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Evidence that impaired sleep recovery may complicate burnout improvement independently of depressive mood

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Abstract

Objective: This article examines recovery through sleep in relation to sleep quality, exhaustion, and depression in clinical burnout. We focus on actual recovery per night, given its relevance to burnout improvement. **Methods:** Sixty clinically burned-out participants and 40 healthy controls recorded symptoms with an electronic diary for 2 weeks at random times per day. Recovery through sleep was defined as the difference in fatigue between late evening and the next morning. **Results:** In clinical burnout, sleep quality and recovery are impaired, and depression is elevated. Poor recovery through sleep is associated with poor same-night sleep quality, clarifying the mechanisms underlying poor recovery. Individual differences in recovery though sleep were related to differences in refreshed awakening, but not to other sleep problems. Impaired recovery was also related to severity of exhaustion, but not to severity of depressive mood, indicating that, in burnout, nonprofit from sleep is a symptom of energy depletion, not a sign of depression. **Conclusion:** Impaired recovery through sleep may hamper recovery from burnout independently of the influence of depression.

Keywords: Clinical burnout; Depression; Electronic diary; Energy depletion; Experience sampling method; Sleep quality

Introduction

Today, clinical burnout [1] is a widespread health problem [2] that is costly, both personally and economically, due to its resistance to change and its insusceptibility to normal periods of rest and recuperation [2]. Although burnout research was instigated by descriptions of severe cases, scientists lost sight of the dead end of burnout when symptoms led to sickness absence and treatment was deemed necessary [1]. The focus shifted to milder expressions of burnout in relatively healthy employees who are still at work. In addition, most knowledge on burnout is based on research using between-persons designs, and still little is known about the dynamics of burnout (i.e., how burnout complaints develop within persons). Therefore, the current study focuses on persons who suffer from severe burnout and uses a within-subject design. The focus of the present paper is on *concurring* complaints of clinical burnout: How impaired are those with clinical burnout with regard to sleep quality, recovery from fatigue through sleep, and depression as compared to healthy participants based on moment-to-moment assessments? Moreover, what are the associations between these impairments?

Recovery from fatigue through sleep

At the heart of the burnout syndrome is chronic and severe exhaustion of energy [3,4]. Exhaustion has been defined as the chronic form of acute fatigue, which is uncommon in healthy individuals. Although exhaustion levels are shown to be fairly stable across months and even years [5], acute fatigue does fluctuate within days in clinically burned-out individuals [6,7], albeit to a lesser extent than in healthy individuals [7]. Recently, an electronic diary study on burned-out individuals who were on

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extended-sickness absence provoked the idea that sleep has lost its ability to restore energy on a daily basis [7]. The aforementioned study examined diurnal patterns of fatigue in burnout and showed that fatigue levels after the awakening of clinically burned-out and healthy participants diverged more than fatigue levels of both groups before going to sleep, suggesting that sleep does not have the same recovering effect in both groups [7]. Little is known about how to reverse energy depletion, but it seems of primary importance to find ways of reinitiating profit from nightly rest in order to prevent both the development and the maintenance of burnout. Although sleep may not immediately affect chronic fatigue (exhaustion), small restorative effects of acute fatigue levels may accumulate in the long run and may restore chronically depleted energy.

Disturbed sleep might contribute substantially to limited recovery from fatigue through sleep in burnout. Sleep is found to be disturbed in clinical burnout [6,8] and is already disturbed in the early stage of the burnout process [9–12]. Like exhaustion, these sleep disturbances—particularly nonrestorative sleep and trouble falling asleep [9,12]—seem to persist in the absence of the original work stressor. To our knowledge, no attempts have been made to study lack of recovery through sleep in a clinically burned-out sample and to relate it to sleep quality. In a syndrome that bears some parallelism with burnout [chronic fatigue syndrome (CFS)], sleep problems are prominent as well [13] and were found to be a complicating factor with respect to health recovery [14]. When sleep problems do not resolve while off work and when they hinder the onset of recovery, this may sustain the state of energy depletion.

A crucial question pertains to the role of depression in sleep problems that characterize burnout. Sleep disturbances are signs of an episode of major depressive disorder [15,16]. Moreover, sleep disturbances increase the risk of the development of depression [17] and reduce treatment effects [18]. Depression is the most prominent comorbid psychological distress factor in burnout [19]. However, preliminary evidence contradicts the idea that poorer sleep quality in burnout is due to depression. The differences in sleep disturbances between mildly high and mildly low burned-out individuals remained when accounting for depression [9]. Moreover, no correlations were found between mood states and ratings from both sleep questionnaires and polysomnographic parameters. This corresponds with findings on CFS, where sleep problems were unrelated to depressive mood and CFS patients with concurring psychiatric disorders did not report more sleep disturbances than did CFS patients without comorbidity [14]. Considering these findings, we assume that poor recovery through sleep, just like sleep quality in both mild burnout and CFS, is not a sign of depression in clinical burnout.

Electronic diary

The usual approach to investigating the phenomenon under study is the use of questionnaires, which request participants to recollect and integrate past experiences and to give an overall estimation of their symptom severity. But questionnaire assessments are affected by retrospection bias, especially when assessing fluctuating symptoms [20]. In the present study, prospective electronic diary monitoring according to the standards of the experience sampling method (ESM) [21] and ecological momentary assessment (EMA) [22] was used to establish concurring burnout symptoms (i.e., recovery, sleep problems, and depression) accurately and validly. A diary obtains direct moment-to-moment assessments of symptom severity. Consequently, this method offers the opportunity to distinguish the influence of variables on subject level (e.g., characteristics that distinguish between individuals, such as the individual mean level of sleep quality) from within-subject fluctuations of variables (e.g., Is sleep quality on a specific night related to recovery through sleep on the following morning, regardless of the individual mean level of sleep quality?). Moreover, this method allowed us to define and assess poor recovery through sleep as the actual difference in fatigue between late evening and the next morning.

Inherent to this method is the measurement of fatigue as a general and unidimensional concept. Despite conceptual differences between physical, mental, and emotional fatigue, as well as sleepiness and fatigue, in daily experience, individuals cannot distinguish the different dimensions of their fatigue experience [23], and “I am tired” is the common expression of fatigue of any kind in spoken language [24].

Hypotheses

Based on the assumption that clinically burned-out individuals recover less through sleep on a daily basis and suffer from poorer sleep quality than do healthy individuals, we formulated the following hypotheses:

Hypothesis 1. Low recovery through sleep is associated with poorer sleep quality in clinical burnout. We will explore whether burned-out individuals with overall poor sleep quality have worse recovery through sleep (between-subjects level) and/or whether an individual who has had a bad night’s sleep experiences little recovery from fatigue on that particular morning (within-subject level).

Hypothesis 2. Low recovery through sleep is not associated with severity of depression in clinical burnout, but with severity of exhaustion.

Method

Participants

Participants were 60 clinically burned-out individuals (mean age=42.9 years, S.D.=8.75 years; 55% females; 65% educated at college/university level) and 40 healthy controls, matched according to age, gender, and educational

level. Burned-out employees were recruited from new enrollments in Dutch centers with expertise on burnout treatment (42%) and from the Internet (58%) and were eligible for participation when they met the following three inclusion criteria: (a) severe burnout complaints according to validated cutoff points from the Dutch Maslach Burnout Inventory—General Survey (MBI-GS) [25] and the Checklist Individual Strength (CIS) [26]; (b) extended absence and/or enrollment in professional care due to burnout symptoms; and (c) fulfillment of criteria for work-related neurasthenia [*International Classification of Diseases, Tenth Revision* (*ICD-10*)] [15], which has been proposed as the psychiatric equivalent of clinical burnout [1]. We allowed *secondary* psychiatric disorders to co-occur with burnout, given the recent finding that 53% of severe burnout cases met *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (*DSM-IV*) criteria for depressive disorders [27]. The Symptom Checklist 90-R (SCL-90-R) [28] served as a screening tool for severe psychopathology, and burned-out participants with a general severity index of >214 were excluded from the study. Subsequently, a semistructured clinical interview [29] conducted by a senior clinical psychologist or by junior psychologists under supervision was used to assess work-related neurasthenia and secondary comorbid psychiatric disorders, and to exclude primary psychiatric disorders. The clinical interview consisted of general anamnesis and systematic assessment of *DSM-IV* Axis I disorders and work-related neurasthenia according to the *ICD-10*, respectively. A concurring psychiatric disorder was considered secondary when: (a) exhaustion was reported as the main complaint (and fulfilled the *ICD-10* criteria for neurasthenia); (b) exhaustion was considered by the individual as a result of chronic work stress; and (c) the reported onset of other psychiatric disorders was more recent than that of exhaustion. Healthy controls were recruited from the community through newspaper advertisements and personal contacts. They had to be "healthy" according to validated cutoff points from the MBI-GS, the CIS, and the SCL-90-R. Exclusion criteria for individuals were as follows: use of antidepressants, anxiolytics, corticosteroids, or hormones; pregnancy; or report of medical conditions that could be responsible for their complaints.

All burned-out participants were on sick leave (53% on full sick leave; 47% partial sick leave) for 4 months, on average (S.D.=3.6). Compared to healthy controls, complaints in the burnout group were significant and were at clinical level [i.e., MBI-GS exhaustion: mean=4.75 (S.D.=0.99); cynicism: mean=3.53 (S.D.=1.34); personal accomplishment: mean=3.56 (S.D.=1.31); CIS: mean=106.4 (S.D.=14.9)]. Twenty-one burned-out participants (35%) suffered from comorbid psychiatric disorders. The most common comorbid psychiatric disorders were major depressive disorders (n=12), which were accompanied in three cases by anxiety disorders and in one case by a somatization disorder. Other comorbidities were anxiety disorder (n=6), chronic pain disorder (n=1), somatization disorder (n=1), and adjustment disorder (n=1). Since burned-out participants were recruited through both treatment centers and the Internet, we conducted a multivariate test between both groups on demographic variables, burnout characteristics, and diary variables under study. No significant group differences were observed [$F(7,43)=1.52$, $P=.19$].

Procedure

A brochure, a screening questionnaire (MBI-GS, CIS, and SCL-90), and a consent form giving permission to be approached were sent to potential participants. When inclusion criteria on questionnaires were met, the clinical interview was conducted either at home or at the research center. Included participants received an informed consent form. Recruitment among burned-out participants rendered 409 responses; 289 (71%) were willing to participate and returned the screening checklist. Finally, 65 respondents (22%) met the inclusion criteria. Seventy-four supposedly burned-out individuals were excluded due to psychopathology, as reported in the screening checklist (SCL-90>214), and 24 individuals were excluded based on the clinical interview. Sixty healthy participants responded to newspaper and Internet advertisements (n=21) or were approached by research assistants (n=39). Fifty healthy participants (83%) returned the screening questionnaire, of whom seven were excluded because of advanced age (n=2) or MBI-GS-detected symptoms of burnout (n=5).

The use of personal digital assistant (PDA) pocket computer and electronic diary was explained during a 1-h instruction session at home. Within 2 days, participants were interviewed by phone about their first experiences and potential problems. Telephone assistance was made available during the entire recording period. The assessment period was concluded with a debriefing interview and collection of PDA. Of the 108 participants included, three clinically burned-out individuals (4.8%) retreated from the study during the first week of assessment because they considered the required effort as being too much; one burned-out participant and three healthy control participants produced unreliable data due to serious neglect of instructions; and one burnout case's data were erased due to technical problems. The study was approved by the Medical Ethics Review Committee of the Utrecht University Medical Center.

Electronic diary measurement

The variables under study were measured with singular diary items, according to ESM premises [30], and are presented in Table 1. *Recovery* from fatigue through sleep was calculated as the difference between fatigue intensity ("Right now I am tired") before going to sleep and fatigue intensity after awakening on the following morning. *Sleep quality* was assessed in two separate ways. In accordance with a previous diary study of Peters et al. [31], we

Table 1
Diary items for exhaustion, recovery, sleep, and depression

Category	Symptom	Geared by	Items	Rating	Occurrence
Exhaustion	Exhaustion	MBI-GS exhaustion scale	Right now I feel exhausted	7-Point scale	All diaries
Recovery through sleep (difference of fatigue level in evening diary and fatigue level in morning diary)	Fatigue	CIS	Right now I am tired	7-Point scale	All diaries
Sleep	Sleep quality	Previous diary studies (Peters et al. [31])	Tonight I slept well	7-Point scale	Morning diary
	Sleep duration	Babkoff et al. [32]	Tonight I slept for __ hours	Number	Morning diary
	Trouble falling asleep	Babkoff et al. [32]	Tonight I had trouble falling asleep	7-Point scale	Morning diary
	Number of sleep disruptions	Babkoff et al. [32]	Tonight I woke up __ times	Number	Morning diary
	Refreshing sleep	Babkoff et al. [32]	Right now I feel refreshed	7-Point scale	Morning diary
Depression	Depressed mood	*DSM-IV* (49)/previous diary studies	Right now I feel depressed	7-Point scale	Alarm-controlled diary
	Enjoyment of activities	*DSM-IV*	Right now I enjoy what I am doing	7-Point scale	Alarm-controlled diary
	Life worth living	*DSM-IV*	Today life was worth living	7-Point scale	Evening diary
	Appetite	*DSM-IV*	Today I had a good appetite	7-Point scale	Evening diary

The 7-point scale ranged from 1 (*not at all*) to 7 (*very much*).

considered the item "Tonight I slept well" as a general measure of sleep quality. Additionally, we assessed four subcategories of sleep problems according to the three main sleep difficulties in the *DSM-IV* criteria of primary insomnia [16] (i.e., difficulty falling asleep, nocturnal awakenings, and not feeling refreshed) and added sleep duration to these, in accordance with Babkoff et al. [32].

The electronic diary was programmed into PalmOne (PDA) using Pendragon software [33] and a separate program that generated randomized alarms [34]. On each day for two consecutive weeks, participants kept the electronic diary, which consisted of: (1) a *morning* diary after waking up; (2) an *evening* diary before going to bed; and (3) an *alarm-controlled* diary at (on average) five random time points per day. A beeping signal was programmed to occur randomly within 2.5-h time units during the entire waking day and prompted participants to fill out the alarm-controlled diary.

Compliance was high in both groups: 81% of all alarms were answered by a diary entry, 96% of all alarms of morning diaries were answered by a diary entry, and 94% of all alarms of evening diaries were answered by a diary entry. For the burnout group, the study yielded a total of 3245 alarm-controlled diaries (mean=55, range=26–73), 802 morning diaries (mean=13, range=0–16), and 797 evening diaries (mean=13, range=0–15); for unknown reasons, one burned-out participant rendered no morning diaries, and another burned-out participant rendered no evening diaries. For the control group, the number of diaries was 2210 (mean=56, range=28–76), 542 (mean=14, range=12–15), and 520 (mean=13, range=7–15), respectively. Participants of both groups appreciated the method, and no reactivity effects were detected (i.e., changes in ratings of symptoms over time due to the method of diarykeeping itself). The method itself is described in more detail elsewhere [35].

Statistical analysis

To examine symptom severity and relations between symptoms, we first calculated the mean symptom intensity across all diary records for each individual before using multilevel regression analysis.

Multilevel regression modeling [36] is recommended for ESM/EMA data because it accounts for within-subject dependencies of data points applied to our data that contain multiple measurements of the same subjects [37]. This method is comparable to multiple regression in that its intercept and slope parameters are analogous to nonstandardized coefficients in regular regression analysis. Multilevel regression analysis is carried out in several consecutive steps: first, an empty model is fitted to establish the proportion of the total variance of the dependent variable (recovery) due to differences *between* participants and differences *within* participants, respectively, induced by day. Subsequently, groups of variables are entered according to their level of measurement, starting with the lowest level. Because the dependent variable (recovery) is measured once a day, the lowest level in the current study is the *day level* instead of the moment level.

After modeling the empty model (Model 1), we entered in Model 2 the severity of fatigue before going to sleep because we expected severity of fatigue in the evening to influence our measure of recovery (i.e., when fatigue is low in the evening, little room is left for recovery, while in this case, low recovery does not indicate a meaningful and alarming sign of energy depletion). Therefore, we calculated the explained variance of predictors by comparing the

Table 2
Group differences in recovery, sleep problems, and depression

Diary (mean of average intensity per individual)	Group: Clinical burnout (n=60)	Group: Healthy (n=40)	Effect size
Recovery through sleep[a]	1.35 (1.05)	2.23 (1.37)	−0.73**
Sleep			
Sleep quality[b]	4.46 (.88)	5.39 (.79)	−1.09**
Sleep duration	7.17 (.90)	7.32 (.47)	ns
Trouble falling asleep[b]	3.02 (1.32)	1.95 (.85)	0.92**
Number of sleep disruptions	1.84 (1.28)	1.34 (1.09)	ns
Refreshing sleep[b]	3.50 (.86)	4.84 (.94)	−1.49**
Depression			
Depressive mood[b]	2.79 (1.01)	1.40 (.46)	1.66**
Enjoyment of activities[b]	4.59 (.61)	4.96 (.53)	−0.64*
Life is worth living[b]	4.96 (.92)	5.83 (.67)	−1.04**
Appetite[b]	5.26 (.94)	5.70 (.78)	−0.50*

No differences were found between burned-out participants on full sick leave and burned-out participants on partial sick leave.

[a] Difference between fatigue intensity before going to sleep and fatigue intensity after awakening on the following morning. Fatigue was rated on a 7-point scale ranging from 1 (*not at all*) to 7 (*very much*).

[b] The scale ranged from 1 (*not at all*) to 7 (*very much*).

* $P < .05$.

** $P < .01$.

variance of the particular model to the variance in Model 2. We tested Hypothesis 1 in two subsequent steps (Models 3 and 4) following the procedures proposed by Schwartz and Stone [37]. In Model 3, we entered within-person fluctuations of sleep quality, calculated as a pure within-person variable [within-person daily variability of sleep quality$_{ij}$= actual recorded sleep quality$_{ij}$−individually aggregated mean of sleep quality$_i$]. Subsequently, we entered the individual mean levels of sleep quality (between-persons variable) into Model 4. We repeated the process of Models 3 and 4 with the four subcategories of sleep problems and entered these variables simultaneously. Hypothesis 2 was tested in Model 5, where we simultaneously entered the aggregated individual means of exhaustion and depression. The significance of effects was determined with the Wald test: Z=estimate/standard error of estimate, where Z refers to standard normal distribution.

Results

Affected sleep in clinical burnout

Table 2 shows differences in symptom severity between clinically burned-out and healthy participants. As assumed, clinically burned-out individuals experienced less recovery through sleep compared to healthy participants. Moreover, clinically burned-out participants reported more sleep problems (Table 2), particularly nonrefreshing sleep and trouble falling asleep, while sleep duration was equal in both groups. The correlation of sleep quality and recovery was moderate (r=.50, P<.001). Eight burned-out individuals (13.3%) and none of the healthy individuals (χ^2=5.80, df=1, P=.02) used sleep medication. The burned-out individuals who used sleep medication experienced shorter sleep duration [$t(56)$=3.40, P=.001] and more sleep disruptions than burned-out individuals without sleep medication [$t(56)$=−2.18, P=.03]. But differences between the healthy group and the clinical burnout group remained upon exclusion of burned-out individuals who used sleep medication. Naps were more common among burned-out individuals (thrice a week, on average, compared to once a week in healthy individuals; $t(97)$=−5.47, P<.001) but were unrelated to recovery and sleep problems. Burned-out individuals did not differ from healthy participants on the time of awakening [$t(96)$=−1.34, P=.19].

Sleep quality as a predictor of recovery through sleep (Hypothesis 1)

To test the associations of sleep quality with recovery on both subject level and day level (Hypothesis 1), multilevel regression analysis was used. We wanted to examine whether poor recovery through sleep was related to the individual mean of sleep quality (*between-subjects level*) and whether daily within-person fluctuations of recovery through sleep were related to daily within-person fluctuations of sleep quality (*within-subject level*). To calculate recovery (i.e., the morning level of fatigue subtracted from the evening level), a complete set of evening diary and the next day's morning diary were needed. Largely due to the first day and the last day of the measurement period, where either a morning diary or an evening diary was missing, 761 of 802 daily records of burned-out participants were used in the analyses.

Multilevel regression analysis showed that recovery differed between participants and fluctuated within participants since 26% of the variance was attributed to subject level and 74% of the variance was attributed to day level. Actual testing of Hypothesis 1 indicated a significant influence of daily fluctuations in sleep quality on recovery ($\beta_{\text{WP Sleep Quality}}$=.33, P<.001). Additionally, the individual mean of sleep quality was significantly positively related to recovery as well ($\beta_{\text{BP Sleep Quality}}$=.26, P<.001). These results indicate that within individuals, sleep quality during the night was directly related to recovery from fatigue on the following morning. Moreover, burned-out individuals who generally experienced low sleep quality generally experienced poor recovery from sleep as well.

General sleep quality was significantly related to all four types of sleep problems (r=±.36–.61, P<.001), which in turn significantly predicted sleep quality with multilevel regression analysis (standardized β values: sleep duration: β=.26, P<.01; sleep onset: β=−.20, P<.01; sleep disturbance: β=.34, P<.01; nonrefreshing sleep: β=.38, P<.01). Directly regressing the four subcategories of sleep problems on recovery revealed that the effect of sleep quality was particularly due to nonrefreshing sleep. Within a person, refreshing sleep had the strongest predictive effect on poor

recovery (β=.42, P<.001), whereas trouble falling asleep had a minor effect (β=−.05, P=.005). Between individuals, refreshing sleep was the only predictor of poor recovery (β=.34, P<.001).

Since nonrefreshing sleep is an outcome of poor sleep quality rather than a determinant and is strongly related to poor recovery (r=.64, P<.001), we regressed the different aspects of sleep a second time, but this time excluded refreshing sleep from the model. Within an individual, poor recovery was predicted by shorter sleep duration (β=.14, P<.001), trouble falling asleep (β=−.08, P=.002), and more sleep disruptions (β=−.09, P=.001). At the within-person level, we controlled for time of awakening, naps, mental effort, and physical effort during the day prior to night sleep. Waking up early was related to poorer recovery (β=.09, P=.002) but did not change the effects of other sleep variables. Between persons, a persistent short duration of sleep was the only sleep variable that significantly predicted poor recovery (β=.09, P=.03), but this effect disappeared upon exclusion of burned-out participants who used sleep medication. Thus, in burned-out individuals without sleep medication, differences between persons in poor recovery are not related to any of the sleep variables. Besides sleep medication and time of awakening, we controlled for the confounding influence of several other variables on between-persons level [i.e., usual time of awakening, naps, mental effort, and physical effort], comorbid depressive disorder (both as a predictor and excluding those with comorbid depression), recruitment method, and full or partial sick leave. None of these variables explained any additional variance nor changed the results.

Association of poor recovery with depression and exhaustion (Hypothesis 2)

Table 2 shows that depression was more prevalent in the burnout group than in the healthy group. The most prominent difference was found for depressed mood, but burned-out participants suffered from all four depressive symptoms measured. In line with our hypothesis, both recovery and sleep problems were unrelated to depression on the subject level when calculating Pearson Product–Moment Correlation Coefficients on aggregated diary scores (r=−.04, P=.79, and r=.01, P=.95, respectively). Poor sleep quality was not related to severity of exhaustion (r=−.12, P=.37), but higher exhaustion related to lower recovery through sleep (r=−.33, P=.01).

Contrary to bivariate correlations, multilevel analysis analyzed the effects of depression, partialling out (controlling for) the effects of exhaustion and sleep quality. Now, as expected and in line with Pearson Product–Moment Correlation Coefficients, recovery was negatively related to the individual average of exhaustion ($\beta_{\text{BP Exhaustion}}$=−.34, P<.001), but contrary to expectations, recovery was positively related to the individual average of depression ($\beta_{\text{BP Depression}}$=.16, P=.01). In short, poor recovery through sleep was related to high exhaustion levels and low levels of depression.

Discussion

The current study intended to clarify the manifestations of concurring symptoms in clinical burnout, in particular whether poor sleep quality is related to low recovery from fatigue during the night, and to rule out the explanation that low recovery through sleep in clinical burnout is due to depression instead of energy depletion.

Sleep quality as a predictor of nightly recovery from fatigue (Hypothesis 1)

Clinically burned-out individuals did not recover as much through sleep as healthy individuals did. Burned-out participants reported all kinds of sleep problems, particularly trouble falling asleep and nonrefreshing sleep, consistent with the literature [9,12]. Sleep duration was equal in both groups, which is in line with research among those with mild burnout but is inconsistent with a study in a clinical burnout sample [6]. This inconsistency might be due to the small sample size of the latter study (n=12). In line with previous findings in mild burnout [12], we are led to the conclusion that sleep duration is not shorter in clinical burnout but sleep is of lower quality. Burned-out participants who were on partial sickness absence and partially working suffered similarly from poor sleep quality and poor recovery as those on full sickness absence. This might indicate that, in burnout, sleep problems and lack of recovery persist independently of the original work stressor.

Poor sleep quality explained a significant part of differences in recovery through sleep within the burnout group. Recovery was a fluctuating phenomenon within persons across days. Fluctuations in recovery within persons were predicted by fluctuations in sleep quality, in particular, sleep duration, trouble falling asleep, and disruptions of sleep. In addition, early awakening predicted poor recovery. These results indicate that, within clinically burned-out individuals, poor recovery from fatigue on a particular morning can (partially) be explained by poor sleep quality during the night. Although chronic exhaustion in clinical burnout obviously does not instantly disappear after a good night's sleep, acute fatigue in burnout is responsive to nightly rest.

Between-persons relations were less clear. Poor sleep quality was related to poor recovery, indicating that burned-out individuals who consistently reported poor sleep quality reported poor recovery through sleep as well. Examination of the determinants of poor sleep quality showed that not feeling refreshed in the morning was the only variable that accounted for this association. Although not feeling refreshed is an indication of poor sleep quality, it is better understood as an outcome variable (such as recovery) than as a determinant. Therefore, we repeated multilevel analysis

with three subcategories of sleep problems and found no additional associations for burned-out individuals when controlling for the use of sleep medication. These results indicate that clinically burned-out participants who consistently felt not refreshed in the morning truly had poor recovery through sleep. Moreover, burned-out individuals who particularly recovered poorly through sleep were not the ones who experienced sleep problems. In sum, poor recovery is directly influenced by poor sleep quality, but the most impaired burned-out individuals in relation to recovery are not characterized by greater impairment of sleep problems, except for not feeling refreshed after awakening.

Association of poor recovery with depression and exhaustion (Hypothesis 2)

Although sleep problems are a sign of depression, in our clinically burned-out sample, neither sleep quality nor recovery from fatigue through sleep was related to depression when calculating product–moment correlations on average symptom levels. When using multilevel regression analysis, we partialled out (controlled for) the effects of exhaustion and obtained different results. Our second hypothesis was partially contradicted: there *was* a significant association of recovery through sleep with severity of depression, but instead of high levels of depression in clinically burned-out participants who did not sufficiently benefit from sleep, we found *lower* levels of depression. Moreover, low recovery was associated with higher levels of exhaustion. This suggests that inability to benefit from sleep is a symptom of energy depletion in clinical burnout rather than a sign of depression. The current results extend the finding that depression and exhaustion are phenomena distinct (as established for mild burnout) [19,38] from the severest burnout cases who are on extended sickness absence.

Since depressive mood is not similar to a comorbid major depressive disorder, we additionally executed analyses excluding participants suffering from a concurring major depressive disorder. Differences between healthy and burned-out participants remained, in line with prior findings in both burnout [9] and CFS [14]. The current results support the view that poor recovery and sleep complaints are independent concurring symptoms in burnout and should be taken into account regardless of the severity of depressed mood.

Limitations

First, secondary comorbid psychopathology was allowed in our clinical burnout sample, which could have compromised the results. Although we carefully screened whether comorbidity was primary or secondary, the causal relation of burnout and comorbid psychopathology might be more complex. Comorbid psychopathology did not affect the outcomes, however. Since comorbid psychiatric disorders are common among severely burned-out patients [27], the inclusion of these cases in fact increased the generalizability of our results. Second, participants were excluded on their subjective reports of medical conditions, which could be responsible for their complaints. Although almost all burned-out participants had consulted their general practitioner and/or their occupational physician (92%), an additional independent systematic medical examination would have been more unambiguous. Third, we did not know the intrinsic diurnal sleep–wake patterns of burned-out individuals, which might have influenced fatigue ratings in the morning. We do know that awakening time did not differ significantly between both groups, though. Fourth, our measure for recovery through sleep was based on subjective reports of unidimensional fatigue. The current method did not allow for discernment of multiple dimensions of fatigue, or discernment of sleepiness and fatigue, since individuals are unable to clearly discern these states themselves [24]. We must therefore acknowledge that our sampling of fatigue in the present study may include several dimensions of fatigue, as well as states of sleepiness. Finally, although we circumvented many problems of self-report by sampling experiences with an electronic diary [20], the current study assessed sleep quality through self-report. Objective sleep measures have to confirm the mechanisms of sleep quality affecting recovery. Moreover, although experience sampling is a prospective method at the within-person level, most analyses were conducted at the between-subjects level, resembling a cross-sectional design. Obviously, longitudinal testing and experimental studies should clarify whether lack of recovery, sleep problems, and depression truly complicate the course of clinical burnout.

Implications

First of all, the current findings add to the clinical presentation of clinical burnout. Both sleep problems and subclinical levels of depression prominently concur with exhaustion, but our results underscore that these problems should be assessed separately and independently. Second, persistent sleep problems in employees who still are at work might be an important early warning sign of progressive erosion of energy. Although this issue deserves further empirical study, we suggest that sleep problems and inflated recovery from sleep be targeted in instruments for the early detection of burnout risk. Third, the present results underscore the importance of sleep management and sleep hygiene in burnout, particularly in severe clinical cases, because, evidently, sleep problems do not resolve spontaneously. We suggest that behavioral sleep medicine be actively incorporated into the treatment of burnout, and cognitive–behavioral therapy appears to be getting ready for the task [39].

Final note

By clarifying the relationship between poor sleep quality and low recovery through sleep in clinical burnout, the current study intends to clarify the mechanisms leading to

and out of this severe state of energy depletion. This study intends to stimulate research among the severest burned-out cases and to contribute to evidence-based practice of the diagnosis and treatment of clinically burned-out individuals. Our expectation that chronicity of burnout can be prevented is increased.

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