mediation models conditional to the results to our main analyses was explicitly considered in our preregistration (see the 'Exploratory analyses' section at https://osf.io/h9zvq)

**Table 5**. Multilevel regression models predicting evening emotional exhaustion and next morning sleep disturbances.

| | Emotional exhaustion | | | | | | Sleep disturbances | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M1 (baseline) | | M2 (main effect) | | M3 (interaction) | | M1 (baseline) | | M2 (main effect) | | M3 (interaction) | |
| *Predictors* | *b (SE)* | *CI* | *b (SE)* | *CI* | *b (SE)* | *CI* | *b (SE)* | *CI* | *b (SE)* | *CI* | *b (SE)* | *CI* |
| **Level 2 (between):** | | | | | | | | | | | | |
| Intercept | 3.12 (0.14) | 2.84, 3.40 | 3.12 (0.14) | 2.85, 3.40 | 3.12 (0.14) | 2.84, 3.39 | 2.75 (0.12) | 2.53, 2.98 | 2.75 (0.12) | 2.52, 2.98 | 2.75 (0.12) | 2.52, 2.98 |
| Gender [men] | 0.18 (0.21) | -0.22, 0.59 | 0.18 (0.21) | -0.22, 0.57 | 0.18 (0.21) | -0.22, 0.59 | -0.40 (0.17) | **-0.72, -0.06** | -0.40 (0.17) | **-0.72, -0.06** | -0.39 (0.17) | **-0.72, -0.07** |
| Trait workahol. (1-7) | 0.47 (0.08) | **0.32, 0.62** | 0.47 (0.08) | **0.31, 0.62** | 0.47 (0.08) | **0.31, 0.62** | 0.34 (0.06) | **0.22, 0.47** | 0.34 (0.06) | **0.21, 0.47** | 0.34 (0.06) | **0.21, 0.47** |
| **Level 1 (within):** | | | | | | | | | | | | |
| Detachment (1-7) | -0.08 (0.03) | **-0.14, -0.03** | -0.07 (0.03) | **-0.13, -0.02** | -0.07 (0.03) | **-0.13, -0.02** | -0.03 (0.03) | -0.08, 0.03 | -0.02 (0.03) | -0.08, 0.04 | -0.02 (0.03) | -0.08, 0.03 |
| State workahol. (1-7) | | | 0.19 (0.04) | **0.11, 0.27** | 0.19 (0.04) | **0.11, 0.27** | | | 0.11 (0.04) | **0.03, 0.20** | 0.11 (0.04) | **0.03, 0.19** |
| State workaholism × Detachment | | | | | -0.04 (0.03) | -0.10, 0.02 | | | | | -0.07 (0.03) | **-0.14, -0.01** |
| **Random Effects** | | | | | | | | | | | | |
| $\tau_{00}{}^2$ | 1.02 | | 1.03 | | 1.03 | | 0.60 | | 0.60 | | 0.61 | |
| $\sigma^2$ | 1.09 | | 1.05 | | 1.05 | | 1.13 | | 1.12 | | 1.11 | |

Notes. SE = standard error; CI = non-parametric bootstrap confidence intervals. Level-2 continuous predictors were grand-mean-centered, whereas level-1 continuous predictors were person-mean-centered before fitting the models. Bold type highlights cases where 95% CI excluded zero. The models were fitted considering all complete responses (779 and 723 observations for emotional exhaustion and sleep quality, respectively) from the 114 included participants.

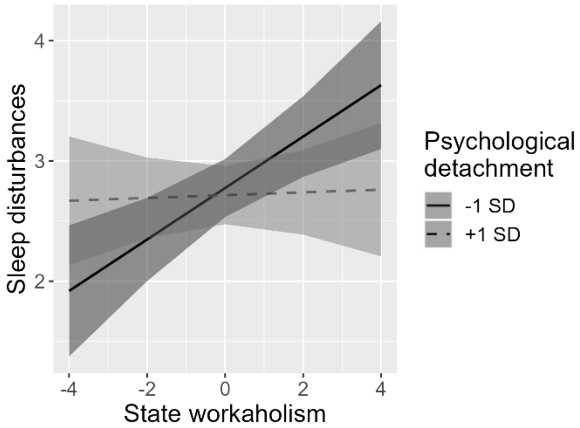


**Figure 4**. Within-individual interactions between afternoon ratings of state workaholism and evening psychological detachment in the model predicting sleep disturbances.

*Robustness checks*

Robustness checks were conducted to evaluate the consistency of our results across alternative pre-processing and analytical scenarios (see Steegen et al., 2016). These involved both the inclusion of additional control variables that were not retained in our main analyses due to their weak relationship with our outcome variables (i.e., job position, having children, time, and blood pressure confounders such as physical activity) and the replication of the same models based on different data subsets and modeling strategies. Specifically, in line with the HIC approach (Spector, 2021), the robustness of the direct and interactive relationships resulting from our main analyses was assessed by adding additional controls one-by-one to models **M1-M3**, which we also replicated without including any control variable. Further pre-processing and analytical 'forking paths' that we considered include: the removal of influential cases (i.e., two-to-five participants showing extreme Cook's distances); the exclusion of participants reporting sleep dysfunctions or hormonal/psychotropic medications (*n* = 23); the inclusion of all participants (*n* = 135); the inclusion of a random slope for state workaholism; the use of alternative estimators and family distributions (e.g., Gamma, log-Normal); the removal of flagged measurements with extreme blood pressure values (*n* = 8-10) or unusual timing (e.g., morning measurements recorded in the early afternoon) ($n$ = 18); the use of the two workaholism dimensions (i.e., working compulsively and working excessively) instead of the total score; and the operationalization of trait workaholism through the full 10-item retrospective DUWAS scale (i.e., administered in the preliminary questionnaire, Cronbach's α = . 80, 95% CI [.74, .85]) rather than through the average state workaholism score. Overall, the robustness checks were highly consistent with the main analyses (see **Supplementary Materials**), supporting the robustness and generalizability of our findings beyond our pre-processing and modeling pre-registered choices.

## Discussion

The present study answers specific calls for person-centric studies on workaholism (Clark et al., 2016) and for deepening the investigation of the causal paths leading from workaholic cognitions and behaviors to the enduring health consequences highlighted by previous research. Workaholism, being commonly conceptualized as a stable individual tendency (Andreassen, 2014; Andreassen, Schaufeli, et al., 2018; Loscalzo & Giannini, 2017; Menghini et al., 2023), has been mainly investigated by cross-sectional comparisons of health and well-being outcomes in individuals with higher vs. lower *trait workaholism* (e.g., Balducci et al., 2018; Huyghebaert et al., 2018; Salanova et al., 2016). In contrast, our study investigates the short-term health impairment effects fueled by the phenomenon by focusing on the differences between workdays characterized by higher- vs. lower-than-usual state workaholism (i.e., symptoms of compulsive overwork), net to the individual differences in the trait component. Building on the allostatic load model and recovery theory, we investigated whether state workaholism could exert a range of psychophysiological responses functionally similar to those typically highlighted for external job demands, corroborating the stressful nature of workaholism.

First, state workaholism was positively related to afternoon levels of systolic and diastolic blood pressure (Hypothesis 1a). This result corroborates and strengthens previous findings by Balducci et al. (2022), highlighting the potential of workaholism to trigger sympathetically-driven physiological patterns of acute stress. By fueling obsessive work-related thoughts, self-imposed overwork, and pervasive dysphoric states (Balducci et al., 2021; Clark et al., 2016; Schaufeli, Shimazu, et al., 2009), workaholism represents a substantial pressure that individuals pose on themselves. In line with the allostatic load model (McEwen, 2004, 2006), the psychophysiological reactivity highlighted in this study might be a first sign (primary mediator) of the health impairment process activated by workaholism. In turn, primary physiological changes can cumulate over longer time, leading to the between-individual differences in health and well-being for individuals with high vs. low trait workaholism.

Second, although we did not find a substantial direct relationship between state workaholism and evening blood pressure (contrarily to Hypothesis 1b), the results of our explorative analyses are consistent with an indirect relationship fully mediated by afternoon blood pressure. This is in line with a prolonged activation effect of workaholism (see Brosschot et al., 2005), according to which the increased afternoon blood pressure characterizing workdays with higher workaholism symptoms would require longer time to be counteracted by the organism through its natural unwinding processes, resulting in a full mediation. It may also be that on such workdays work-related rumination and obsessive thoughts keep enduring over the evening, which we did not directly measure, explaining the prolonged activation effects of state workaholism consistently with the perseverative cognition hypothesis (Brosschot et al., 2006, 2010). Although the former interpretation is more parsimonious, the latter is theoretically plausible and worthy of further scrutiny. In both cases, the immediate psychophysiological reactivity to state workaholism can be somehow functional to sustain the additional work investment generated by workaholic thoughts and behaviors, whereas its continuation outside work can increase the risk of health problems in the long run (Brosschot et al., 2005; Pieper & Brosschot, 2005).

Third, state workaholism was also positively related to bedtime momentary ratings of emotional exhaustion and next morning ratings of sleep disturbances (Hypotheses 2 and 3). These can be thought as two additional indices of prolonged strain responses, further corroborating the idea that workaholism depletes individuals' energy and impairs their recovery. Particularly, after-work emotional exhaustion may be considered a direct subjective manifestation of slow unwinding ensuing the experience of a particularly stressful workday (Geurts & Sonnentag, 2006; Sonnentag & Fritz, 2015). Emotional exhaustion is also the first emerging component of burnout (Kristensen et al., 2005; Maslach et al., 2001), a chronic and debilitating work-related stress syndrome that has been recently included in the International Classification of Diseases (World Health Organization, 2019). Thus, our results shed light on the initial stages of the strain generation mechanism activated by workaholism also in relation to the genesis of burnout. Sporadic emotional exhaustion at the end of the workday may consolidate in response to the frequent experience of workaholism symptoms, opening the way to the other facets of burnout (depersonalization and reduced professional efficacy) and their consequences (see Maslach & Jackson, 1981).

Similarly, sleep disturbances are well-known stress correlates indicative of impaired recovery, with previous research highlighting reciprocal relationships between stress and sleep, resulting in a vicious cycle where individuals are progressively more exposed and vulnerable to environmental stressors (Cardoso et al., 2021; Garefelt et al., 2020; Konjarski et al., 2018). For instance, the longitudinal study by Van Laethem et al. (2015) showed an intriguing pattern of bidirectional relations where stress and sleep affected each other, partially or completely through perseverative cognition. Indeed, prolonged activation triggered by conscious and unconscious work-related perseverative cognitions is a highly plausible mechanism through which workaholism can impair subsequent sleep quality (Brosschot et al., 2007, 2010; Pieper & Brosschot, 2005; Vahle-Hinz et al., 2014). This is also consistent with the hyperarousal model of insomnia (see Bonnet & Arand, 2010), based on which insomniacs tend to experience increased physiological and cognitive activation during both night and daytime, making it difficult to initiate and maintain sleep. In turn, this heightened state of arousal (prolonged activation) is predicted to disrupt the natural sleep-wake rhythms and perpetuate the insomnia symptoms (Bonnet & Arand, 2010; Riemann et al., 2010).

Finally, our findings only partially supported the buffering role of evening psychological detachment on the delayed outcomes of state workaholism, with a significant moderation emerging for sleep disturbances (Hypothesis 4c). That is, we found that the within-individual relationship between state workaholism and sleep disturbances was only significant in those workdays where participants reported lower psychological detachment than they usually experience. This result is consistent with both the stressor-detachment framework (Sonnentag & Fritz, 2015) and the perseverative cognition hypothesis (Brosschot et al., 2006, 2010), corroborating the protective role of psychological detachment in the stressor-strain relationship. In contrast, no significant moderation was found for evening blood pressure and emotional exhaustion (contrarily to Hypotheses 4a and 4b), possibly due to different reasons. For instance, psychological detachment might need more time to produce its beneficial effects on physiological and psychological recovery, considering that the three variables were concurrently measured at bedtime. In contrast, sleep disturbances were measured the following morning, and such a time delay might have possibly allowed detachment to better fulfill its beneficial effects. Alternatively, it could be that other recovery experiences than psychological detachment, such as relaxation, mastery, and control (see Sonnentag & Fritz, 2007) need to be considered to exhaustively document the buffering effects of recovery on the health and well-being implications of workaholism. While future research should explore these aspects more in depth, future studies focusing on both the potential moderation and mediation role of psychological detachment are warranted (Sonnentag & Fritz, 2015).

Our study has several strengths, including the pre-registered hypotheses and procedures (ensuring higher transparency, replicability, and credibility), the rigorous blood pressure monitoring protocol compliant with updated guidelines and recommendations (Kallioinen et al., 2017; Shimbo et al., 2020; Stergiou et al., 2021), the open data and materials (ensuring better reproducibility), and the implementation of several robustness checks using alternative data pre-processing, filtering, and analysis procedures, making our results more consistent and generalizable (see Steegen et al., 2016). Moreover, the multimethod approach that integrates objective and subjective measures (see Kasl, 1998; Kristensen, 1996) while temporally separating predictor and outcome measures (see P. M. Podsakoff et al., 2003, 2012) distinguishes our study from previous investigations on day-level workaholism (e.g., Clark et al., 2021; Xu et al., 2021). Finally, while we corroborated previous evidence that workaholism symptoms can fluctuate within-person on a daily basis (i.e., within-individual variance was about 40% of the total), to our knowledge this is the first study reporting evidence of cross-level isomorphism in a workaholism measure, which provide further support for the conceptualization of workaholism as a multilevel construct (see Stapleton & Johnson, 2019). Importantly, our study and its results raise new research questions concerning the dynamic features of within-individual fluctuations in state workaholism (e.g., how quickly do these fluctuations occur? How large are them? How quickly do employees return to their baseline level?). Particularly, new research avenues might build from recent insights into personality dynamics (e.g., Fleeson & Jayawickreme, 2015). For instance, Sosnowska et al. (2019, 2020) advocated for a more integrated investigation of stable and momentary personality expressions based on dynamic system theory, identifying 'baseline personality' (i.e., trait-level set point), 'personality variability' (i.e., amount of within-individual fluctuations around the baseline level), and 'personality attractor strength' (i.e., self-regulating stability reflected by the attraction to one's baseline) as the key parameters capturing an individual's typical pattern of changes in personality states. Future workaholism research can significantly benefit from the simultaneous consideration of these three parameters, building from our results to better understand the pattern of changes in workaholism symptoms, their antecedents, and their consequences.

*Limitations and practical implications*

Our study limitations include the convenience and relatively small sample of Italian workers recruited from several job sectors, implying some threats to the results generalizability. Particularly, our findings might be poorly generalizable outside the Western (and specifically the Italian) context. Although workaholism has been widely investigated in non-Western countries showing straining effects in line with our results (e.g., Xu et al., 2021; Shimazu et al., 2015), future studies should carefully address their generalizability to other cultural and economic contexts. Second, state workaholism and the related outcomes were only measured during workdays and not during weekends, preventing alternative operationalizations of prolonged activation (e.g., from weekdays to weekends) and possibly masking part of the protective role of psychological detachment (e.g., Cho & Park, 2018; Yulita et al., 2022). Third, emotional exhaustion, unlike blood pressure, was only measured in the evening but not in the afternoon, preventing a differentiation between short-term and delayed responses. Moreover, it was measured with items not explicitly referred to the work domain (e.g., "At this moment, I feel tired" rather than "I feel tired due to my work"). While this operationalization might better approximate participant experience (i.e., generally feeling exhausted with no clear identification of the specific causes), future studies might use more specific items to be repeatedly administered at multiple time points. Fourth, and more generally, most our findings are based on self-report measures. Although our ESM design and focus at the within-individual level should mitigate measurement biases, we cannot exclude that some results were affected by response styles and other biases implied by self-reports.

Finally, whereas we provided resounding evidence of the direct within-individual relationships between workaholism and strain, we did not investigate the 'generating hypothetical mechanisms' behind these relationships (see Spector, 2021). For instance, job demands are plausible mediators of the straining effects of workaholism, if not even indicators of the working excessively dimension. Similarly, strain reactions might result from the higher home demands (e.g., relationship tension) following higher workaholism symptoms, as suggested by

Clark et al. (2021). Yet, both types of demands are also plausible predictors as well as moderators of compulsive overwork. For instance, the same study by Clark et al. (2021) reported higher state workaholism in workdays characterized by higher-than-usual anticipated workload. While disentangling the role of such variables is beyond the scope of our study and would require more extensive research efforts, we provided a robust starting point for future inquiry. Particularly, anticipated workload and other potential triggers of workaholism (e.g., reward practices, time pressure, and organizational climate) should be better investigated to reach a finer understanding of the nature of the phenomenon, including its genesis. Such knowledge is particularly crucial for identifying the working conditions that can be concretely modified to prevent the development of transient and more stable workaholic tendencies.

Indeed, on the practical side, our results should not lead to the wrong conclusions that workers alone are responsible for their work stress. Instead, employers and managers should understand what changes can be implemented in the work design and psychosocial context, and training can be provided to prevent and discourage workaholism tendencies, their frequent enactment in everyday working life, and their health and well-being impact (for a review, see Cossin et al., 2021). For instance, overwork endorsement, that is the employee's perceptions of a work environment that endorses working overtime, has been highlighted as an important predictor of workaholic tendencies (Mazzetti et al., 2014, 2016). Of course, an obvious implication of considering workaholism as an internal job-related demand is the need to include it in routine psychosocial risk management programs, especially for those occupations where it might be more prevalent, such as agriculture, construction, communication, consultancy, and commerce/trade workers, in addition to managers and higher professionals (see Taris et al., 2012). Finally, our results support the importance of promoting and incentivizing recovery experiences in the evening, which is predicted to favor job detachment and potentially attenuate the prolonged activation effects of workaholism symptoms.

*Conclusion*

Our study provides new insights into the short-term straining effects of workaholism, which is conceptualized as a multilevel construct varying both inter- and intra-individually and acting as an internal job-related demand. Our study suggests that workaholism symptoms are capable of triggering multiple concurrent and delayed straining effects including higher blood pressure, emotional exhaustion, and sleep disturbances. In turn, these primary responses, when not adequately managed, are likely to result in longer-term enduring health conditions and disease endpoints. For these reasons, it is pivotal to conduct more research on the short- and long-term antecedents and consequences of workaholism and to design effective interventions to discourage and reduce its enactment.

## Supplementary Materials

The following supplementary materials are available online from: https://osf.io/awbxj.

- S1: Diary questionnaire items
- S2: Raw data used in the analyses
- S3: Data pre-processing detailed report, R code, and full outputs
- S4: Psychometrics and data reduction report, R code, and full outputs
- S5: Descriptive statistics and covariate selection report, R code, and full outputs
- S6: Multilevel regression data analysis report, R code, and full outputs
- S7: Deviations from the preregistration of the study
- S8: Preregistered materials

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