AIMS *Public Health*

Research article

Behavioral dysregulation at work: A moderated mediation analysis of sleep impairment, work-related stress, and substance use

Francesco Marcatto[1],*, Donatella Ferrante[1], Mateusz Paliga[2], Edanur Kanbur[3] and Nicola Magnavita[4]

[1] Department of Life Sciences, University of Trieste, Trieste, Italy
[2] Institute of Psychology, Faculty of Social Sciences, University of Silesia, Katowice, Poland
[3] Department of Psychology, Ibn Haldun University, Istanbul, Türkiye
[4] Post-graduate School of Occupational Health, Università Cattolica del Sacro Cuore, Rome, Italy

* Correspondence: Email: fmarcatto@units.it; Tel: +393401575454.

Abstract: *Background:* Sleep impairment and work-related stress are common issues that influence employee well-being and organizational outcomes. Impaired sleep depletes cognitive and emotional resources, increasing stress and the likelihood of counterproductive work behaviors directed toward the organization (CWB-O). This cross-sectional study, guided by the conservation of resources (COR) theory, explores the relationships between impaired sleep, work-related stress, and CWB-O, considering substance use as a dysfunctional coping strategy. *Methods:* A sample of 302 Italian employees completed an online survey. Sleep impairment was assessed using the Insomnia Severity Index, work-related stress was assessed with the Perceived Stress Scale, CWB-O was assessed with the Counterproductive Work Behavior Checklist, and substance use as a coping strategy was assessed using the Brief COPE. A moderated mediation model was tested to examine the indirect effects of sleep impairment on CWB-O via work-related stress, with substance use moderating both the sleep–stress and stress–CWB-O relationships. *Results:* The results supported the hypothesis that the relationship between sleep impairment and CWB-O is mediated by work-related stress. Sleep difficulties significantly increased work-related stress, which in turn led to higher levels of CWB-O. Substance use did not moderate the relationship between sleep and work-related stress. It did, however, significantly moderate the relationship between work-related stress and CWB-O, with higher levels of substance use amplifying the impact of stress on behavioral dysregulation. *Conclusion:* This study contributes to our understanding

of how impaired sleep, work-related stress, and substance use interact to influence deviant behaviors at work. The findings align with COR theory, highlighting the role of resource depletion and dysfunctional coping in workplace behavior, and suggest that organizational interventions should also consider programs aimed at improving sleep quality and addressing substance use to reduce the likelihood of deviant behaviors at work.

1. Introduction

The organization of work—the complex series of factors that govern the way in which work is divided, controlled, and coordinated—requires close interdependence among workers [1]. Work organization is one of the factors that allow a company to compete in the market. According to the literature, good organization is associated with higher worker satisfaction and well-being, which in turn positively impacts productivity, innovation, and overall organizational success, which are key factors in maintaining a competitive edge [2,3]. Conversely, organizational problems are linked to physical and psychological health issues among workers, potentially leading to reduced performance and absenteeism [4–6]. Evidence from the literature indicates that workers' behavior significantly influences the organization of work. For example, collaborative behaviors among employees can enhance coordination and efficiency, while counterproductive behaviors may disrupt workflow and hinder organizational goals [7,8].

Counterproductive work behaviors directed toward the organization (CWB-O) represent a serious form of behavioral dysregulation consisting of intentional actions that directly conflict with organizational goals, such as sabotage, theft, or deliberate inefficiency [9]. Research suggests that these actions can be interpreted as maladaptive reactions and impaired functioning resulting from factors such as sleep impairment, work-related stress, and dysfunctional coping mechanisms, including the use of substances like alcohol or drugs to manage stress or fatigue [10,11].

Sleep problems, which include sleep disorders and sleep deprivation, can dramatically disrupt an individual's daily functioning, general health, and work performance [12,13]. Sleep disorders are a heterogeneous group of conditions that are often underdiagnosed and undertreated, with the most common being obstructive sleep apnea and insomnia [14,15]. Sleep deprivation is usually intentional or due to circumstances that prevent someone from getting enough sleep, such as long work hours, shift work, staying up late, caregiving, or excessive use of electronic devices [16,17]. Research shows an elevated incidence of sleep deprivation in Western countries, with one out of three persons reporting sleep problems [18].

Sleep impairment, particularly difficulties falling asleep and/or staying asleep, is common among workers across multiple disciplines. The health, manufacturing, and service sectors are among the most at-risk industries [19]. Sleep impairment negatively impacts workers' health, work performance, and work safety [15,20–23], making it a primary concern for both employees and employers [24]. Lack of sleep and poor sleep quality are known to heighten emotional reactivity, decrease attention, and impair decision-making [25–29], ultimately lowering employees' ability to work effectively.

One of the most important factors associated with sleep problems is work-related stress since it interferes with both the quality and quantity of sleep [21,30,31]. Work-related stress is defined as a set of behavioral, emotional, cognitive, and physiological responses to unpleasant aspects of work, characterized by elevated levels of arousal and distress [32]. Similarly to sleep impairment, work-related stress is a well-known risk factor for different negative outcomes, such as mental and physical illnesses, burnout, reduced job satisfaction, and increased turnover intention [33–37].

Risk factors for work-related stress include excessive job demands [38], shift work [39], extended working hours [40], workplace violence [41,42], and lack of adequate support and bad relationships at work [43]. According to scientific literature, impaired sleep is both a consequence and a risk factor for work-related stress. Indeed, employees who experience higher job stress suffer more frequently from insomnia [44], and working in an unfavorable psychological environment is known to double the risk of suffering from insomnia [45]. On the other hand, sleep-deprived employees may find it difficult to cope with job demands and are therefore more vulnerable to work-related stress [14,46,47]. This circular relationship suggests that impaired sleep and work-related stress are interconnected, with each amplifying the effect of the other [22,31,48] in a vicious cycle that affects both employee health and organizational effectiveness [49–51].

CWB-O can be seen as an organizational-level consequence of this interplay between sleep and work-related stress [10]. Indeed, employees experiencing high levels of stress and sleep deprivation might be more likely to engage in such behaviors as a form of retaliation, further worsening their negative impacts on the organization [52–54].

In addition to the effects of impaired sleep and work-related stress on CWB-O, this study also considers the role of substance use as a dysfunctional coping mechanism. Substance use may worsen the negative effects of inadequate sleep and occupational stress, increasing the likelihood of behavioral dysregulation [55,56]. This study aims to investigate the intricate relationships among these constructs, with a focus on substance use as a dysfunctional coping strategy that moderates these relationships, a dimension scarcely explored in prior research. By shedding light on how these interactions affect employee voluntary behavior aimed at harming the organization and its outcomes, this study also aims to provide insights for developing strategies to mitigate these risks and promote healthier and more productive workplaces.

1.1. Theoretical framework

1.1.1. The conservation of resources theory

The conservation of resources (COR) theory provides a comprehensive framework for understanding how individuals react to stress, especially regarding resource gain and loss [57]. According to COR theory, people are motivated to acquire, protect, and maintain resources necessary for their well-being and protection against possible resource loss. These resources include material possessions (e.g., money), personal characteristics (e.g., self-esteem), and energy (e.g., attention). People experience stress when there is a threat of resource loss, an actual loss of resources, or insufficient resource gain after an investment of resources [58].

In the context of this study, COR theory is especially relevant for explaining the relationships among impaired sleep, work-related stress, and CWB-O. Since sleep is essential for preserving overall health, emotional stability, and cognitive function, it can be viewed as a critical personal resource [59]. This vital

resource is exhausted by poor or interrupted sleep, which increases a person's susceptibility to stress [54]. Therefore, according to this theory, when employees do not get enough sleep, their ability to handle their job demands may be diminished, which could result in an increase in work-related stress [60].

This depletion of resources, as described by COR theory, also has implications for employees' behavior at work. People who experience a decrease in sleep-related resources may become more stressed and engage in maladaptive behaviors, like CWB-O, to deal with or react to this perceived loss of resources [56,61].

Moreover, COR theory contributes to the understanding of how dysfunctional coping strategies, such as substance use, moderate the relationship between impaired sleep, work-related stress, and CWB-O [62]. Substance use can be viewed as a maladaptive and avoidant [63] attempt to cope with stress and lack of sleep and to replenish lost resources [64,65]. However, instead of restoring resources, substance use further depletes them by worsening sleep quality and increasing stress, thus leading to a resource-loss spiral [58]. Therefore, engaging in substance use as a coping strategy could exacerbate the strength of the vicious cycle in which lack of sleep leads to further work-related stress, ultimately increasing the likelihood of behavioral dysregulation in the form of counterproductive behaviors at work [9,56,66].

In summary, COR theory offers a useful lens to understand the connections among impaired sleep, work-related stress, and counterproductive work behaviors. By framing these constructs in terms of resource loss and conservation, COR theory highlights the importance of managing sleep and stress in order to prevent the escalation of negative behaviors in the workplace.

1.1.2. Impaired sleep and work-related stress

Sleep is an essential resource that restores the emotional and cognitive reserves needed for effective functioning [59,66]. Lack of sleep prevents fully replenishing these reserves, leading to a reduced ability to handle job demands [67,68], decreased job performance, and increased sick leaves and accidents [19]. Therefore, employees suffering from sleep impairment are more likely to perceive job demands as overwhelming and less likely to feel confident in their ability to meet them. As employees feel less capable of coping with their duties, this negative appraisal of job demands can increase stress levels [24,69]. This, in turn, can lead to further sleep disruption, perpetuating a cycle of resource loss that reduces both individual well-being and workplace performance, lowering job satisfaction and increasing the likelihood of burnout and engaging in counterproductive work behaviors [70,71].

Although there is a reciprocal relationship between work-related stress and sleep problems, with each influencing the other [22,31,48], longitudinal research indicates that, over time, sleep impairment is more likely to predict increases in work-related stress than work-related stress is to predict sleep problems [21]. This finding emphasizes the critical role of sleep as a precursor to stress, rather than just a consequence of it, also highlighting the necessity of treating sleep issues to prevent work-related stress from getting worse.

1.1.3. Work-related stress and counterproductive work behaviors

Work-related stress is a significant predictor of counterproductive work behaviors directed toward the organization (CWB-O), which consist of intentional actions of employees that infringe on an organization's

interests, violate its rules, and hurt the organization itself [10,72]. It includes actions such as taking longer breaks, reducing effort, or even deliberately harming organizational assets. High levels of stress can impair employees' ability to manage emotions, maintain self-control, and follow organizational norms, leading to an increased likelihood of engaging in these dysfunctional behaviors [52,73].

Depletion of psychological and emotional resources represents one of the mechanisms through which work-related stress contributes to CWB-O [10,60]. Stress depletes the mental and emotional energy needed to respond effectively to job demands and challenges. Consequently, as stress levels rise, employees can experience feelings of overload, frustration, or even resentment, and respond by engaging in behaviors that harm the organization. Indeed, these actions can be interpreted as an attempt to recover a sense of control or balance in response to the stress caused by resource depletion. For example, an employee who feels overwhelmed by excessive job demands and exhausted due to lack of sleep may decide to sabotage organizational processes or violate workplace norms. These actions could include taking longer breaks than allowed or taking sick leaves under false pretenses, either as a form of retaliation or as a misguided effort to conserve the remaining personal resources [74].

Moreover, work-related stress can also evoke negative emotions and attitudes and thus distort employees' perception of their workplace, increasing the likelihood that they will view it as unjust or even hostile [75,76], fostering feelings of dissatisfaction and disengagement, which could further increase the likelihood of CWB-O [56,77]. Indeed, employees who feel unfairly treated may justify deviant actions as retaliation against perceived injustice [78].

High levels of stress can also impair decision-making and self-regulation, leading to impulsive or short-sighted behaviors that employees might not otherwise consider [79,80]. When employees are not experiencing high levels of stress or are working in a supportive environment, they are usually capable of following workplace norms and regulations, but when overwhelmed by stress, they are less capable of controlling their impulses [81]. As a consequence, they are more prone to acts of retaliation or sabotage, which hurt in the long run both the organization and the employee, even though they may seem satisfactory in the short term [79].

In summary, by depleting personal resources, increasing negative perceptions of the workplace, reducing self-regulation, and impairing decision-making, work-related stress contributes to the occurrence of CWB-O.

1.1.4. The moderating role of substance use

Coping mechanisms are critical in determining which behaviors will be adopted to address aversive situations [82]. The use of substances such as alcohol, drugs, or other psychoactive agents can serve as a coping strategy that people could use to manage stress and discomfort [64]. Differently from functional coping strategies, such as seeking social support [83], substance use may provide short-term relief only, since it does not address the underlying causes, and often leads to further psychological and physiological issues, thus exacerbating the very problems it was meant to alleviate [84]. Therefore, we believe that substance use could play a relevant role in the relationships between impaired sleep, work-related stress, and CWB-O, leading to a higher likelihood of engaging in deviant behaviors at work.

First, substance use may strengthen the relationship between sleep difficulties and work-related stress. Lack of sleep already depletes cognitive and emotional resources, leaving individuals vulnerable to stress. When substances such as alcohol, cannabis, benzodiazepines (BZD), or opioids are used as a coping mechanism, they further disrupt sleep quality, thus increasing resource depletion [85–87]. Research has

shown that alcohol and cannabis use can increase sleep latency and disrupt the normal architecture of REM and NREM sleep [88], while chronic BZD use reduces slow-wave brain activity [89], and long-term opioid use leads to increased awakenings, decreased total sleep time, and diminished sleep efficiency [87]. These effects aggravate the vicious cycle where both sleep quality and stress levels continue to deteriorate.

Second, substance use may also moderate the relationship between work-related stress and CWB-O. Substance use, including alcohol and stimulants, intensifies the negative emotions associated with stress, such as frustration, anxiety, and irritability [90]. It also impairs decision-making [91] and self-regulation [92], therefore increasing the likelihood that stressed employees will act out against their organization. For example, alcohol consumption has been shown to heighten emotional reactivity and reduce impulse control, while stimulants such as cocaine impair long-term decision-making and increase risk-taking behaviors [90–92]. This combination of sleep disruption, heightened stress, and impaired self-regulation could represent a strong risk factor for the onset of deviant behaviors such as CWB-O.

1.2. Hypotheses development

Drawing upon the theoretical framework and the relationships between the constructs described in the previous sections, we propose a set of hypotheses about the connections among sleep, work-related stress, and CWB-O, also considering the moderating role of substance use.

As previously noted, according to COR theory, sleep problems deplete a critical personal resource, restorative sleep, essential for preserving cognitive, emotional, and behavioral functioning. Moreover, the lack of sleep impairs judgment, reduces emotional resilience, and heightens irritability, which can increase the likelihood of engaging in deviant behaviors at work. This relationship between impaired sleep and CWB-O, however, may be mediated by work-related stress. Due to the cognitive and emotional resource depletion caused by impaired sleep, employees are more likely to struggle in managing job demands and interactions at work, therefore being more susceptible to stress. This increased stress, in turn, can lead to higher levels of CWB-O as employees struggle to manage their duties effectively. Therefore, we hypothesize:

H1: Impaired sleep is a significant predictor of CWB-O, but this relationship is mediated by work-related stress.

Substance use, as a dysfunctional coping strategy, can amplify the negative effects of both impaired sleep and work-related stress. When employees take substances to relieve the discomfort caused by sleep problems and stress, they deplete their cognitive and emotional resources even more. This additional resource depletion heightens the negative impact of lack of sleep on stress. Moreover, the impairment in decision-making and self-regulation caused by substance use makes it more difficult for individuals to manage their stress and, therefore, increases the likelihood of engaging in CWB-O. Thus, we hypothesize:

H2a: The relationship between impaired sleep and work-related stress is moderated by the dysfunctional coping strategy of substance use.

H2b: The relationship between work-related stress and CWB-O is moderated by the dysfunctional coping strategy of substance use.

These hypotheses are conceptualized in the model presented in Figure 1.
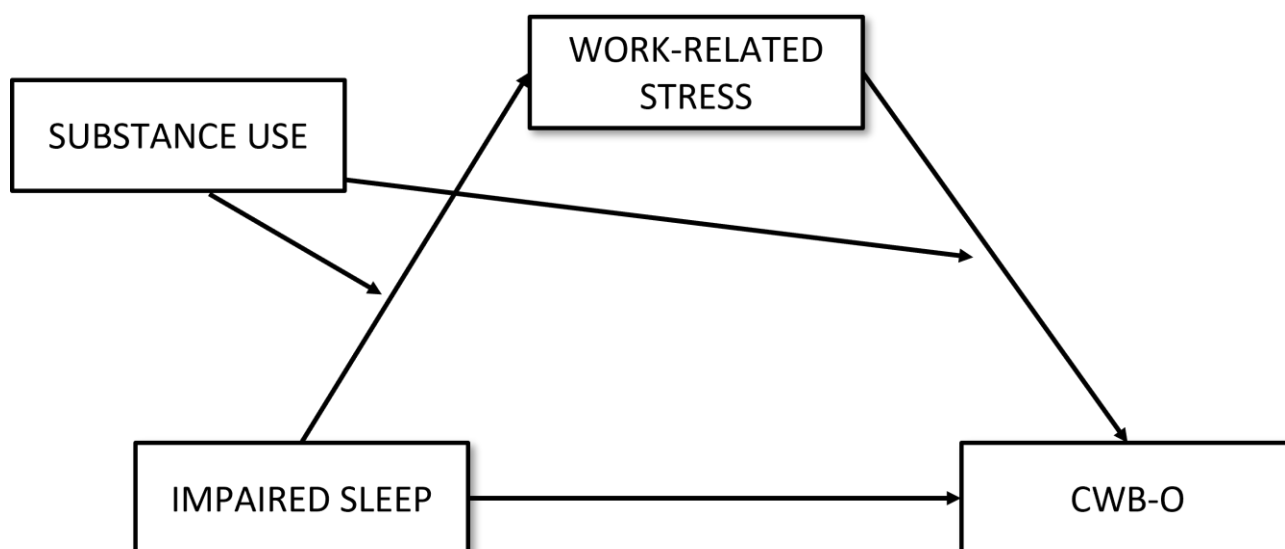
Figure 1. A conceptual model for testing moderated mediation.

2. Materials and methods

2.1. Participants and procedure

A total of 302 participants were recruited through Prolific©, an online survey platform. The source population comprised Italian adult employees registered on the Prolific© panel. The choice of the Prolific© platform for case recruitment was made on the basis of a careful assessment of data security conditions. The platform in fact acts as a data controller, leaving the researcher with the responsibility for complying with data protection laws. Using the platform's filtering system, we identified and invited eligible participants who met the following inclusion criteria: being at least 18 years old, currently employed, residing in Italy, and having Italian as their primary language. There were no additional exclusion criteria. To ensure that participants were actually employed, they had to confirm their current employment status on the first page of the questionnaire. Participants received the link to the online questionnaire developed specifically for this study via Prolific© and were financially compensated with £0.75 for their participation. The study used a cross-sectional design and was approved by the Ethics Committee of the University of Trieste, Italy (Minutes No. 5, dated May 27, 2024), and was conducted in accordance with the Helsinki Declaration. Written informed consent, which emphasized the confidentiality of the data and the participant's right to withdraw from the study at any time, was provided on the first page of the questionnaire, where participants were asked to click "I consent" to proceed with the study. Data was collected between May 28, 2024, and May 30, 2024.

2.2. Measures

Participants were asked to complete a questionnaire that included the validated psychometric tools described below.

Insomnia Severity Index. The Insomnia Severity Index (ISI) [93] is a self-report instrument designed to evaluate perceived sleep difficulties. It consists of seven items evaluating the subjective symptoms and daytime consequences of insomnia, with responses on a 5-point Likert scale (from 0 to

4). The total score, which ranges from 0 to 28, is derived by summing the individual item responses, with higher scores indicating greater perceived sleep difficulties. In this study, we employed the Italian version of the tool [94]. Cronbach's alpha in the current study was 0.87.

Perceived Occupational Stress Scale. The Perceived Occupational Stress Scale (POS) [95] is a four-item psychometric tool that measures the level of stress that individuals experience at work. Each item is rated on a 5-point Likert scale (from 1 to 5). The total score, which ranges from 1 to 5, is calculated by averaging the individual item responses, with higher scores reflecting a higher level of perceived stress at work. Cronbach's alpha in the current study was 0.87.

Counterproductive Work Behavior Checklist. The Italian version of the Counterproductive Work Behavior Checklist [96] is a 45-item questionnaire that measures the frequency of two types of CWB: those directed toward the organization (CWB-O, e.g., "Purposely did your work incorrectly") and those directed at individuals (CWB-I, e.g., "Refused to help someone at work"). Items are answered on a 5-point scale (from 1 to 5). For each subscale, a total score, which ranges from 1 to 5, is calculated by averaging the individual item responses, with higher scores indicating a higher frequency of CWB. In this study, only the CWB-O subscale was used, with a Cronbach's alpha of 0.89.

Brief COPE Scale. The Italian Brief COPE [97] is a 21-item scale used to assess six coping strategies that individuals might use in stressful situations, namely activation, deactivation, social support, humorous reframing, religious/spiritual reliance, and substance use. Items are rated on a 4-point Likert scale (from 1 to 4). For each subscale, a total score, which ranges from 1 to 4, is calculated by averaging the individual item responses, with higher scores indicating greater use of that coping strategy. In this study, only the substance use subscale (COPE-SUBST) was used, with a Cronbach's alpha of 0.92.

2.3. Data analysis

First, standard descriptive statistics and correlational analyses (using the Pearson correlation coefficient) were conducted to explore the relationships among the variables. Then, the hypothesized moderated mediation model (Figure 1) was tested in a single model, using the Jamm module v. 1.2.1 for Jamovi. This approach allowed for the assessment of the significance of the indirect effects of impaired sleep on CWB-O through work-related stress across different levels of the moderator (substance use). To evaluate the mediational relationship (ISI–POS–CWB-O) at varying levels of substance use, analyses were conducted at three specific levels of the moderator: low (1 SD below the mean COPE-SUBST score), average (mean COPE-SUBST score), and high (1 SD above the mean COPE-SUBST score). Mediation (H1) was considered to occur when a significant indirect effect was observed at the average level of COPE-SUBST. The difference in indirect effects across the low, average, and high levels of COPE-SUBST was used to assess the presence of moderated mediation (H2a and H2b), indicating whether the strength of the mediation effect varied depending on the level of substance use. A p-value < 0.05 was used as the threshold for statistical significance. No formal a priori sample size calculation was conducted for this study. However, with a sample size of 302 participants, the study had more than adequate statistical power to detect medium-sized effects, as per standard guidelines for regression-based analyses in behavioral research [98]. Moreover, a post hoc power analysis for the indirect path in the moderated mediation model was conducted using the online MedPower tool [99]. With a sample size of 302 participants, the power to detect the indirect effect was estimated to be 0.84, indicating adequate statistical power for the analysis.

Missing data were minimal (approximately 1%), and listwise deletion of cases was used.

3.   Results

Demographic and work-related data of the study sample are reported in Table 1.

Table 1. Demographic and work-related characteristics of the study sample.

Variable	n (%)/mean (SD)
GENDER	
Female	127 (42%)
Male	175 (58%)
AGE (years, range 21–65)	35.2 (10.0)
YEARS OF JOB EXPERIENCE	
0–1	36 (11.9%)
2–5	111(36.8%)
6–10	53 (17.5%)
11–20	58 (19.2%)
21–30	29 (9.6%)
>30	15 (5%)
TYPE OF EMPLOYMENT	
Part-time	90 (30%)
Full-time	212 (70%)

The descriptive statistics and Pearson correlations among the variables included in the study are reported in Table 2. All correlations were statistically significant, with the strongest association being between impaired sleep (ISI) and work-related stress (POS) ($r = 0.38$) and the weakest between work-related stress (POS) and substance use (COPE-SUBST) ($r = 0.12$).

Table 2. Descriptive statistics and Pearson's correlations among the measures of interest.

Variable	Mean (SD)	Median	Min/max	ISI	POS	CWB-O
ISI	9.28 (5.57)	9.00	0/28	-		
POS	2.69 (0.92)	2.75	1/5	0.38***	-	
CWB-O	1.51 (0.45)	1.38	1/3.38	0.24***	0.26***	-
COPE-SUBST	1.30 (0.69)	1.00	1/4	0.26***	0.12*	0.34***

Note: ISI: Insomnia Severity Index; POS: Perceived Occupational Stress; CWB-O: Counterproductive Work Behavior toward the Organization; COPE-SUBST: Brief COPE Substance Use subscale. * p < 0.05, ** p < 0.01, *** p < 0.001.

A moderated mediation analysis was conducted to test the three hypotheses. The results of the indirect effect of ISI on CWB-O via POS, at three levels of COPE-SUBST (Mean, Mean − 1SD, and Mean + 1SD), are presented in Table 3. At the average level of COPE-SUBST, ISI was found to be a significant predictor of POS ($\beta = 0.37, p < 0.001$), which in turn was significantly associated with CWB-O ($\beta = 0.18, p < 0.001$). The direct effect of ISI on CWB-O was not significant ($\beta = 0.10, p = 0.08$), but the overall indirect (i.e., mediated by POS) effect was significant ($\beta = 0.07, p < 0.01$), thus supporting H1.

Table 3. Mediation effects for different COPE-SUBST moderator levels.

Moderator levels							
COPE-SUBST	Type	Effect	b	95% C.I.	β	z	p
Mean − 1SD	Indirect effect	ISI⇒POS⇒CWB-O	0.003	−0.001/0.006	0.03	1.53	0.13
Mean − 1SD	Path	ISI⇒POS	0.06	0.04/0.09	0.37	4.91	<0.001
Mean − 1SD	Path	POS⇒CWB-O	0.04	−0.01/0.10	0.09	1.61	0.11
Mean − 1SD	Direct effect	ISI⇒CWB-O	0.01	−0.001/0.02	0.10	1.70	0.09
Mean − 1SD	Total effect	ISI⇒CWB-O	0.02	0.01/0.03	0.24	4.31	<0.001
Mean	Indirect effect	ISI⇒POS⇒CWB-O	0.005	0.002/0.009	0.07	2.91	<0.01
Mean	Path	ISI⇒POS	0.06	0.04/0.08	0.37	6.70	<0.001
Mean	Path	POS⇒CWB-O	0.09	0.03/0.14	0.18	3.24	<0.001
Mean	Direct effect	ISI⇒CWB-O	0.008	−0.001/0.02	0.10	1.74	0.08
Mean	Total effect	ISI⇒CWB-O	0.02	0.01/0.03	0.24	4.31	<0.001
Mean + 1SD	Indirect effect	ISI⇒POS⇒CWB-O	0.008	0.003/0.01	0.10	3.26	<0.001
Mean + 1SD	Path	ISI⇒POS	0.06	0.03/0.09	0.37	4.40	<0.001
Mean + 1SD	Path	POS⇒CWB-O	0.13	0.08/0.19	0.27	4.87	<0.001
Mean + 1SD	Direct effect	ISI⇒CWB-O	0.008	−0.001/0.02	0.10	1.77	0.08
Mean + 1SD	Total effect	ISI⇒CWB-O	0.02	0.01/0.03	0.24	4.31	<0.001

Note: ISI: Insomnia Severity Index; POS: Perceived Occupational Stress; CWB-O: Counterproductive Work Behavior toward the Organization; COPE-SUBST: Brief COPE Substance Use subscale.

The strength of the indirect effect of ISI on CWB-O via POS varied depending on the level of COPE-SUBST. At low levels of substance use (Mean − 1SD COPE-SUBST), the indirect effect was not significant ($\beta = 0.03$, $p = 0.13$). However, at high levels of substance use (Mean + 1SD COPE-SUBST), the indirect effect was both significant and stronger ($\beta = 0.10$, $p < 0.001$) than at average levels of COPE-SUBST ($\beta = 0.07$, $p < 0.01$). Furthermore, the effect of POS on CWB-O also varied with levels of substance use: it was not significant at low levels of COPE-SUBST ($\beta = 0.09$, $p = 0.11$) but became significant and stronger at high levels of COPE-SUBST ($\beta = 0.27$, $p < 0.001$). Notably, the effect of ISI on POS remained consistent across different levels of COPE-SUBST ($\beta = 0.37$, $p < 0.001$ at low, average, and high levels).

Table 4. Effects of moderation taking into account the relationships of the mediation model.

Moderator	Interaction	b	95% C.I.	β	z	p
COPE-SUBST	ISI: COPE-SUBST⇒POS	−0.001	−0.03/0.03	−0.002	−0.03	0.97
	POS: COPE-SUBST⇒CWB-O	0.06	0.04/0.09	0.30	5.66	<0.001

Note: ISI: Insomnia Severity Index; POS: Perceived Occupational Stress; CWB-O: Counterproductive Work Behavior toward the Organization; COPE-SUBST: Brief COPE Substance Use subscale.

Table 4 confirms the significant interaction effect between POS and COPE-SUBST on CWB-O (β = 0.30, p < 0.001), indicating that the relationship between work-related stress and counterproductive work behaviors directed toward the organization is moderated by the use of substances as a coping strategy. This interaction suggests that as substance use increases, the impact of work-related stress on CWB-O is amplified. To illustrate this interaction effect, the predicted levels of CWB-O at low, medium, and high levels of COPE-SUBST are plotted in Figure 2. This finding supports H2b, demonstrating the conditional effect of substance use on the stress–CWB-O relationship.
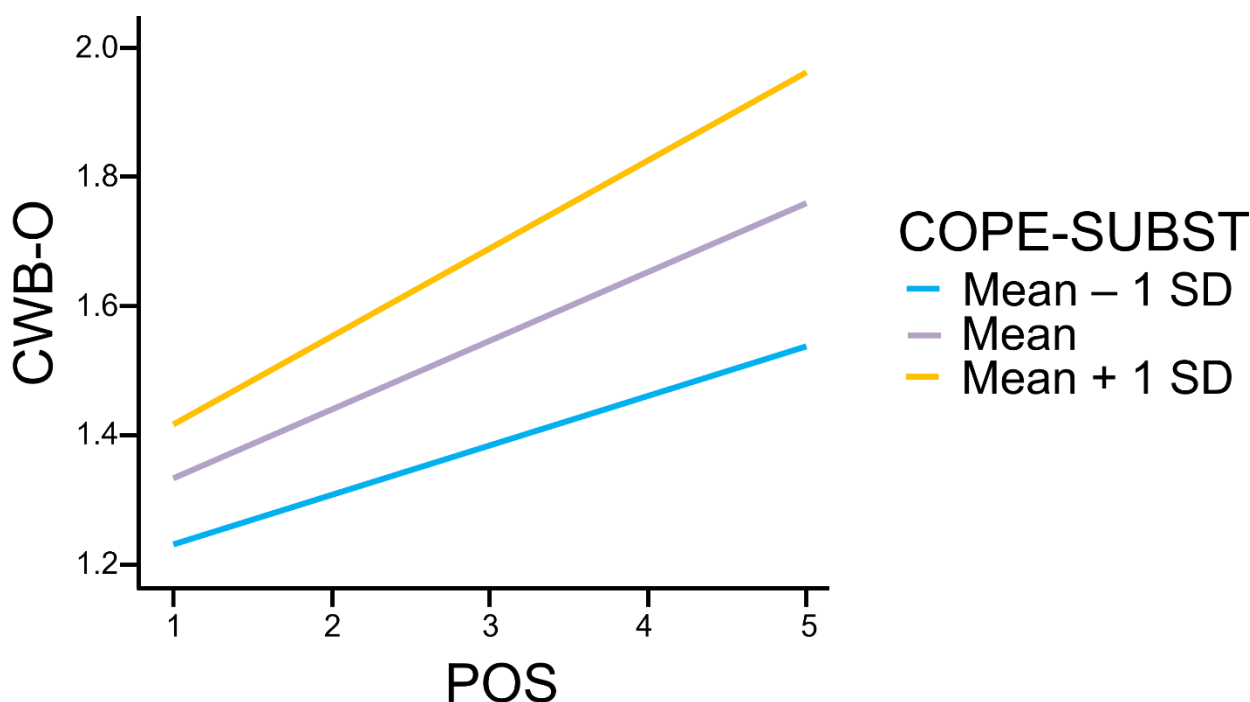
Figure 2. The moderating effect of substance use (COPE-SUBST) on the relationship between work-related stress (POS) and counterproductive work behavior toward the organization (CWB-O).

Conversely, as reported in Table 4, no significant interaction was found between ISI and COPE-SUBST on POS (β = −0.002, p = 0.97), suggesting that the relationship between impaired sleep and work-related stress does not change based on the level of substance use. Therefore, H2a was not supported.

The standardized coefficients for the individual paths in the moderated mediation model are presented in Figure 3.
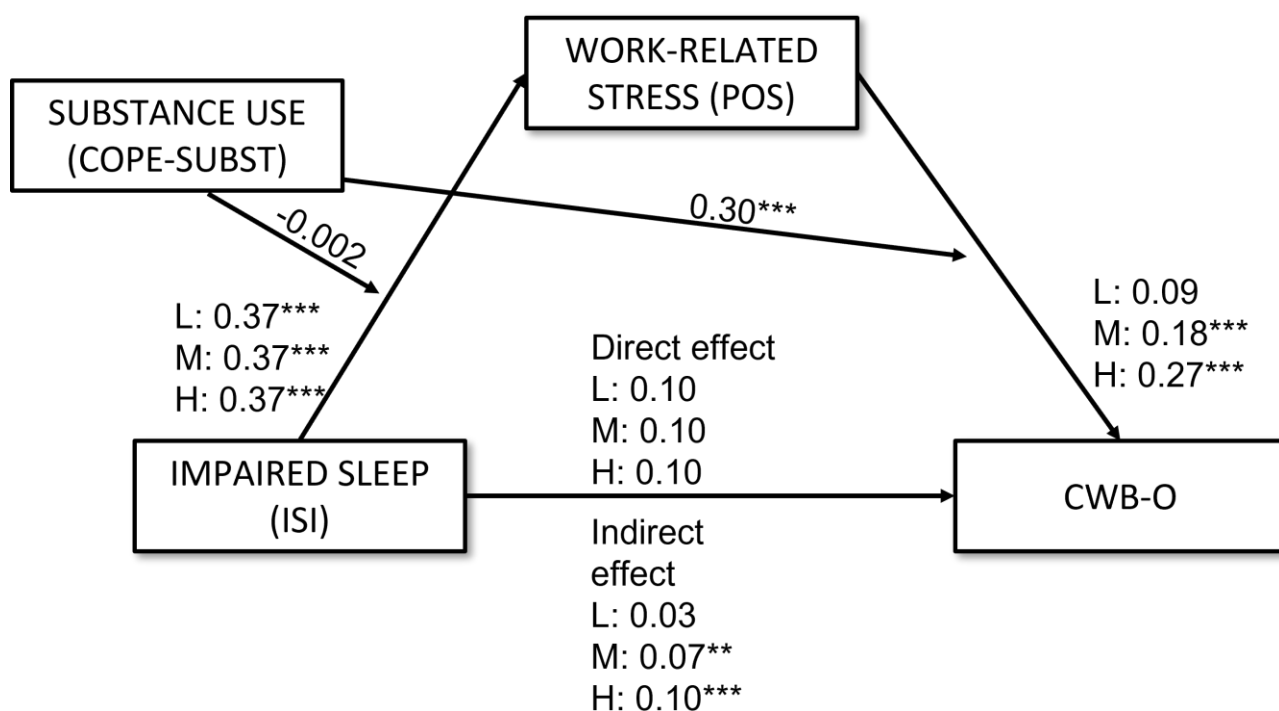
Figure 3. Results of the moderated mediation model (in standardized beta scores) for low (L), medium (M), and high (H) levels of substance use. * p < 0.05, ** p < 0.01, *** p < 0.001.

4. Discussion

The aim of the present study was to explore the complex relationships among sleep problems, work-related stress, and counterproductive work behaviors directed toward the organization, and the moderating role of substance use as a dysfunctional coping strategy. The results contribute to a better understanding of how these factors interact and offer new insights into the mechanisms that underlie behavioral dysregulation at work, especially in situations of resource depletion, in accordance with COR theory [57,58].

The first hypothesis (H1) stated that work-related stress would mediate the relationship between impaired sleep and CWB-O. The results supported this hypothesis, indicating that sleep difficulties significantly intensify employee's perceived stress at work, which in turn increases the likelihood of engaging in CWB-O. This finding is consistent with COR theory, which states that when essential resources like sleep are depleted, individuals become more vulnerable to stress and, as a consequence, more prone to deviant behaviors [62]. These behaviors, oftentimes aggressive, can, in fact, be a defense strategy taken on to mitigate adverse circumstances and protect whatever resources individuals still have [58]. It is noteworthy that the direct effect of sleep on CWB-O was not significant, indicating that it is the work-related stress increased by sleep impairment, rather than lack of sleep itself, that drives these deviant behaviors.

The second hypothesis (H2a) proposed that the relationship between sleep impairment and work-related stress would be moderated by substance use as a dysfunctional coping strategy. This hypothesis, however, was not supported since the effect of sleep on stress levels remained constant independent of substance use levels. A possible explanation for this result is that the relationship between lack of sleep,

substance use, and work-related stress could be more complex than a straightforward interaction. For example, the direct effect of impaired sleep on stress could be so strong that only a very high level of substance use would significantly moderate this relationship [100]. This potential threshold effect could not have been captured by the theoretical model used in this study. Also, we employed a non-clinical sample; therefore, participants may not have engaged in substance use at levels high enough to affect the sleep–stress relationship. Additionally, the tool employed to measure substance use (the Brief COPE) specifically assesses the use of substances as a coping mechanism for stress, which may have limited its ability to capture substance use aimed at coping with sleep problems. Another possibility is that substance use acts as an independent risk factor for sleep impairment, rather than interacting directly with the sleep–stress relationship. Specifically, it could contribute to poorer sleep quality, which, in turn, leads to higher levels of stress [85,86] in a resource loss cycle [58], where individuals lose multiple resources and over time become increasingly limited in their ability to offset potential strains at work.

Finally, results provided substantial support for the third hypothesis (H2b), which stated that the relationship between work-related stress and CWB-O would be moderated by the dysfunctional coping strategy of substance use. Indeed, higher substance use increases the effect of work-related stress on CWB-O, a relationship that was not even significant for low levels of substance use. This finding aligns with existing literature suggesting that substance use impairs cognitive and emotional functioning, leading to poorer decision-making and reduced self-regulation [91,92]. Specifically, a possible explanation can be that a maladaptive strategy of coping with work-related stress by substance use, although perceived as helpful in the short term, results in a downward spiral in the long run, in which employees are even more susceptible to experiencing low mood, negative emotions, and negative attitudes toward the stressful environment at work. As a consequence, individuals under stress who engage in substance use are more likely to engage in deviant behaviors at work as a means of defense. Thus, while substance use does not affect the relationship between sleep impairment and work-related stress, it plays a critical role in how work-related stress contributes to dysregulated behaviors at work.

These findings contribute to the growing body of literature on workplace behavioral dysregulation and occupational stress by highlighting the critical role of substance use as a moderator in the stress-behavior relationship. From a theoretical standpoint, this study extends the COR theory by demonstrating that the use of substances as a coping mechanism can amplify the effects of resource depletion, specifically in the context of behavioral dysregulation in the workplace. In practice, these findings suggest that organizational interventions, other than focusing on stress management, should also promote healthy sleep patterns and address substance use as crucial factors in increasing employees' well-being and reducing counterproductive behaviors.

One of the strengths of this study consists of the use of a moderated mediation model, which is able to capture not only direct effects between variables but also conditional and interactive effects. This approach is particularly useful in organizational research because it acknowledges that behaviors and outcomes are rarely the product of a single factor. Rather, they result from the interaction of multiple factors, also including sleep disorders and coping strategies.

Some limitations should also be acknowledged. First, the cross-sectional design of the study limits the ability to draw causal conclusions. Although the theoretical model we developed included specific directional relationships derived from existing literature [21,73], further longitudinal research is needed to confirm the temporal sequence of these effects. Second, the study sample was drawn from an online survey platform, therefore the generalizability of the findings to broader populations could be limited. Additionally,

we did not collect information about the types of jobs participants were employed in, which could provide important context for understanding their stress and coping behaviors. Third, we used the substance use subscale of the Brief COPE because it evaluates the frequency of using substances specifically as a coping mechanism, but it lacks details about the types of substances and their patterns of use. Finally, the use of self-report measures may introduce potential biases, such as common method bias or recall bias, which could affect data accuracy. Future studies should consider using objective measures, for example for assessing the severity of sleep problems and substance use, and exploring the relationship between these factors and work-related stress across diverse job types.

In conclusion, this study contributes to our understanding of the relationship between impaired sleep, work-related stress, and counterproductive work behaviors, considering the effect of substance use, a common dysfunctional coping strategy. By shedding light on the conditions under which work-related stress leads to deviant, dysregulated behaviors in the workplace, this research provides insights for both theory and practice. Through the inclusion of sleep quality programs and support for substance abuse in occupational stress management programs, organizations could at the same time improve employee well-being and reduce the incidence of deviant behaviors at work, ultimately creating a more productive and positive work environment.

Use of AI tools declaration

The authors declare they have not used Artificial Intelligence (AI) tools in the creation of this article.

Acknowledgments

Authors' contribution

Study conception and design: FM and DF; data collection: FM; analysis and interpretation of results: FM, DF, MP, and NM; draft manuscript preparation: FM and EK; critical review and editing: DF, MP, and NM. All authors reviewed the results and approved the final version of the manuscript.

Conflict of interest

Nicola Magnavita is an editorial board member for AIMS Public Health, and he is also a guest editor of AIMS Public Health Special Issue. He was not involved in the editorial review or the decision to publish this article. The authors declare no conflicts of interest.

References

1. European Foundation for the Improvement of Living and Working Conditions. Work organisation. [cited 2024 Dec 08th] Available from: https://www.eurofound.europa.eu/en/topic/work-organisation.
2. Wilson MG, Dejoy DM, Vandenberg RJ, et al. (2004) Work characteristics and employee health and well-being: Test of a model of healthy work organization. *J Occup Organ Psychol* 77: 565–588. https://doi.org/10.1348/0963179042596522

3. Di Fabio A (2017) Positive Healthy Organizations: Promoting Well-Being, Meaningfulness, and Sustainability in Organizations. *Front Psychol* 8: 1938. https://doi.org/10.3389/fpsyg.2017.01938

4. Elovainio M, Heponiemi T, Sinervo T, et al. (2010) Organizational justice and health; review of evidence. *G Ital Med Lav Ergon* 32: B5–B9.

5. Magnavita N, Chiorri C, Acquadro Maran D, et al. (2022) Organizational Justice and Health: A Survey in Hospital Workers. *Int J Environ Res Public Health* 19: 9739. https://doi.org/10.3390/ijerph19159739

6. Magnavita N, Chiorri C, Karimi L, et al. (2022) The Impact of Quality of Work Organization on Distress and Absenteeism among Healthcare Workers. *Int J Environ Res Public Health* 19: 13458. https://doi.org/10.3390/ijerph192013458

7. Whitford AB, Lee SY, Yun T, et al. (2010) Collaborative Behavior and the Performance of Government Agencies. *Int Public Manag J* 13: 321–349. https://doi.org/10.1080/10967494.2010.529378

8. Fleming AC, O'Brien K, Steele S, et al. (2022) An investigation of the nature and consequences of counterproductive work behavior. *Hum Perform* 35: 178–192. https://doi.org/10.1080/08959285.2022.2102635

9. Spector PE, Fox S (2002) An emotion-centered model of voluntary work behavior: Some parallels between counterproductive work behavior and organizational citizenship behavior. *Hum Resour Manag Rev* 12: 269–292. https://doi.org/10.1016/S1053-4822(02)00049-9

10. De Clercq D, Haq IU, Azeem MU (2019) Time-related work stress and counterproductive work behavior. *Pers Rev* 48: 1756–1781. https://doi.org/10.1108/PR-07-2018-0241

11. Lehman WE, Simpson DD (1992) Employee substance use and on-the-job behaviors. *J Appl Psychol* 77: 309–321. https://psycnet.apa.org/doi/10.1037/0021-9010.77.3.309

12. Garbarino S, Lanteri P, Durando P, et al. (2016) Co-Morbidity, Mortality, Quality of Life and the Healthcare/Welfare/Social Costs of Disordered Sleep: A Rapid Review. *Int J Environ Res Public Health* 13: 831. https://doi.org/10.3390/ijerph13080831

13. Magnavita N, Garbarino S (2017) Sleep, Health and Wellness at Work: A Scoping Review. *Int J Environ Res Public Health* 14: 1347. https://doi.org/10.3390/ijerph14111347

14. Garbarino S, Guglielmi O, Sanna A, et al. (2016) Risk of Occupational Accidents in Workers with Obstructive Sleep Apnea: Systematic Review and Meta-analysis. *Sleep* 39: 1211–1218. https://doi.org/10.5665/sleep.5834

15. Garbarino S, Magnavita N, Guglielmi O, et al. (2017) Insomnia is associated with road accidents. Further evidence from a study on truck drivers. *PLoS One* 12: e0187256. https://doi.org/10.1371/journal.pone.0187256

16. Chang AM, Aeschbach D, Duffy JF, et al. (2015) Evening use of light-emitting eReaders negatively affects sleep, circadian timing, and next-morning alertness. *Proc Natl Acad Sci* 112: 1232–1237. https://doi.org/10.1073/pnas.1418490112

17. Dawson D, Encel N, Lushington K (1995) Improving Adaptation to Simulated Night Shift: Timed Exposure to Bright Light Versus Daytime Melatonin Administration. *Sleep* 18: 11–21. https://doi.org/10.1093/sleep/18.1.11

18. LeBlanc M, Mérette C, Savard J, et al. (2009) Incidence and Risk Factors of Insomnia in a Population-Based Sample. *Sleep* 32: 1027–1037. https://doi.org/10.1093/sleep/32.8.1027

19. Fietze I, Rosenblum L, Salanitro M, et al. (2022) The Interplay Between Poor Sleep and Work-Related Health. *Front Public Health* 10. https://doi.org/10.3389/fpubh.2022.866750

20. Swanson LM, Arnedt JT, Rosekind MR, et al. (2011) Sleep disorders and work performance: findings from the 2008 National Sleep Foundation Sleep in America poll. *J Sleep Res* 20: 487–494. https://doi.org/10.1111/j.1365-2869.2010.00890.x

21. Van Laethem M, Beckers DGJ, Kompier MAJ, et al. (2015) Bidirectional relations between work-related stress, sleep quality and perseverative cognition. *J Psychosom Res* 79: 391–398. https://doi.org/10.1016/j.jpsychores.2015.08.011

22. Magnavita N, Chirico F, Garbarino S, et al. (2024) Stress, sleep, and cardiovascular risk in police officers: A scoping review. *J Health Soc Sci* 9: 9–23. https://dx.doi.org/10.19204/2024/STRS1

23. Garbarino S, Durando P, Guglielmi O, et al. (2016) Sleep Apnea, Sleep Debt and Daytime Sleepiness Are Independently Associated with Road Accidents. A Cross-Sectional Study on Truck Drivers. *PLoS One* 11: e0166262. https://doi.org/10.1371/journal.pone.0166262

24. Qiu D, Li Y, Li R, et al. (2022) Long working hours, work-related stressors and sleep disturbances among Chinese government employees: A large population-based follow-up study. *Sleep Med* 96: 79–86. https://doi.org/10.1016/j.sleep.2022.05.005

25. Barnes CM, Guarana C, Lee J, et al. (2023) Using wearable technology (closed loop acoustic stimulation) to improve sleep quality and work outcomes. *J Appl Psychol* 108: 1391–1407. https://psycnet.apa.org/doi/10.1037/apl0001077

26. Killgore WDS (2010) Effects of sleep deprivation on cognition, In: Kerkhof GA, Dongen HPA van (Eds.), *Progress in Brain Research*, Elsevier, 105–129. https://doi.org/10.1016/B978-0-444-53702-7.00007-5

27. Walker MP (2009) The Role of Sleep in Cognition and Emotion. *Ann N Y Acad Sci* 1156: 168–197. https://doi.org/10.1111/j.1749-6632.2009.04416.x

28. Pilcher JJ, Huffcutt AI (1996) Effects of Sleep Deprivation on Performance: A Meta-Analysis. *Sleep* 19: 318–326. https://doi.org/10.1093/sleep/19.4.318

29. Lim J, Dinges DF (2010) A meta-analysis of the impact of short-term sleep deprivation on cognitive variables. *Psychol Bull* 136: 375–389. https://doi.org/10.1037/a0018883

30. Åkerstedt T, Nordin M, Alfredsson L, et al. (2012) Predicting changes in sleep complaints from baseline values and changes in work demands, work control, and work preoccupation – The WOLF-project. *Sleep Med* 13: 73–80. https://doi.org/10.1016/j.sleep.2011.04.015

31. Kim G, Min B, Jung J, et al. (2016) The association of relational and organizational job stress factors with sleep disorder: analysis of the 3rd Korean working conditions survey (2011). *Ann Occup Environ Med* 28: 46. https://doi.org/10.1186/s40557-016-0131-2

32. Levi L (1990) Occupational stress: Spice of life or kiss of death? *Am Psychol* 45: 1142–1145. https://psycnet.apa.org/doi/10.1037/0003-066X.45.10.1142

33. Maslach C, Schaufeli WB, Leiter MP (2001) Job Burnout. *Annu Rev Psychol* 52: 397–422. https://doi.org/10.1146/annurev.psych.52.1.397

34. Podsakoff NP, LePine JA, LePine MA (2007) Differential challenge stressor-hindrance stressor relationships with job attitudes, turnover intentions, turnover, and withdrawal behavior: A meta-analysis. *J Appl Psychol* 92: 438–454. https://psycnet.apa.org/doi/10.1037/0021-9010.92.2.438

35. Guglielmi O, Magnavita N, Garbarino S (2018) Sleep quality, obstructive sleep apnea, and psychological distress in truck drivers: a cross-sectional study. *Soc Psychiatry Psychiatr Epidemiol* 53: 531–536. https://doi.org/10.1007/s00127-017-1474-x

36. Magnavita N, Capitanelli I, Garbarino S, et al. (2018) Work-related stress as a cardiovascular risk factor in police officers: a systematic review of evidence. *Int Arch Occup Environ Health* 91: 377–389. https://doi.org/10.1007/s00420-018-1290-y

37. Marcatto F, Ferrante D (2021) Beyond the assessment of work-related stress risk: the management standards approach for organizational wellbeing. *G Ital Med Lav Ergon* 43: 126–130.

38. Marcatto F, Patriarca E, Bramuzzo D, et al. (2024) Job demands and DHEA-S levels: a study on healthcare workers. *Occup Med* 74: 225–229. https://doi.org/10.1093/occmed/kqae017

39. Acquadro Maran D, Magnavita N, Garbarino S (2022) Identifying Organizational Stressors That Could Be a Source of Discomfort in Police Officers: A Thematic Review. *Int J Environ Res Public Health* 19: 3720. https://doi.org/10.3390/ijerph19063720

40. Rees G (2020) Getting the Sergeants on your side: the importance of interpersonal relationships and cultural interoperability for generating interagency collaboration between nurses and the police in custody suites. *Sociol Health Illn* 42: 111–125. https://doi.org/10.1111/1467-9566.12989

41. Magnavita N (2014) Workplace violence and occupational stress in healthcare workers: a chicken-and-egg situation-results of a 6-year follow-up study. *J Nurs Scholarsh* 46: 366–376. https://doi.org/10.1111/jnu.12088

42. Magnavita N (2013) The exploding spark: workplace violence in an infectious disease hospital--a longitudinal study. *BioMed Res Int* 2013: 316358. https://doi.org/10.1155/2013/316358

43. Marcatto F, Orrico K, Luis O, et al. (2021) Exposure to organizational stressors and health outcomes in a sample of Italian local police officers. *Polic J Policy Pract* 15: 2241–2251. https://doi.org/10.1093/police/paab052

44. Kim H, Kim B, Min K, et al. (2011) Association between Job Stress and Insomnia in Korean Workers. *J Occup Health* 53: 164–174. https://doi.org/10.1539/joh.10-0032-OA

45. Linton SJ (2004) Does work stress predict insomnia? A prospective study. *Br J Health Psychol* 9: 127–136. https://doi.org/10.1348/135910704773891005

46. Åkerstedt T (2006) Psychosocial stress and impaired sleep. *Scand J Work Environ Health* 32: 493–501. https://doi.org/10.5271/sjweh.1054

47. Sonnentag S, Binnewies C, Mojza EJ (2008) 'Did you have a nice evening?' A day-level study on recovery experiences, sleep, and affect. *J Appl Psychol* 93: 674–684. https://psycnet.apa.org/doi/10.1037/0021-9010.93.3.674

48. Garbarino S, Magnavita N (2019) Sleep problems are a strong predictor of stress-related metabolic changes in police officers. A prospective study. *PLoS One* 14: e0224259. https://doi.org/10.1371/journal.pone.0224259

49. Törnroos M, Hakulinen C, Hintsanen M, et al. (2017) Reciprocal relationships between psychosocial work characteristics and sleep problems: A two-wave study. *Work Stress* 31: 63–81. https://doi.org/10.1080/02678373.2017.1297968

50. Roehrs T, Roth T (2008) Caffeine: Sleep and daytime sleepiness. *Sleep Med Rev* 12: 153–162. https://doi.org/10.1016/j.smrv.2007.07.004

51. Crain TL, Hammer LB, Bodner T, et al. (2014) Work–family conflict, family-supportive supervisor behaviors (FSSB), and sleep outcomes. *J Occup Health Psychol* 19: 155–167. https://doi.org/10.1037/a0036010

52. Spector PE, Fox S (2005) The Stressor-Emotion Model of Counterproductive Work Behavior, In: Fox S, Spector PE (Eds.), *Counterproductive work behavior: Investigations of actors and targets*, Washington DC, US, American Psychological Association, 151–174. https://psycnet.apa.org/doi/10.1037/10893-007

53. Christian MS, Ellis APJ (2011) Examining the Effects of Sleep Deprivation on Workplace Deviance: A Self-Regulatory Perspective. *Acad Manage J* 54: 913–934. https://doi.org/10.5465/amj.2010.0179

54. Barnes CM, Wagner DT (2009) Changing to daylight saving time cuts into sleep and increases workplace injuries. *J Appl Psychol* 94: 1305–1317. https://doi.org/10.1037/a0015320

55. Frone MR (2015) Relations of negative and positive work experiences to employee alcohol use: Testing the intervening role of negative and positive work rumination. *J Occup Health Psychol* 20: 148–160. https://doi.org/10.1037/a0038375

56. Krischer MM, Penney LM, Hunter EM (2010) Can counterproductive work behaviors be productive? CWB as emotion-focused coping. *J Occup Health Psychol* 15: 154–166. https://psycnet.apa.org/doi/10.1037/a0018349

57. Hobfoll SE (1989) Conservation of resources: A new attempt at conceptualizing stress. *Am Psychol* 44: 513–524. https://doi.org/10.1037//0003-066x.44.3.513

58. Hobfoll SE, Halbesleben J, Neveu JP, et al. (2018) Conservation of Resources in the Organizational Context: The Reality of Resources and Their Consequences. *Annu Rev Organ Psychol Organ Behav* 5: 103–128. https://doi.org/10.1146/annurev-orgpsych-032117-104640

59. Heydarifard Z, Krasikova DV (2023) Losing sleep over speaking up at work: A daily study of voice and insomnia. *J Appl Psychol* 108: 1559–1572. https://doi.org/10.1037/apl0001087

60. Hobfoll SE, Shirom A (2001) Conservation of resources theory: Applications to stress and management in the workplace, *Handbook of organizational behavior,* 2nd ed., rev. ed. and exp. ed, New York, NY, US, Marcel Dekker, 57–80.

61. Henderson AA, Horan KA (2021) A meta-analysis of sleep and work performance: An examination of moderators and mediators. *J Organ Behav* 42: 1–19. https://doi.org/10.1002/job.2486

62. Hobfoll SE (2001) The Influence of Culture, Community, and the Nested-Self in the Stress Process: Advancing Conservation of Resources Theory. *Appl Psychol* 50: 337–421. https://doi.org/10.1111/1464-0597.00062

63. Kuper LE, Gallop R, Greenfield SF (2010) Changes in Coping Moderate Substance Abuse Outcomes Differentially across Behavioral Treatment Modality. *Am J Addict* 19: 543–549. https://doi.org/10.1111/j.1521-0391.2010.00074.x

64. Wills TA (1990) Stress and coping factors in the epidemiology of substance use, *Research advances in alcohol and drug problems,* New York, NY, US, Plenum Press, 215–250. https://doi.org/10.1007/978-1-4899-1669-3_7

65. Mauro PM, Canham SL, Martins SS, et al. (2015) Substance-use coping and self-rated health among US middle-aged and older adults. *Addict Behav* 42: 96–100. https://doi.org/10.1016/j.addbeh.2014.10.031

66. Jeong J, Lee JH, Karau SJ (2024) Sleepless nights at work: examining the mediating role of insomnia in customer mistreatment. *Balt J Manag* 19: 308–326. https://doi.org/10.1108/BJM-11-2023-0426

67. Walker MP (2008) Cognitive consequences of sleep and sleep loss. *Sleep Med* 9: S29–S34. https://doi.org/10.1016/S1389-9457(08)70014-5

68. Opoku MA, Kang SW, Kim N (2023) Sleep-deprived and emotionally exhausted: depleted resources as inhibitors of creativity at work. *Pers Rev* 52: 1437–1461. https://doi.org/10.1108/PR-09-2021-0620

69. Dahlgren A, Kecklund G, Åkerstedt T (2005) Different levels of work-related stress and the effects on sleep, fatigue and cortisol. *Scand J Work Environ Health* 31: 277–285. https://psycnet.apa.org/doi/10.5271/sjweh.883

70. Hobfoll SE, Freedy J (1993) Conservation of Resources: A General Stress Theory Applied To Burnout, *Professional Burnout*, Routledge, 115–129.

71. Opoku MA, Kang SW, Choi SB (2023) The influence of sleep on job satisfaction: examining a serial mediation model of psychological capital and burnout. *Front Public Health* 11: 1149367. https://doi.org/10.3389/fpubh.2023.1149367

72. Penney LM, Spector PE (2005) Job stress, incivility, and counterproductive work behavior (CWB): the moderating role of negative affectivity. *J Organ Behav* 26: 777–796. https://doi.org/10.1002/job.336

73. Fox S, Spector PE, Miles D (2001) Counterproductive Work Behavior (CWB) in Response to Job Stressors and Organizational Justice: Some Mediator and Moderator Tests for Autonomy and Emotions. *J Vocat Behav* 59: 291–309. https://doi.org/10.1006/jvbe.2001.1803

74. Zhao C, Zhu Y, Zhuang JY (2024) Spillover and spillback: Linking daily job insecurity to next-day counterproductive work behavior. *Scand J Psychol* 65: 195–205. https://doi.org/10.1111/sjop.12968

75. Saleem F, Gopinath C (2015) Injustice, Counterproductive Work Behavior and mediating role of Work Stress. *Pak J Commer Soc Sci* 9: 683–699.

76. Francis L, Barling J (2005) Organizational injustice and psychological strain. *Can J Behav Sci Rev Can Sci Comport* 37: 250–261. https://psycnet.apa.org/doi/10.1037/h0087260

77. Cohen A, Diamant A (2019) The role of justice perceptions in determining counterproductive work behaviors. *Int J Hum Resour Manag* 30: 2901–2924. https://doi.org/10.1080/09585192.2017.1340321

78. Kelloway EK, Francis L, Prosser M, et al. (2010) Counterproductive work behavior as protest. *Hum Resour Manag Rev* 20: 18–25. https://doi.org/10.1016/j.hrmr.2009.03.014

79. Bakker AB, Vries JD de (2021) Job Demands–Resources theory and self-regulation: new explanations and remedies for job burnout. *Anxiety Stress Coping* 34: 1–21. https://doi.org/10.1080/10615806.2020.1797695

80. Mitchell MS, Greenbaum RL, Vogel RM, et al. (2019) Can You Handle the Pressure? The Effect of Performance Pressure on Stress Appraisals, Self-regulation, and Behavior. *Acad Manage J* 62: 531–552. https://doi.org/10.5465/amj.2016.0646

81. Johnson RE, Lin SH, Lee HW (2018) Self-Control as the Fuel for Effective Self-Regulation at Work: Antecedents, Consequences, and Boundary Conditions of Employee Self-Control, In: Elliot AJ (Ed.), *Advances in Motivation Science*, Elsevier, 87–128. https://doi.org/10.1016/bs.adms.2018.01.004

82. Baqutayan SMS (2015) Stress and Coping Mechanisms: A Historical Overview. *Mediterr J Soc Sci* 6: 479–488. https://doi.org/10.5901/mjss.2015.v6n2s1p479

83. Carver CS, Scheier MF, Weintraub JK (1989) Assessing coping strategies: A theoretically based approach. *J Pers Soc Psychol* 56: 267–283. https://doi.org/10.1037/0022-3514.56.2.267

84. Brady KT, Sonne SC (1999) The role of stress in alcohol use, alcoholism treatment, and relapse. *Alcohol Res Health J Natl Inst Alcohol Abuse Alcohol* 23: 263–271.

85. Provencher T, Lemyre A, Vallières A, et al. (2020) Insomnia in personality disorders and substance use disorders. *Curr Opin Psychol* 34: 72–76. https://doi.org/10.1016/j.copsyc.2019.10.005

86. Taylor DJ, Bramoweth AD, Grieser EA, et al. (2013) Epidemiology of Insomnia in College Students: Relationship With Mental Health, Quality of Life, and Substance Use Difficulties. *Behav Ther* 44: 339–348. https://doi.org/10.1016/j.beth.2012.12.001

87. Angarita GA, Emadi N, Hodges S, et al. (2016) Sleep abnormalities associated with alcohol, cannabis, cocaine, and opiate use: a comprehensive review. *Addict Sci Clin Pract* 11: 9. https://doi.org/10.1186/s13722-016-0056-7

88. Chakravorty S, Vandrey RG, He S, et al. (2018) Sleep Management Among Patients with Substance Use Disorders. *Med Clin North Am* 102: 733–743. https://doi.org/10.1016/j.mcna.2018.02.012

89. Manconi M, Ferri R, Miano S, et al. (2017) Sleep architecture in insomniacs with severe benzodiazepine abuse. *Clin Neurophysiol Off J Int Fed Clin Neurophysiol* 128: 875–881. https://doi.org/10.1016/j.clinph.2017.03.009

90. Weiss NH, Kiefer R, Goncharenko S, et al. (2022) Emotion regulation and substance use: A meta-analysis. *Drug Alcohol Depend* 230: 109131. https://doi.org/10.1016/j.drugalcdep.2021.109131

91. Grant S, Contoreggi C, London ED (2000) Drug abusers show impaired performance in a laboratory test of decision making. *Neuropsychologia* 38: 1180–1187. https://doi.org/10.1016/S0028-3932(99)00158-X

92. de Wit H (2009) Impulsivity as a determinant and consequence of drug use: a review of underlying processes. *Addict Biol* 14: 22–31. https://doi.org/10.1111/j.1369-1600.2008.00129.x

93. Bastien CH, Vallières A, Morin CM (2001) Validation of the Insomnia Severity Index as an outcome measure for insomnia research. *Sleep Med* 2: 297–307. https://doi.org/10.1016/S1389-9457(00)00065-4

94. Castronovo V, Galbiati A, Marelli S, et al. (2016) Validation study of the Italian version of the Insomnia Severity Index (ISI). *Neurol Sci* 37: 1517–1524. https://doi.org/10.1007/s10072-016-2620-z

95. Marcatto F, Di Blas L, Luis O, et al. (2022) The Perceived Occupational Stress Scale: A brief tool for measuring workers' perceptions of stress at work. *Eur J Psychol Assess* 38: 293–306. https://psycnet.apa.org/doi/10.1027/1015-5759/a000677

96. Barbaranelli C, Fida R, Gualandri M (2013) Assessing counterproductive work behavior: A study on the dimensionality of CWB-Checklist. *TPM-Test Psychom Methodol Appl Psychol* 20: 235–248.

97. Bongelli R, Fermani A, Canestrari C, et al. (2022) Italian validation of the situational Brief Cope Scale (I-Brief Cope). *PLoS One* 17: e0278486. https://doi.org/10.1371/journal.pone.0278486

98. Wilson Van Voorhis CR, Morgan BL (2007) Understanding Power and Rules of Thumb for Determining Sample Sizes. *Tutor Quant Methods Psychol* 3: 43–50. https://doi.org/10.20982/tqmp.03.2.p043

99. Kenny DA (2017) MedPower: An interactive tool for the estimation of power in tests of mediation [Computer Software]. Available from: https://davidakenny.shinyapps.io/MedPower/.

100. Wills T, Shiffman S (1986) Coping and Substance Use: A Conceptual Framework, In: Shiffman S, Wills TA (Eds.), *Coping and substance use*, Orlando, FL, Academic Press, 3–24.