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SHORT COMMUNICATION

Is boredom at work bad for your health? Examining the links between job boredom and autonomic nervous system dysfunction

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Abstract

Job boredom refers to an unpleasant state of passiveness at work that has been found to negatively relate to self-reported health. To date, however, the relation between job boredom and physiological indicators of health has not been examined. The present study investigates whether job boredom relates to dysfunction in autonomic nervous system (ANS) activity as indicated by reduced heart rate variability (HRV) during night sleep. The sample of this study consisted of Finnish public sector workers (n = 125). Job boredom was assessed with an electronic questionnaire and HRV with an ambulatory monitoring period of two nights of sleep. The results supported the hypothesis by showing a negative relation between job boredom and HRV, after controlling for demographic and lifestyle factors. The findings extend previous knowledge on the detrimental consequences of job boredom by showing that it is related to dysfunction in ANS activity. Consequently, it is important to acknowledge boredom at work as a threat to occupational health and well-being and pay more attention to how it can be prevented at workplaces.

KEYWORDS
autonomic nervous system activity, employee health, heart rate variability, job boredom, sleep

1 | INTRODUCTION

Job boredom is defined as an unpleasant state of low arousal at work (Daniels, 2000) that is characterised by attentional difficulties (Fisher, 1993). Job boredom is commonly considered to be a response to insufficient demands at work (Daniels et al., 2004; Reijseger et al., 2013). This distinguishes job boredom from more traditional states of occupational ill-being, namely job stress and job burnout, which occur as a response to excessive job demands (Demerouti et al., 2001).

Job boredom has been associated with several negative outcomes for both the organisation and the employees. For example, studies have found an association between boredom at work and more counterproductive work behaviours (van Hooff & van Hooft, 2014), less organizational commitment and more turnover intentions (Reijseger et al., 2013). Furthermore, job boredom is also shown to relate to impaired self-rated workability and self-rated health (Harju et al., 2014).

Although there is thus some evidence that job boredom may have a negative impact on health, empirical studies investigating these relations with objective indicators of health are lacking. Boredom as a general experience has, however, been associated with increased disease risk. Specifically, Britton and Shipley (2010) found that civil servants who reported more boredom were more likely to

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die some 20 years later from cardiovascular disease. Although their study did not control for the effect of lifestyle factors, such as smoking, or examine the psychophysiological mechanisms that might have explained this relationship, its findings point towards potentially adverse health effects of boredom. In addition, there are some experimental studies, which indicate that boredom and unstimulating tasks may negatively relate to physiological outcomes (Merrifield & Danckert, 2014; Oshuga et al., 2001).

The purpose of this study is to extend this knowledge by examining the relation between job boredom and ANS activity. We focus on ANS activity because it plays an important role in linking psychological states (e.g., boredom at work) and physiological outcomes (McCraty & Shaffer, 2015; Thayer & Lane, 2009). Furthermore, optimal functioning of ANS activity is important for good health, whereas long-term dysfunction presents a health risk (Thayer & Lane, 2007; Thayer et al., 2012).

Our study contributes to the literature on occupational ill-being in general and job boredom in particular in two specific ways: First, to the best of our knowledge, this study is the first to investigate the relation between job boredom and ANS dysfunction, and hence it provides novel and important information on whether boredom at work may cause a health risk for the employees. In doing so, we build on previous research that has shown a negative relation between job boredom and self-rated health (Harju et al., 2014) by linking job boredom with indicators of ANS activity, namely HRV measured during night sleep over two consecutive nights. Second, our field study design involves a real-life setting that increases the ecological validity of the study. Previous studies on general boredom or understimulating tasks and physiological outcomes have been conducted in a laboratory with students (Merrifield & Danckert, 2014; Oshuga et al., 2001), and do not therefore enable understanding the physiological correlates of job boredom among working population. With these advances, we aim to shed light on the potentially serious implications of boredom at the workplace that have thus far remained unknown. Our study argues that job boredom may have detrimental effects on health and thus have negative spill-over effects from work to the non-work domain.

1.1 | Job boredom

In this study, we focus on state boredom that results from an inadequately stimulating activity or a situation (Mikulas & Vodanovich, 1993) and should be distinguished from trait boredom that refers to the individual propensity to feel bored (Farmer & Sundberg, 1986). State boredom involves affective (e.g., unpleasant feeling), cognitive (e.g., attentional difficulties, sense of slow passing of time) and behavioural (e.g., engaging in distractions or non-task related behaviours and thoughts) manifestations (Raffaelli et al., 2018; Reijseger et al., 2013). State boredom at work is a transient emotion that is suggested to pass once the individual is no longer exposed to the boring activity or situation (Fisher, 1993). It can nevertheless persist or recur if the individual faces such situations frequently (Daniels et al., 2004).

Traditionally, state boredom at work has been considered to involve monotonous and repetitive work (see Loukidou et al., 2009 for a review). More recently, workplace boredom is suggested to be a growing problem in numerous safety-critical jobs, such as in transportation, traffic control and mining industry, wherein increased automation of tasks is likely to render work environments less stimulating (Cummings et al., 2016). Boredom is not limited to low-skilled work as it is also reported among white-collar workers (Costas & Kärreman, 2016; Harju & Hakanen, 2016; van der Heijden et al., 2012) and highly educated workforce (Harju et al., 2016). In a survey conducted in 2006 among 2113 college graduates in the United Kingdom, about 61% reported boredom at work due to a lack of challenging tasks and most boredom was reported in administrative jobs and manufacturing (cf. Cummings et al., 2016). Job boredom is also reported more often among employees in non-managerial positions, younger employees, and males (Harju et al., 2014, 2016). One possible explanation is that these employee groups may wish to take on more demanding tasks than what is available to them.

Boredom at work is suggested to be a response to lacking job demands (e.g., workload, responsibility) and job resources (e.g., autonomy, skill variety), because work that lacks such characteristics does not stimulate or motivate the employee (Reijseger et al., 2013; Toscanelli et al., 2022). In addition, studies suggest that boredom may be a response not just to lacking challenging activity but also to lacking meaning in activity (Pekrun, 2006; Van Tilburg & Igou, 2012; Westgate & Wilson, 2018). For example, Harju et al. (2022) found that organizational red-tape, which is generally considered meaningless by the employees, predicted job boredom over and beyond the effects of workload. This indicates that job boredom is a response to lacking quality rather than quantity of work, which may explain why it is experienced in a variety of jobs.

Whether boredom at work is good or bad for health has been debated in the literature. On the one hand, boredom is considered as a deactivated, low-arousal experience (Daniels, 2000; Van Tilburg & Igou, 2017), and thus it should not be straining (Mikulas & Vodanovich, 1993; Ursin & Eriksen, 2004). Some scholars suggest that feeling bored may even have positive implications, such as creativity (Park et al., 2019) and prosocial behaviour (Van Tilburg & Igou, 2017), as individuals seek to find something meaningful to do. On the other hand, studies have linked boredom with frustration (van Hooft & van Hooff, 2018), anxiety and anger (Fahlman et al., 2013), as well as irritation and restlessness (Westgate & Wilson, 2018), which implies that boredom can also be a negative high-arousal experience and if it maintains a potential risk for health and well-being (Danna & Griffin, 1999).

Thus, while occasional boredom at work is a common and typically harmless experience, the more frequently job boredom is reported the more adverse it is likely to be (Daniels, 2000). Supporting this argument, studies have found job boredom to positively relate to

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burnout (Harju et al., 2022) and negatively to self-rated workability and health (Harju et al., 2014). Hence, while there is some evidence that job boredom may have negative health effects, the psychophysiological mediating mechanism for these effects is not yet known. The purpose of this study is to address this gap by examining the relation between job boredom and ANS activity.

1.2 | Job boredom and ANS dysfunction

ANS is a psychophysiological system, which consists of two main branches, the sympathetic (SNS) and the parasympathetic (PNS) nervous systems (Guyton & Hall, 2020). Shortly, SNS activation is involved in energy mobilisation, and it activates in effortful situations, such as when employees must carry out demanding tasks. PNS activation, in turn, has the opposite function as it enables energy conservation and it is activated during rest and recovery. However, at any time there exists a dynamic interaction between SNS and PNS activity and when one system becomes activated, the other system becomes inhibited.

It is possible to assess ANS activity by measuring HRV during normal daily life (Berntson et al., 1997; Task Force Guidelines, 1996). HRV is mainly under control of ANS activity and thus can be used as an indicator of it. HRV describes the variability between subsequent heartbeats (Task Force Guidelines, 1996). SNS activation increases the overall activity of the heart that causes the time between heart beats to become shorter and HRV to decrease, whereas PNS activation mainly causes the opposite effects that causes the time between heartbeats to become longer and HRV to increase (McCraty & Shaffer, 2015; Thayer et al., 2012).

In healthy individuals, a demanding stimulus, such as a demanding work task, generally causes a brief increase in SNS activity and a decrease in PNS activity (i.e., a decrease in HRV). In contrast, when individuals are constantly strained, such as when the demanding stimulus continues, SNS activity keeps dominating PNS activity, which causes autonomic imbalance that manifests in a prolonged decrease in HRV (Porges, 2007; Thayer & Brosschot, 2005). PNS activity and higher HRV is important for good health whereas long-term autonomic imbalance and especially constantly reduced PNS activity (i.e., reduced HRV) has been related to increased risk of several diseases, such as cardiovascular disease, and even accentuated mortality (Thayer & Lane, 2007; Thayer et al., 2012). Previous research has indeed shown that HRV is an essential independent mediator of health (Jarczok et al., 2015; Thayer et al., 2012).

A vast amount of research has consistently shown that job stress and burnout relate to autonomic imbalance during which SNS activity continuously dominates PNS activity (Chandola et al., 2008; Melamed et al., 2006) indicated with reduced HRV (Collins & Karasek, 2010; Garza et al., 2015; Vrijkotte et al., 2000). While research has not yet examined whether job boredom relates to reduced PNS activity, there are some experimental studies indicating that a link may exist. For example, experiencing boredom has been found to relate to increased heart rate of undergraduate students in a laboratory setting (Merrifield & Danckert, 2014). Moreover, studies have shown that monotonous tasks, which are typically associated with boredom (see Loukidou et al., 2009 for a review), are related to increased heart rate in a similar way than high-intensity tasks (Lundberg et al., 1993; Ohsuga et al., 2001). Consequently, based on the previous empirical findings, we expect a negative relationship between job boredom and PNS activity as indicated by decreased HRV. Hence, we present the hypothesis of this study: *There is a negative relationship between job boredom and HRV*.

2 | METHODS

2.1 | Participants and study procedure

This study was conducted among the entire staff (n = 268) of a municipality in Central Finland. Following the Helsinki Declaration, the study protocol was accepted, and ethical approval was obtained from the Ethics Board of the Finnish institute of Occupational Health (ETR 01/2019/Seppälä) before the recruitment of the participants. Participation in the study was free of charge for the municipality and voluntary for each participant. The participants gave their informed consent and did not receive compensation for their contribution.

Each voluntary participant completed an electronic questionnaire (Webropol Surveys, 2023) for background information and an assessment of job boredom in March 2019. Participants received the electronic questionnaire through personal links sent via work email. The participants underwent HRV measurements for a 72-h period, that is, three nights and three workdays, in the same week as the questionnaire data were gathered. The questionnaire data and HRV measurements were gathered in following weeks in March so that around 80 employees had a possibility to participate in the HRV measurements at the same time. Furthermore, during ambulatory monitoring, the participants kept an online diary (Firstbeat Technologies, 2022) describing their daily activities (e.g., start of sleep time, waking-up time, working hours, alcohol intake, medication, and acute sickness) to reveal the confounding variables and/or possible exclusion criteria for the use of the HRV measurements. The study design is presented in Figure 1.

HRV measurements were conducted so that two research nurses visited the workplaces on Monday or Tuesday afternoons to start the ambulatory monitoring. The ambulatory monitoring period started on Monday or on Tuesday afternoons depending on which one better suited the participant's workday. Participants received detailed spoken and written instructions for taking the recordings successfully. In addition, a contact person was available during office hours to assist with any problems. The participants were instructed to maintain their normal daily routines, but they were instructed not to consume alcohol during the HRV measurements. The participants were working morning and afternoon shifts and none of the participants were working night shifts.

HRV measurements were taken with two single-use adhesive electrodes and using a Firstbeat Bodyguard 2 heart rate monitor (Firstbeat Technologies, 2022). The ambulatory monitoring period

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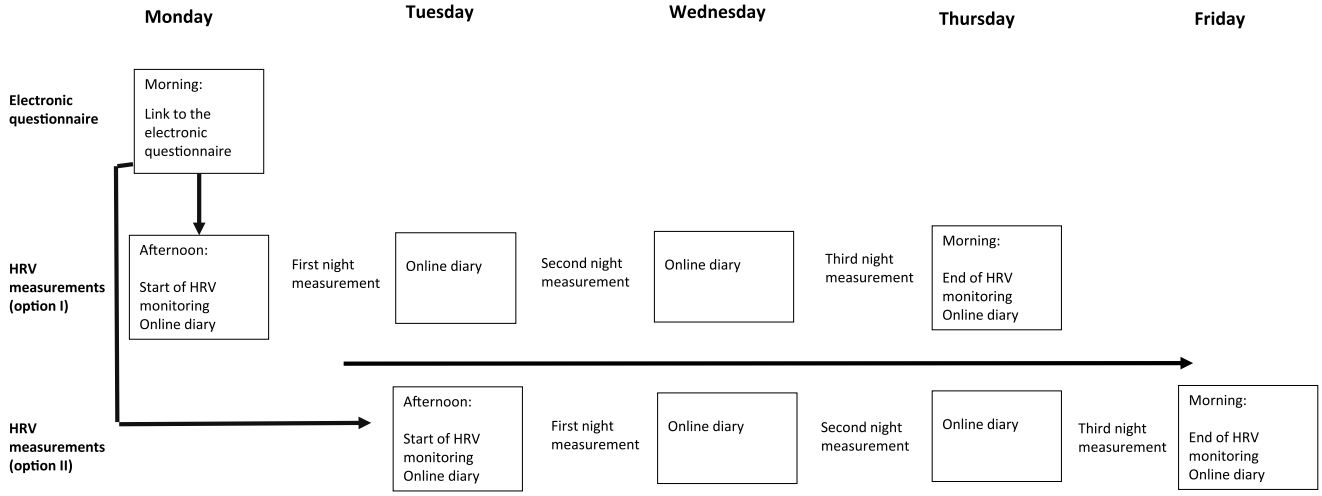


FIGURE 1 Study design. Ambulatory monitoring period started on Monday (i.e., option I) or on Tuesday (i.e., option II) afternoon depending on which one suited better for the participant's workday. First night of HRV measurement was excluded from the analyses, while the second and third night were included.

was further divided into segments of work, sleep, and other, based on the participants' diary. This study focused on sleep periods starting 30 min after the participants reported going to bed and ending at the reported wake-up time. We focused on sleep periods because HRV measurement is sensitive to various environmental factors and body movements (Laborde et al., 2017). Sleep periods enable controlling for the physical activity and environmental factors during the measurement period and it has been shown to provide a highly standardized condition to measure HRV and interpretation of PNS activity (Brandenberger et al., 2005; Laborde et al., 2017).

The first night (i.e., the adjustment night to the electrodes) was excluded from the analyses to improve the accuracy of the measurements. The investigated period consisted of two subsequent nights (i.e., the second and third nights, see Figure 1). The measuring period was aggregated by computing mean values of HRV to reduce unpredictable confounding influences (Bertsch et al., 2012). Furthermore, averaging HRV over the whole night is advisable as it decreases the variance in HRV in different sleep stages (Herzig et al., 2018). In addition, resting levels of HRV have high reliability (Alida et al., 2007; Herzig et al., 2018; Kerkering et al., 2022) and stability (Bertsch et al., 2012), when aggregated values across at least two measurement times are used (Bertsch et al., 2012).

Altogether 155 employees out of 268 (i.e., 58%) responded to an electronic questionnaire, and 160 out of 268 employees (i.e., 60%) underwent HRV measurements. This study focused on those 148 participants who underwent both the HRV measurements and responded to the electronic questionnaire to have the background information (such as information on medication) needed in HRV measurements. Some participants' HRV measurements showed possible confounding factors such as acute sickness (e.g., a cold, a stomachache), medical illness (e.g., a pacemaker, considerable arrhythmias), and/or measurement failures (e.g., defective electrode contacts during sleep).

Consequently, one participant was excluded for medical reasons, five because of acute sickness, and 17 because of failures in measurements (20% or more of the corrected artefacts) yielding a final sample of 125 participants (i.e., 47% of the original sample). The sample size of this study is in line with the previous studies investigating the relationship between occupational ill-being (i.e., job stress or job burnout) and HRV in field settings (e.g., Collins et al., 2005; Uusitalo et al., 2011; Van Doornen et al., 2009; Vrijkotte et al., 2000), and with the few existing experimental studies of boredom and/or unstimulating tasks and heart rate (Merrifield & Danckert, 2014; Ohsuga et al., 2001).

Most of the 125 employees were female (89%) and their mean age was 45.62 years (SD = 10.79). The majority (84%) were permanently employed and worked full time (89%). Mean job tenure was 19 years (SD = 11.10), and 84% worked in a non-managerial position. The majority (45%) had completed higher degree education, 22% post-secondary level, 30% secondary level education, and 3% primary level education. Nearly half of the participants (46%) worked in education and culture services (e.g., school and early childhood teachers, library workers), a third (34%) worked in social and care services (e.g., nurses in elderly care and social workers), and 20% worked in other sectors, such as administration and technical services (e.g., road and street maintenance and waste management).

2.2 | Measures

2.2.1 | Job boredom

Job boredom was measured with a short version of the Dutch Boredom Scale (Reijseger et al., 2013). DUBS has been found to be a valid instrument to capture boredom at work in different countries and occupational contexts (e.g., Harju et al., 2014; Harju et al., 2022;

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Toscanelli et al., 2022; van Wyk et al., 2016). The shortened three-item version of DUBS has likewise been used in other studies among Finnish employees (Harju et al., 2023; Kaltiainen & Hakanen, 2022; Li et al., 2023).

The scale included three items assessing affective ("I feel bored at my job"), cognitive ("At work, time goes by very slowly") and behavioural ("During work, my mind wanders to other things") manifestations of boredom. The items were rated on a seven-point scale from 1 ("never") to 7 ("every day"). Total job boredom score was calculated as the mean of the three items and used in further analyses ($\alpha = 0.69$).

2.2.2 | Control variables

The electronic questionnaire and the online diary included questions on medical illness, medication, weight, height, and lifestyle factors to control for possible confounding factors. Consequently, age, gender, body mass index (BMI), caffeine and nicotine consumption, and the use of medication were used as control variables in the statistical analyses because of their expected influence on HRV (De Meersman & Stein, 2007; Fagard et al., 1999; Koenig et al., 2014). In addition, although participants were instructed not to use alcohol during the HRV measurement period, if alcohol consumption had been reported, it was included as a control variable.

2.2.3 | HRV

We investigated PNS activity with parasympathetically-mediated HRV during night sleep for the period of two consecutive nights during the work week (see Figure 1). A frequently used measure of parasympathetically-mediated HRV is the root mean square of successive differences between normal heartbeats (RMSSD; Shaffer & Ginsberg, 2017). RMSSD is mainly influenced by parasympathetic activity, and thus can be used as a valid indicator of it (Berntson et al., 1997; Task Force, 1996). Furthermore, the use of RMSSD is recommended for studies in natural field settings because it is less affected by artefacts caused by breathing than other indicators of parasympathetic activity (Laborde et al., 2017). Therefore, we chose RMSSD as an indicator of PNS activity for this study.

Firstbeat Analysis Server 7.9.2 (Firstbeat Technologies, 2022) was used for RRI analysis and export. It was also used to scan and correct any artefacts. Then artefact corrected RRI data were transferred to Matlab 9.1 software (MATLAB, 2016) to compute RMSSD. However, if the measurement period contained more than 20% of corrected artefacts, it was excluded from further analyses. RMSSD was computed by the variability in the intervals between successive RRIs following the Task Force Guidelines (1996). Then we aggregated the measurement period by computing the RMSSD mean values for the investigated two-night period. This was done to reduce the effects of possible unpredictable confounding influences. RMSSD is reported in milliseconds (ms) and the values during sleep periods vary by around 40 ms with a standard deviation of about 20 ms (Task Force Guidelines, 1996).

2.3 | Statistical analyses

The statistical analyses were conducted using multiple linear regression analysis and Mplus statistical programme version 8 (Muthen & Muthen, 1998–2017). Multiple linear regression analysis was used to examine the relationship between job boredom and RMSSD after adjusting for possible confounders. The statistical analyses were conducted in two steps: In the first step we included the control variables (i.e., age, gender, BMI, caffeine, alcohol, and nicotine consumption, and the use of medication) in the model. In the second step we included the controls and job boredom in the model. The parameters of the regression model were estimated using maximum likelihood estimation with robust standard errors (MLR), which is robust to possible non-normality of the variables (Muthen & Muthen, 1998–2017).

3 | RESULTS

3.1 | Descriptive results

HRV-related characteristics of the participants are presented in Table 1. In addition, Table 1 presents the mean levels and standard deviations of the study variables.

TABLE 1 Characteristics of the study participants ($n = 125$).

Characteristics	Mean (SD)	N (%)
Nicotine intake (yes)		10 (8%)
Caffeine intake (yes)		108 (86%)
Medication (yes)		25 (20%)
Alcohol intake (1–6 dosages)		3 (2%)
Heart rate (bpm) for the two nights	64.23 (8.22)	
Sleep time (hrs) for the investigated two nights	7.37 (0.51)	
Working time (hrs) for the two workdays	7.33 (0.57)	
RMSSD for the two nights	41.60 (20.85)	
Job boredom	2.29 (1.19)	

Abbreviations: Alcohol intake, number of individuals using alcohol during the evening before HRV measurement period and used dosages; *M*, mean; RMSSD, root mean square of successive differences between normal heartbeats, reported in milliseconds; SD, standard deviation; Sleep time, mean sleeping time of the two investigated nights; Working time, mean working time of the two workdays before HRV measurements.

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TABLE 2 Standardized estimates of multiple linear regression models of job boredom and RMSSD (n = 125).

	RMSSD Model 1 *b (SE)*	*p*	RMSSD Model 2 *b (SE)*	*p*
Age	−0.514 (0.08)	<0.001	−0.542 (0.09)	<0.001
Gender	0.144 (0.10)	0.14	0.129 (0.10)	0.17
BMI	−0.042 (0.08)	0.62	−0.023 (0.09)	0.79
Nicotine intake (y/*n*)	−0.245 (0.06)	<0.001	−0.255 (0.07)	<0.001
Caffeine intake (y/*n*)	−0.002 (0.07)	0.97	−0.010 (0.07)	0.88
Alcohol intake (number of dosages)	−0.073 (0.09)	0.43	−0.075 (0.10)	0.43
Medication (y/*n*)	0.013 (0.10)	0.90	−0.013 (0.11)	0.90
Job boredom			−0.178 (0.07)	0.007

Note: Model 1 includes all the investigated confounding variables; Model 2 includes all the investigated confounding variables and job boredom. Gender 1 = female, 2 = male; Nicotine and caffeine intake 1 = no, 2 = yes; Medication 1 = no, 2 = yes.

Abbreviations: *b*, standardized estimates; RMSSD, mean value of the root mean square of successive differences between normal heartbeats during a two-night period; SE, standard error.

3.2 | Multiple linear regression models

Table 2 presents the standardized estimates of the multiple linear regression models. Of the control variables included in Model 1, age and nicotine intake had a significant negative effect on RMSSD. Altogether, Model 1 accounted for 30% of the variance in RMSSD during the two-night sleep period. In Model 2, after accounting for the effects of the confounding variables, job boredom had a significant negative effect on RMSSD during two nights of sleep (b = −0.178, SE = 0.07, 95% confidence interval (CI) [−0.308]–[−0.047], p = 0.007). Hence, supporting our hypothesis the results showed that an increase in job boredom related to a decrease in RMSSD. Altogether, Model 2 accounted for 33% of the variance in RMSSD.

Finally, out of the 125 study participants, 25 were using medication for diagnosed medical disease. Six participants were using antihypertensive medicine for hypertension, 12 had medication for mental disorders (such as depression), and seven participants were using some other medication (e.g., hormonal therapy for hypothyroidism), all of which may affect RMSSD (Task Force Guidelines, 1996). The participants took the same medication during the whole 72-h HRV measurement period. To exclude the possibility that medication and/or illness would have affected the results, we also performed the analyses without including these 25 employees. The results, however, remained the same and revealed that job boredom decreased RMSSD during sleep (b = −0.274, SE = 0.06, p < 0.001) after including the confounding variables (i.e., age, gender, BMI, caffeine, alcohol, and nicotine consumption).

3.3 | Post-hoc power analysis

We conducted a post-hoc power analysis with the G × Power (version 3.1, Faul et al., 2009) to reveal the power of a test for the increase in the proportion of variance explained due to the inclusion of job boredom. This analysis revealed that the power of this test was 0.65.

4 | DISCUSSION

The current study was the first to investigate whether job boredom is related to dysfunction in ANS activity, indicated by reduced HRV (i.e., RMSSD) during two nights of sleep. In line with the hypothesis, we found that job boredom negatively related to HRV after controlling for the effect of various confounding variables (i.e., age, gender, BMI, caffeine, alcohol, and nicotine consumption, and the use of medication).

This study extends the previous literature on the association between occupational ill-being (i.e., job stress/burnout) and decreased HRV (Collins & Karasek, 2010; Collins et al., 2005; Garza et al., 2015; Kanthak et al., 2017; Vrijkotte et al., 2000) by including job boredom among work-related mental states that may contribute to ANS dysfunction. This study found job boredom to relate to reduced HRV during two consecutive nights. Furthermore, as a prolonged decrease in HRV is shown to relate to elevated risk of morbidity and even mortality (Thayer & Lane, 2007; Thayer et al., 2012), the results of this study provide support for the thus far under-studied and underestimated role that job boredom may have for health—job boredom may present a risk for employee health through ANS dysfunction.

Furthermore, by showing that job boredom relates to similar physiological measures than job stress and/or burnout, this study also sheds light on the debate over whether boredom involves high or low arousal. While some evidence exists from self-reported data that boredom may be accompanied by high arousal indicators, the field has called for physiological measures of arousal to clarify the matter (Westgate & Wilson, 2018). Previous studies that have observed a link between boredom and increased heart rate have measured the physiological response only briefly in the laboratory (Merrifield & Danckert, 2014), which makes it difficult to assess the robustness of the findings beyond the experimental contexts. Our study extends this previous work by measuring HRV during sleep and over two nights in a field setting.

Finally, this study contributes to previous discussion on whether job boredom may be beneficial for the employee. On the one hand, studies have suggested that boredom may be good for individuals, because it should launch them towards more meaningful, satisfying, or creative pursuits (Elpidourou, 2014; Van Tilburg & Igou, 2017).

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Our study, on the other hand, suggests that, at least in the context of work, the more often boredom is experienced, the more likely it is to have detrimental implications for individuals. While it may be that the self-regulatory function of boredom may lead to positive outcomes in contexts, where individuals perceive that they can choose a more interesting activity over a boring one, work context may not always provide such an opportunity, at least not in the short term. Even though job boredom is considered as a transient and short-lived state and thus studies often focus on its immediate effects at the workplace, such as counterproductive work behaviours (e.g., Bruursema et al., 2011; Pindek et al., 2018; Spanouli et al., 2023; van Hooff & van Hooft, 2014), our results show that the effects of job boredom may extend beyond the workplace and be observed even after the workday ends.

From a practical viewpoint, organisations have focused on the health risks of excessively demanding work, and thus the risks of understimulating work have often gone overlooked. Our findings broaden this knowledge by pointing towards a need to pay attention also to the possible health risks of boredom at work. It would be important for organisations to identify signs of employee boredom early, so that work may be adjusted to reduce the risks for employee health. When designing stimulating jobs, however, it is important to note that it may not be sufficient to provide the employees with more tasks, but rather to make sure that the tasks are motivating (Campion & McClelland, 1993) and that the employees have sufficient resources to carry them out (Reijseger et al., 2013).

Understanding what may be driving employee boredom at the workplace is crucial for effective interventions. For example, if employees are bored because they have to spend a lot of time tackling organizational constraints, trying to reduce boredom by increasing workload will not only be ineffective but may also lead to burnout (Harju et al., 2022). In addition to traditional top-down job design in which organisations and/or managers are considered responsible for structuring the jobs for employees, employees may also adopt an active role in crafting their jobs by altering the boundaries or content of their tasks or shaping their relational environment to better fit their needs (Wrzesniewski & Dutton, 2001). For example, proactively seeking new challenges is shown to decrease boredom at work (Harju et al., 2016). Hence, job crafting behaviours and proactive changes to one's work design could act as a buffer against job boredom and protect employees from its harmful physiological effects. It should, however, be noted that bored employees are less likely to initiate these changes themselves (Harju et al., 2016). While job crafting may thus protect from job boredom, managerial initiative may be required to support, guide and authorise employees to craft their job.

4.1 | Limitations and suggestions for future studies

This study also has its limitations, which need to be considered when interpreting the results. First, this study focused on public sector workers of one municipality in Finland and the results may therefore not be generalisable to other sectors. However, the sample included employees from different occupations (e.g., education, day care, library services, road and street maintenance, technical services, waste management, and social services), hence providing information on the potential effects of boredom across jobs. Second, the majority (80%) of municipal sector workers in Finland are female, which is reflected in this study's sample that was likewise female dominated (89%). Thus, the relationships found are mostly generalisable to female public sector workers, and future studies are needed to replicate the study finding with a more gender-balanced sample and in other occupational groups. Third, the statistical power of a test for the increase in the proportion of variance explained due to the inclusion of job boredom was weak, which may increase a risk for making a Type II error (Cohen, 1988). However, the actual results of the present study (i.e., *b*-coefficient, *p*-value, and 95% CI; Heckman et al., 2022; Hoenig & Heisey, 2001) revealed that the null hypothesis was correctly rejected, and a false negative finding did not occur in this study. Future studies investigating the physiological correlates of job boredom should, nevertheless, utilise lager sample sizes to reduce a likelihood of making a Type II error.

Fourth, while this study used a multi-source data with objective measures, job boredom was measured only once, which does not enable inferring the direction of the negative association between job boredom and reduced HRV from the data. Fifth, the relatively short time frame (i.e., two consecutive nights during one work week) does not provide knowledge on whether the negative relation between job boredom and PNS activity persists over a longer timeframe. However, the measurement period of the present study is in line or exceeds the measurement periods generally utilised when investigating occupational ill-being and ANS activity. Nevertheless, future studies with a longitudinal design and several measurement points could establish the direction of the found relationship and provide more information on the possible longer-term effects. Sixth, and finally, although we accounted for the influence of several general background variables, a natural field study design does not enable us to rule out all possible confounding factors. However, we were able to find support for the study hypothesis and reveal a link between job boredom and reduced PNS activity even after a number of important demographic and lifestyle factors were accounted for.

5 | CONCLUSIONS

This is the first study to investigate whether job boredom, an overlooked area of employee well-being, relates to ANS dysfunction. The results showed that job boredom related to reduced HRV during two nights of sleep. Job boredom had a significant negative influence on PNS activity even after accounting for the general background influences of age, gender, BMI, medication, and alcohol, nicotine, and caffeine consumption. The results of this study suggest that job boredom may have detrimental implications for employee health, and it should thus be given more attention in occupational health research and organizational practice.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data are not publicly available due sensitive and health-related nature of the data. The data will be archived in an institutional repository and made available upon a reasonable request.

ETHICS STATEMENT

The study protocol was accepted, and ethical approval was obtained from the Ethics Board of the Finnish institute of Occupational Health (ETR 01/2019/Seppälä) before the recruitment of the participants. All the participants gave their informed consent.

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