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Need for recovery among male technical distal on-call workers

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The objectives of this study were to (1) examine whether need for recovery differs between workers (i) not on-call, (ii) on-call but not called and (iii) on-call and called, and (2) investigate the associations between age, health, work and social characteristics with need for recovery for the three scenarios (i–iii). Cross-sectional data of $N = 169$ Dutch distal on-call workers were analysed with multivariate logistic regression. Need for recovery differed significantly between the three scenarios (i–iii), with lowest need for recovery for scenario (i) ‘not on-call’ and highest need for recovery for scenario (iii) ‘on-call and called’. Poor mental health and high work–family interference were associated with higher need for recovery in all three scenarios (i–iii), whereas high work demands was only associated with being on-call (ii and iii). The results suggest that the mere possibility of being called affects the need for recovery, especially in workers reporting poor mental health, high-work demands and work–family interference.

Practitioner summary: On-call work is a scarcely studied but demanding working time arrangement. We examined need for recovery and its associations with age, health, work and social characteristics among distal on-call workers. The results suggest that the mere possibility of being called can affect worker well-being and need for recovery.

Keywords: work schedule tolerance; health; work–family interference; age

Introduction

One in five EU working time arrangements include regular on-call periods, requiring an individual’s availability outside usual working hours (Eurofound 2010). On-call work is common in professions that have to provide 24/7 coverage, but that do not require the amount of evening, night and weekend work for full shift coverage. During on-call services, workers either stay at the workplace (proximal on-call, which is common in e.g. healthcare) or they stay outside the workplace, but in vicinity (e.g. home) ready to be called back in case their presence is needed (distal on-call, which is common in e.g. technical professions) (Cebola, Golightly, and Wilson 2012).

To date, most studies focused on proximal on-call work, especially among medical interns and residents. In the medical setting, proximal on-call work often coincides with long working hours. The combination of proximal on-call work and long working hours raised concerns about employee health (Veasey et al. 2002). Only a few studies have examined distal on-call work and health. A literature review till the year 2000 has shown that being on-call negatively impacts sleep, mental health and social life among distal on-call workers (Nicol and Botterill 2004). More recent studies on distal on-call workers have also shown increased levels of stress, anxiety, irritation and negative mood when being on-call (Cebola, Golightly, and Wilson 2012; French, McKinley, and Hastings 2001; Bamberg et al. 2012). Recently, Cebola and colleagues (Cebola, Wilson, and Golightly 2012) proposed a research framework to better understand and manage the risk of distal on-call work, based on their studies in UK distal on-call railway maintenance workers. The framework links on-call work and arrangement with effects on performance, attitude and well-being. Personal factors, work characteristics and on-call intensity and frequency are incorporated as possible effect moderators. In the author’s view, the inherent unpredictability of ‘being called or not’ is the key differentiating factor between distal on-call work and other types of working time arrangements. Other studies support this idea by showing that the mere possibility of being called affects sleep quality, irritation, mood, and social and domestic activities (Bamberg et al. 2012; Åkerstedt, Torsvall, and Gillberg 1987; Torsvall et al. 1987; Wuyts et al. 2012).

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In addition, distal on-call workers may experience problems with detachment from work (Cebola, Golightly, and Wilson 2012), which is critical to unwind and reduce short-term work-induced fatigue, i.e. need for recovery. Need for recovery after work refers to the immediate need to recuperate from work-induced fatigue (Sluiter 1999). Without an opportunity to recover, extra effort has to be exerted at the start of each working period to rebalance the suboptimal psychological state and, prevent performance breakdown (Sluiter 1999). Chronic need for recovery might lead to prolonged fatigue and long-term ill health (Sluiter et al. 2003). Prospective associations have been found between high need for recovery and health complaints, as well as sickness absence (Sluiter et al. 2003; de Croon, Sluiter, and Frings-Dresen 2003; van der Beek et al. 1995). In addition, higher levels of need for recovery are associated with older age, lower educational level, increased work-family conflict, high work demands and more working hours (Sluiter 1999; Jansen, Kant, and van den Brandt 2002; Jansen et al. 2003b; Kiss, De Meester, and Braeckman 2008; Mohren, Jansen, and Kant 2010; Nieuwenhuijsen, Bruinvels, and Frings-Dresen 2010; Kraaijeveld et al. 2014).

The vast majority of studies on need for recovery have been performed in workers with regular daytime jobs, but whether different working time arrangements pose a differential effect on someone's need for recovery remains largely unclear. Jansen et al (Jansen et al. 2003a) found increased need for recovery among shift workers compared with non-shift workers, which attenuated substantially when adjusted for work-related factors (decision latitude, psychological job demands, physical and emotional demands). The authors argued that either work schedules might not significantly contribute in explaining need for recovery levels, or that shift workers might perceive their work as more demanding and thereby adjusting for work-related factors might lead to an underestimation of the association between shift work and need for recovery. Recovery is an important aspect when designing work schedules. To date, no study has examined need for recovery among distal on-call workers.

Similar to sleep quality, irritation, mood, and social and domestic activities, also need for recovery might differ for 'being on-call or not'. Previous studies differentiating between 'being on-call or not', assessed the different on-call scenarios separately using momentary ratings, e.g. diaries (Bamberg et al. 2012; Cebola et al. 2013). Momentary assessments, i.e. assessing the current state of a person, will reduce recall bias (Stone and Shiffman 2002). These techniques are demanding for participants, resulting in relatively small sample sizes (French, McKinley, and Hastings 2001; Bamberg et al. 2012; Cebola et al. 2013). Alternatively, retrospective assessment of the different on-call scenarios allows to include larger samples of workers. Compared with momentary ratings, participants report consistently higher levels of somatic complaints like pain and fatigue in retrospective assessments (Houtveen and Oei 2007; Friedberg and Sohl 2008). Yet, the levels of agreement are moderate to high (Friedberg and Sohl 2008). Although not preferred, retrospective assessments are common in shift work research. A number of validated questionnaires exist that are extensively used to retrospectively assess e.g. health, sleep quality and sleep duration for different work shifts (Barton et al. 1995; Flo et al. 2012; Juda, Vetter, and Roenneberg 2013). Retrospective assessment might also provide to be useful for assessing need for recovery and sleep separately for different on-call scenarios.

Therefore, the current study tested the following hypotheses: (1) workers report higher levels of need for recovery, disturbed sleep and awakening complaints when on-call but not called compared with not on-call, and on-call and called compared with on-call but not called, and (2) high levels of need for recovery in these three on-call scenarios are associated with older age, poor health, more social and caring conflicts and high work demands.

Methods

Study sample and procedure

This cross-sectional study is part of the larger 'Shift Your Work' project examining the effects of different working time arrangements on health, work functioning and social life. In total, $N = 280$ technical distal on-call workers of a company taking care of the infrastructure of the gas distribution system in the Netherlands received a paper questionnaire between October and November 2011. Outside on-call periods, all workers worked during daytime hours (7:45–16:45 h, including breaks). Once every four weeks workers were one week on-call, starting on a Friday at 16:45 h and ending on a following Friday at 16:45 h. During on-call periods, workers are required to be reachable within 60 minutes in case their presence is needed (e.g. to verify a call of a possible gas leak). If possible, problems are handled by phone. All distal on-call workers were informed about the design and aim of the study by the Human Resource department and their direct supervisors. This study adhered to the ethical standards of the Declaration of Helsinki and guidelines of the association of universities in the Netherlands (VSNU 2005). Ethical approval was provided by the Medical Ethics committee of the University Medical Center Groningen (METc 2010.332).

Measurements

Age

Age was calculated from the date of birth and divided into four age categories (≤ 35 , 36–45, 46–55, ≥ 56) (Mohren, Jansen, and Kant 2010).

Health characteristics

General health was assessed with the Short Form 12, a 12-item generic health status measure covering mental (MCS12) and physical (PCS12) health-related quality of life (Ware, Kosinski, and Keller 1996). The items were scored and by algorithm transformed into a norm-based mean of 50 and standard deviation of 10 (Ware, Kosinski, and Keller 1996). Scores range from 0 to 100, with higher scores indicating a better general health. MCS12 and PCS12 scores were dichotomised based on norm scores in the Dutch population (Mols, Pelle, and Kupper 2009).

Sleep quality was assessed with the Karolinska Sleep Questionnaire (Åkerstedt et al. 2002, 2008), separately for (i) not being on-call, (ii) being on-call but not called, and (iii) being on-call and called. Sleep quality was measured with seven items, comprising two indices: Disturbed Sleep Index (difficulties falling asleep, disturbed/restless sleep, repeated awakenings, premature awakenings) and Awakening Complaints Index (difficulties waking up, non-refreshing sleep, exhausted at awakening). Response categories were: '1: Never, 2: Almost never, 3: Sometimes (once or more per month), 4: Mostly (once or more per week), and 5: Always (almost every day)'. Scores were summed and averaged (1–5), with higher scores reflecting lower sleep quality.

Fatigue was measured with the subscale 'fatigue severity' of the Checklist Individual Strength (Vercoulen et al. 1994; Beurskens et al. 2000). The scale fatigue severity comprises 8 statements about general fatigue in the past two weeks (i.e. 'I feel fit'). The response to each statement was scored on a 7-point Likert-scale from '1 = Yes, that is true' to '7 = No, that is not true'. Scores were summed, resulting in a score ranging from 8–56 with higher scores indicating higher fatigue levels.

Work characteristics

Work demands were assessed with eleven self-constructed items tailored to the work demands of the specific population of technical distal on-call workers: '1: irregular working times, 2: night work, 3: amount of work, 4: organisation of work, 5: getting a grip on work, 6: coordination with others, 7: sound/noise, 8: lighting conditions, 9: wearing personal equipment, 10: working outside, and 11: working alone'. The response options to each item varied on a 4-point Likert-scale from Light, Normal, Heavy to Very heavy. The items were summed and averaged, with higher scores indicating higher work demands. The Cronbach's alpha for work demands was 0.72.

Social characteristics

Work–Family Interference was assessed with ten adapted items from the Survey Work-home Interaction Nijmegen (SWING) (Geurts et al. 2005). The adaptations to the SWING aimed to focus specifically on how on-call arrangements affect work-home interactions (e.g. my work schedule allows me to fulfil domestic obligations). The ten items were scored on a 4-point Likert-scale ((almost) never, sometimes, often, (almost) always). The scores were summed and averaged, with higher scores indicating more work–family interference. The Cronbach's alpha for work–family interference was 0.84.

Care for children was measured by household composition. Answers were categorised into living with children at home (yes/no).

Need for recovery

Need for recovery was assessed with a subscale of the Dutch Questionnaire on Perception and Judgement of Work (VBBA) (van Veldhoven et al. 2002) reflecting the immediate need for recovery after a day's work, separately for three scenarios: i) not being on-call, ii) on-call but not called and iii) on-call and called. Need for recovery was measured with eleven dichotomous (yes/no) statements (van Veldhoven and Broersen 2003; de Croon, Sluiter, and Frings-Dresen 2006). The scores for each scenario were summed, converted into a range of 0–100 with higher scores indicating higher need for recovery. For the analyses, the scores were dichotomised upon the upper quartile, with the lowest three quartiles as reference category.

Sensitivity analyses

Due to ethical restrictions, we were not able to link our questionnaires with individual data about the number and timing of calls from the company registers. Instead, self-reported data were collected about the average number of nights and weekends workers received a call, when on-call.

Statistical analyses

To examine possible selection effects, participants with complete data were compared with participants with incomplete data by independent samples t-test and Mann Whitney U test. Further statistical analyses were conducted for participants with complete data on relevant parameters only. Mean scores and standard deviations were given for the three different on-call scenarios for the dichotomised health, social and work characteristics. For hypothesis 1, Wilcoxon signed rank tests for non-linear data were used to test differences within subjects for the three on-call scenarios (I–iii). For hypothesis 2, logistic regression analyses were used to examine between subjects associations for age, health, work, and social characteristics with need for recovery. First, univariate associations were investigated (Model 1), followed by a multivariate analysis including age, health, work and social characteristics (Model 2). Sensitivity analyses were conducted including the average number of nights and weekends having been called, when on-call. All analyses were performed with SPSS version 20.0 (IBM Corp 2011).

Results

Participants with complete versus incomplete data

A total of $N = 205$ (response rate 73.2%) male distal on-call workers returned the questionnaire. Due to missing data on relevant parameters, the final study sample comprised $N = 169$ (60.4%) distal on-call workers. Compared with participants with missing data, participants with complete data had significantly less disturbed sleep for the scenarios not on-call (mean 1.96 vs. 2.26, $p = 0.034$), and on-call and called (mean 2.27 vs. 2.66, $p = 0.044$). No significant differences were found for the other variables. The characteristics of the final study sample for participants with complete data are presented in Table 1.

Levels of need for recovery for age, health, work and social characteristics

Need for recovery scores showed a non-linear trend across the different age groups. Distal on-call workers with poor mental and physical health, and more disturbed sleep, awakening complaints, fatigue, work demands and work–family interference reported consistently a higher need for recovery compared with distal on-call workers with good mental and physical health, and less disturbed sleep, awakening complaints, fatigue, work demands and work–family interference. Distal on-call workers with care for children reported a higher need for recovery for the scenario not on-call (Table 2).

Table 1. Description of study sample ($N = 169$) (SD = Standard deviation).

	Mean	SD	Q3	<i>N</i>	%
Need for recovery					
Not on-call	16.72	21.87	27.27		
On-call but not called	21.41	25.04	36.36		
On-call and called	30.36	29.74	54.55		
<i>Demographics</i>					
Age	44.51	8.60			
<i>Health characteristics</i>					
Mental health	51.26	7.95			
Physical health	51.60	6.02			
Disturbed sleep					
Not on-call	1.96	0.78	2.25		
On-call but not called	2.11	0.85	2.75		
On-call and called	2.27	0.90	3.00		
Awakening complaints					
Not on-call	2.15	0.83	2.67		
On-call but not called	2.24	0.87	2.67		
On-call and called	2.43	0.90	3.00		
Fatigue severity	20.10	10.02	28.00		
<i>Work characteristics</i>					
Work demands	2.22	0.30	2.36		
<i>Social characteristics</i>					
Work–family interference	1.86	0.50	2.20		
Household composition					
No care for children				53	32.12
Care for children				116	70.30

Table 2. Need for recovery scores for age, and health, work and social characteristics ($N = 169$).

	N	Not on-call		On-call but not called		On-call and called	
		Mean	SD	Mean	SD	Mean	SD
<i>Demographics</i>							
<i>Age</i>							
≤ 35	27	22.56	26.13	25.99	26.63	32.05	27.63
35–45	75	13.68	18.55	18.87	23.29	27.20	28.26
45–55	42	19.70	25.39	22.98	27.66	35.45	36.09
> 55	25	14.55	18.92	21.45	24.32	29.45	24.38
<i>Health status</i>							
<i>Mental health</i>							
Good (> 51)	107	9.97	15.13	13.04	18.98	20.26	24.90
Poor (≤ 51)	62	28.37	26.49	35.86	27.66	47.80	29.50
<i>Physical health</i>							
Good (> 51)	110	12.98	18.57	15.39	19.56	23.54	26.42
Poor (≤ 51)	59	23.71	25.70	32.65	29.99	43.08	31.58
<i>Disturbed sleep</i>							
Low (Q1–Q3)	^a	13.32	16.87	15.57	20.16	23.10	24.54
High (Q4)	^a	29.29	31.87	41.55	29.68	51.64	33.51
<i>Awakening complaints</i>							
Low (Q1–Q3)	^a	12.61	16.86	15.30	20.15	23.01	25.51
High (Q4)	^a	32.47	30.49	40.50	29.15	47.85	31.96
<i>Fatigue severity</i>							
Low (Q1–Q3)	128	11.04	16.17	14.77	19.96	23.51	26.51
High (Q4)	41	34.48	27.42	42.17	28.01	51.75	29.39
<i>Work characteristics</i>							
<i>Work demands</i>							
Low (Q1–Q3)	128	13.30	18.71	16.72	21.64	23.90	26.03
High (Q4)	41	27.43	27.24	36.07	29.25	50.53	31.83
<i>Social characteristics</i>							
<i>Household composition</i>							
No care for children	53	13.21	21.29	19.07	25.29	26.07	26.75
Care for children	116	18.33	22.03	22.48	24.95	32.32	30.92
<i>Work–family interference</i>							
Low (Q1–Q3)	131	11.86	17.16	15.31	20.20	23.58	26.29
High (Q4)	38	33.49	27.65	42.44	28.76	53.73	29.37

^aDSI and AwI were assessed separately for three scenarios: for DSI (Low/High): not on call $N = 133/N = 36$, on-call but not called $N = 131/N = 38$, on-call and called $N = 126/N = 43$. For AwI (Low/High): not on-call $N = 134/35$, on-call but not called $N = 128/N = 41$, on-call and called $N = 119/N = 50$.

Hypothesis 1: workers report higher levels of need for recovery, disturbed sleep and awakening complaints when on-call but not called compared with not on-call, and on-call and called compared with on-call but not called

Workers reported significantly higher need for recovery, more disturbed sleep and more awakening complaints when being on-call, compared with when not on-call and significantly higher need for recovery, more disturbed sleep and awakening complaints when they received a call, compared with not being called (all $p < 0.001$; Wilcoxon signed-rank tests), thereby confirming hypothesis 1 (Figure 1).

Hypothesis 2: high levels of need for recovery in three different on-call scenarios are associated with older age, poor health, more social and caring conflicts and high work demands

Univariate analyses (Model 1) showed that poor mental and physical health, more disturbed sleep, awakening complaints, fatigue, high work demands and work–family interference were associated with higher need for recovery, irrespective of the on-call scenario. Age and care for children were not associated with need for recovery.

In the multivariate analysis (Model 2), the odds ratios (OR) for poor mental health and high work–family interference attenuated, but remained statistically significant for all three scenarios. The OR for awakening complaints decreased, but remained statistically significant for the scenario on-call but not called (OR 3.84, 95% CI 1.33–11.08). The ORs for work demands attenuated and remained significant for the scenarios on-call but not called (OR 3.25, 95% CI 1.18–8.93) and on-call and called (OR 3.11, 95% CI 1.15–8.38) (Table 3). For both models, no difference was found between the odds ratios of the three scenarios due to overlapping confidence intervals.

Figure 1. Need for recovery and sleep quality for three on-call scenario's.

For seven out of nine included factors, a crude association was found with need for recovery in Model 1, of which four remained in the multivariate analyses of Model 2, thereby largely confirming hypothesis 2.

Sensitivity analyses

Due to missing data on the number of received calls, $N = 161$ participants were included for the sensitivity analyses. Except for the number of nights having been called for the scenario 'not on-call', participants with many received calls reported higher levels of need for recovery compared with those with few received calls (Table 4). In the full model including the average number of nights and weekends having been called, many awakening complaints and high work demands were found significant contributors for high need for recovery for the scenario 'not on-call'. No differences were observed for the other scenarios (data not presented).

Discussion

The current study examined associations between need for recovery and age, health, work and social characteristics among distal on-call workers for three different on-call scenarios i) not on-call, ii) on-call, but not called, iii) on-call and called. Overall, the findings confirmed our initial hypotheses. On-call workers reported different levels of need for recovery for the three scenarios, with the lowest need for recovery when 'not on-call' and the highest need for recovery when 'on-call and called'. Poor mental health, high work demands and high work–family interference were associated with higher need for recovery. No associations were found between age and care for children with need for recovery.

Although not directly comparable due to differences in setting, population and measures, our finding of higher need for recovery being on-call (scenarios ii and iii) compared with not on-call (scenario i) shows similarities with previous findings regarding sleep quality and work–family interference among distal on-call workers (Cebola, Golightly, and Wilson 2012; Nicol and Botterill 2004; French, McKinley, and Hastings 2001; Bamberg et al. 2012). Not only performing extra work in addition to a regular daytime job, but also the inherent unpredictability of 'being called or not' might have contributed to higher need for recovery in our study population. In contrast to a study on sleep, stress and social activities among distal on-call Information Technology (IT) personnel (Bamberg et al. 2012), our study also showed higher need for recovery when being called compared with not being called during on-call duty. This finding may be due to the different measures in our study compared with the IT study or the relatively low number of calls in the IT study. In our study, no information was available on the objective number of calls, while it is possible that a threshold of number of calls has to be exceeded to affect need for recovery. Furthermore, the IT workers handled calls at home, while the technical workers of our study could be called to a worksite, which might have increased the burden experienced by the on-call workers.

The findings of our study are in line with studies showing associations between poor mental health, high work demands and high work–family interference with higher need for recovery (Sluiter et al. 2003; Jansen, Kant, and van den Brandt 2002; Mohren, Jansen, and Kant 2010; Kraaijeveld et al. 2014). Poor mental health and more work–family interference were associated with higher need for recovery, irrespective of the on-call scenario (i–iii), whereas high work demands was only associated with higher need for recovery when being on-call (scenarios ii and iii). A possible explanation for this finding might be that the negative impact of high work demands is attenuated by psychological detachment from work (Sonnentag and Fritz 2007; Coffeng et al. 2014). Detachment from work has been shown to be more difficult during on-call duty (Cebola, Golightly, and Wilson 2012). However, because we did not assess work demands separately for the three scenarios (I–iii), future studies should explore possible associations for all scenarios.

	Model 1 ^a				Model 2 ^b							
	Not on-call		On-call but not called		On-call and called		Not on-call		On-call but not called		On-call and called	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
<i>Demographics</i>												
Age												
≤ 35	1.00		1.00		1.00		1.00		1.00		1.00	
35–45	0.66	0.23–1.85	0.66	0.23–1.85	0.64	0.24–1.74	0.67	0.15–3.03	0.60	0.14–2.58	0.42	0.11–1.60
45–55	0.89	0.29–2.73	1.43	0.49–4.18	1.46	0.52–4.11	0.50	0.09–2.61	1.01	0.21–4.74	0.73	0.17–3.09
> 55	0.39	0.09–1.71	0.71	0.19–2.63	0.59	0.16–2.14	0.37	0.05–2.92	0.95	0.15–5.95	0.50	0.09–2.76
<i>Health status</i>												
Mental health												
Good (> 51)	1.00		1.00		1.00		1.00		1.00		1.00	
Poor (≤ 51)	7.36	3.14–17.22	4.80	2.25–10.21	5.75	2.75–12.04	4.46	1.40–14.16	4.26	1.47–12.30	5.18	1.87–14.33
Physical health												
Good (> 51)	1.00		1.00		1.00		1.00		1.00		1.00	
Poor (≤ 51)	3.52	1.62–7.65	3.50	1.68–7.29	3.77	1.85–7.70	1.51	0.42–5.44	1.82	0.58–5.79	2.66	0.92–7.68
Disturbed sleep												
Low (Q1–Q3)	1.00		1.00		1.00		1.00		1.00		1.00	
High (Q4)	4.29	1.88–9.75	7.28	3.26–16.26	6.32	2.95–13.54	2.71	0.79–9.33	1.56	0.51–4.81	2.23	0.78–6.36
<i>Awakening complaints</i>												
Low (Q1–Q3)	1.00		1.00		1.00		1.00		1.00		1.00	
High (Q4)	6.50	2.82–14.99	7.08	3.21–15.60	3.28	1.60–6.74	2.97	0.95–9.25	3.84	1.33–11.08	1.14	0.41–3.15
Fatigue severity												
Low (Q1–Q3)	1.00		1.00		1.00		1.00		1.00		1.00	
High (Q4)	6.51	2.88–14.72	3.77	1.75–8.14	4.55	2.14–9.69	2.03	0.57–7.21	0.75	0.22–2.51	0.93	0.29–2.94
<i>Work characteristics</i>												
Work demands												
Low (Q1–Q3)	1.00		1.00		1.00		1.00		1.00		1.00	
High (Q4)	3.91	1.76–8.72	5.14	2.37–11.18	5.29	2.47–11.32	2.82	0.93–8.52	3.25	1.18–8.93	3.11	1.15–8.38
<i>Social characteristics</i>												
Household composition												
No care for children	1.00		1.00		1.00		1.00		1.00		1.00	
Care for children	1.62	0.68–3.88	1.50	0.67–3.35	1.86	0.84–4.11	1.40	0.34–5.79	1.64	0.44–6.06	1.99	0.58–6.83
Work–family interference												
Low (Q1–Q3)	1.00		1.00		1.00		1.00		1.00		1.00	
High (Q4)	7.73	3.36–17.78	7.28	3.26–16.26	6.46	2.94–14.16	5.75	1.95–16.95	4.92	1.74–13.93	4.12	1.46–11.63

²Model 2 includes all independent variables.

Table 4. Need for recovery scores for number of nights and weekends having been called ($N = 161$).

			Not on-call		On-call but not called		On-call and called	
When you were on-call . . .			Mean	SD	Mean	SD	Mean	SD
How many nights did you receive a call?	Q1–Q3	120	16.94	22.28	20.37	25.01	27.84	29.09
	Q4	41	15.81	19.33	24.66	24.70	39.45	30.62
How many weekends did you receive a call?	Q1–Q3	116	13.79	19.41	17.22	23.28	26.23	28.34
	Q4	45	24.04	24.91	32.40	25.92	42.57	30.62

Differences between the univariate and multivariate analyses might be due to the moderate to strong correlation of mental health with the other constructs (Appendix). For example, although being on-call impacts sleep quality and length negatively (Åkerstedt, Torsvall, and Gillberg 1987; Torsvall et al. 1987; Wuyts et al. 2012; Bamberg et al. 2012) and sleep has been associated with need for recovery (Sluiter 1999), no association was found between sleep quality and need for recovery in the full model. The association between sleep and need for recovery might be attenuated due to overlapping mechanisms with sleep and mental health (Foster et al. 2013). Furthermore, analyses for participants with complete and incomplete data revealed that participants with missing items had significantly more disturbed sleep for the scenarios not on-call, and on-call but not called compared with participants with complete data, which might have led to underestimation of the association between sleep and need for recovery.

In the present study, no association was found between age and need for recovery. Our finding is in line with a study among public sector workers in the Netherlands (Bos et al. 2013), though two other studies have found a significant increase in need for recovery up till an age of 55 years, with a decline in need for recovery with further increasing age (Kiss, De Meester, and Braeckman 2008; Mohren, Jansen, and Kant 2010). Both studies do not reflect our specific worker population, because one study was conducted in the public sector in Belgium (Kiss, De Meester, and Braeckman 2008) and one among the general working population in the Netherlands excluding shift workers (Mohren, Jansen, and Kant 2010). Instead of age, different life phases might be related to need for recovery, in particular care for dependent children. After children get past the initial demanding years of intensive care, domestic responsibilities might be reduced. As a result, there might be an increased opportunity at home to recuperate from work induced fatigue. Our study found no association between presence of children and need for recovery. This is in line with a recent study showing that negative effects of distal on-call work (sleep deprivation, spousal sacrifice, intimacy and communication challenges, and diminished quality time with children) were consistent across different life phases (Emmett, Dovey, and Wheeler 2013).

Our study adds to the scarce literature on on-call workers, in particular distal on-call work, and is to our knowledge the first study to examine need for recovery among on-call workers. Previous studies on on-call workers only poorly described the studied working time arrangements, making it difficult to distinguish between important parameters of on-call work, e.g. distal and proximal on-call work. Strengths of our study are the clear description of the working time arrangement and because of the retrospective study design a relatively large sample size. Due to a reasonable response rate (73%), complete data were available for 60% of the initially addressed workers. The comparison between complete and incomplete datasets revealed only marginal differences between the two groups.

Our study has several limitations. First, our study was limited by the cross-sectional design. Hence, no causal inferences can be made. Second, in relation to the cross-sectional design, retrospective assessments are more susceptible for recall bias than momentary ratings (Stone and Shiffman 2002). Although it has been suggested that higher levels of somatic complaints are reported in retrospective assessments compared with momentary ratings (Houtveen and Oei 2007; Friedberg and Sohl 2008), in our study levels of need for recovery are low during regular (non on-call) work periods compared with other studies (Jansen, Kant, and van den Brandt 2002; Sluiter et al. 2003; de Croon, Sluiter, and Frings-Dresen 2003; Kiss, De Meester, and Braeckman 2008; Mohren, Jansen, and Kant 2010; Abma, van der Klink, and Bültmann 2013; Bos et al. 2013). Whether this difference is due to our specific occupational group or the method of assessment, has to be further investigated. Third, no objective data were available about the frequency and timing of actual calls. Therefore, we performed sensitivity analyses including the average number of nights and weekends having been called as a surrogate measure, which only showed marginal differences compared with our initial findings. Participants reporting higher need for recovery when called on weekends compared with called at night, might indicate a larger impact of weekend calls, e.g. calls interfering with social activities. Fourth, not all measures were assessed separately for the three scenarios, although measures of work demands and work–family interference might also differ between the three on-call scenarios. In the present study, distinction in assessments between the three on-call scenarios were kept to a minimum to align with other studies within the larger ‘Shift Your Work’ project.

Future studies are needed to more rigorously validate the methods we used, to help developing validated tools tailored to study distal on-call workers. For example, including both retrospective and, preferably real-time objective, momentary ratings to compare retrospective and momentary ratings. Furthermore, a prospective study design with repeated assessments of various constructs across different on-call scenarios would provide deeper insight into the impact of distal on-call work across time and to examine time course of cause and effect. In addition, the results of our study suggest that future studies may consider to also assess work demands and work-home interference for all three on-call scenarios. To date, little is known about the frequency and distribution of distal on-call shifts in relation to health and well-being. Due to novel technology replacing on-site presence of workers, opportunities for distal on-call work can be expected to increase in the future, emphasising the need for longitudinal research to provide more insight in levels of need for recovery over time for distal on-call workers.

In summary, the present study examined need for recovery in an understudied worker population of distal on-call workers. The results of our study support our initial hypotheses; need for recovery differed between workers 'not on-call', 'on-call, but not called' and 'on-call and called', and was in these three scenarios associated with health, work and social characteristics. The study findings suggest that the mere possibility of being called affects need for recovery, especially in workers with poor mental health, high work demands and high work-family interference. To disentangle the effects of working time arrangements on need for recovery in more detail, future studies should describe working time arrangements of the study population more clearly, preferably using a longitudinal design with repeated measurements across different on-call scenarios.

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Appendix

Table A1. Correlations dependent and independent variables.

	Need for recovery (not on-call)	Need for recovery (on-call but not called)	Need for recovery (on-call and called)	Age	Mental Health	Physical health	Disturbed sleep (not on-call)	Disturbed sleep (on-call but not called)	Disturbed sleep (on-call and called)	Awakening complaints (not on-call)	Awakening complaints (on-call but not called)	Awakening complaints (on-call and called)	Fatigue severity	Work demands	Work-family interference	Care for children
Need for recovery (not on-call)	1.00	0.82	0.70	-0.04	-0.49	-0.26	0.39	0.40	0.35	0.46	0.47	0.45	0.60	0.38	0.48	0.15
Need for recovery (on-call but not called)		1.00	0.84	-0.03	-0.51	-0.31	0.37	0.51	0.45	0.44	0.54	0.52	0.62	0.43	0.53	0.08
Need for recovery (on-call and called)			1.00	0.02	-0.52	-0.27	0.36	0.48	0.54	0.32	0.42	0.57	0.56	0.52	0.55	0.07
Age				1.00	0.00	-0.18	0.22	0.17	0.23	-0.03	-0.05	-0.03	0.09	0.17	-0.04	-0.04
Mental Health					1.00	0.14	-0.43	-0.46	-0.43	-0.42	-0.41	-0.44	-0.65	-0.27	-0.40	-0.09
Physical health						1.00	-0.28	-0.29	-0.28	-0.24	-0.25	-0.24	-0.56	-0.25	-0.24	-0.01
Disturbed sleep (not on-call)							1.00	0.86	0.75	0.51	0.48	0.42	0.36	0.26	0.18	-0.04
Disturbed sleep (on-call but not called)								1.00	0.88	0.48	0.60	0.54	0.40	0.38	0.31	-0.05
Disturbed sleep (on-call and called)									1.00	0.36	0.48	0.58	0.37	0.47	0.36	-0.05
Awakening complaints (not on-call)										1.00	0.93	0.78	0.44	0.16	0.24	-0.04
Awakening complaints (on-call but not called)											1.00	0.86	0.46	0.23	0.33	-0.04
Awakening complaints (on-call and called)												1.00	0.46	0.34	0.40	-0.03
Fatigue severity													1.00	0.36	0.42	0.06
Work demands														1.00	0.40	0.00
Work-family interference															1.00	-0.04
Care for children																1.00

Notes: Pearsons correlation coefficient was used for all continuous variables. Kendall T was used for Care for children. Significant correlations are printed in bold ($p < 0.05$).