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A preliminary investigation of sleep quality in functional neurological disorders: Poor sleep appears common, and is associated with functional impairment☆

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ABSTRACT

Purpose: Functional neurological disorders (FND) are disabling conditions for which there are few empirically-supported treatments. Disturbed sleep appears to be part of the FND context; however, the clinical importance of sleep disturbance (extent, characteristics and impact) remains largely unknown. We described sleep quality in two samples, and investigated the relationship between sleep and FND-related functional impairment.
Methods: We included a sample recruited online via patient charities ($N = 205$) and a consecutive clinical sample ($N = 20$). Participants completed validated measures of sleep quality and sleep characteristics (e.g. total sleep time, sleep efficiency), mood, and FND-related functional impairment.
Results: Poor sleep was common in both samples (89% in the clinical range), which was characterised by low sleep efficiency ($M = 65.40\%$) and low total sleep time ($M = 6.05$ h). In regression analysis, sleep quality was negatively associated with FND-related functional impairment, accounting for 16% of the variance and remaining significant after the introduction of mood variables.
Conclusions: These preliminary analyses suggest that subjective sleep disturbance (low efficiency, short sleep) is common in FND. Sleep quality was negatively associated with the functional impairment attributed to FND, independent of depression. Therefore, sleep disturbance may be a clinically important feature of FND.

1. Introduction

Functional Neurological Disorders (FND) involve neurological symptoms (e.g. seizures, tremor, limb weakness) that are inconsistent with known neurological disease pathologies. There are many theoretical explanations for FND [1,2], and much debate about etiology [3,4]; however, many believe FND to be largely influenced by underlying psychological factors. FND are prevalent conditions [5], representing up to 30% of a neurologist's caseload [5]. They can cause high levels of functional impairment, which detrimentally affects quality of life and mood [6,7]. Prognosis is variable: some become symptom free following diagnosis [8]; for others symptoms persist [6,8] and proliferate [9]. Regarding treatments, depending on symptom type, patients are often referred for psychotherapy or physiotherapy. However, empirically-supported treatments for FND are lacking [10,11]. Improved understanding of the factors that contribute to functional impairment should allow us to develop new direct or adjunctive treatments for FND.

The present research is based on a clinical observation: we noted that people with FND attending a neuropsychology clinic often complained of sleep disturbance that reportedly affected functioning. A search on the topic revealed a literature limited to debate regarding the occurrence of non-epileptic seizures during sleep [12], and one small study ($N = 8$) showing a high proportion of REM sleep in people with non-epileptic seizures compared to those with epilepsy [13]. No investigation of the clinical relevance of sleep disturbance, its extent, broader characteristics and impact, was apparent. This seemed surprising for several reasons. First, we know that poor sleep worsens outcomes (e.g. quality of life and mood) in chronic diseases [14] and neuropsychiatric conditions [15]. It therefore follows that sleep might also contribute to outcomes in FND. This is important because if sleep is a clinically relevant factor in FND, then sleep treatments may be worthy of trial. Second, treatments for sleep disturbance, such as cognitive behaviour therapy for insomnia (CBT-i), show efficacy for improving sleep and consequently other outcomes, such as mood, quality of life and symptom severity, across several neuropsychiatric and chronic disease populations [16].

☆ Data can be accessed via the University of Leeds data repository, or via contact with the first author.

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Therefore, we undertook a study of the clinical relevance of sleep disturbance in FND. We recruited two samples: a consecutive sample of neuropsychology clinic attenders and a larger sample recruited online via FND patient charities. We quantified the extent and nature of sleep disturbance, then tested the hypothesis that sleep quality is associated with FND-related functional impairment.

2. Method

2.1. Participants & procedure

The online sample was recruited via an internet survey (Ethical approval: University of Leeds, Medicine and Health University Ethics Panel, application number MREC15-125). This survey was promoted to people with FND via two FND patient charity websites (FND Hope & FND Action). A link directed participants to online information sheets, consent forms and the questionnaire battery. Participants assessed themselves against inclusion (presence of FND as diagnosed by a neurologist) and exclusion (learning disability; inability to read English) criteria. The questionnaire battery, comprised validated questionnaire measures of sleep, mood and FND-related functional impairment. We also collected information on demographics, including medication use. To help ensure that only those with FND participated, a) recruitment was solely from FND specific charity websites; b) verification questions were included; c) participants registered their e-mail addresses; d) secondary gain was low - there were no rewards for participation.

Routinely collected clinical data from a sample of neuropsychology service users was also included, mainly as a means to cross-check data collected from the online sample. This clinical sample comprised consecutive clinic attenders of the Clinical Neuropsychology Department at St. James University Hospital, between April and November 2016 (ethical approval: considered an NHS clinical audit). All had a diagnosis of FND (made at United Kingdom regional neurosciences centre). As part of routine clinical practice these participants completed a mood questionnaire (CORE-10) that contains an item assessing the frequency of sleep disturbance.

2.2. Questionnaires

2.2.1. Sleep

The **Sleep Condition Indicator (SCI)** [17] measured global sleep quality in the online sample. The SCI comprises 8 items regarding, for example, perceived sleep quality, duration of sleep difficulties and daytime functioning. Participants respond on a five-point scale with lower scores indicating greater difficulties in each area. The SCI is transformed into a score of 0 to 10, with a cut-off of ≤5 indicating the presence of probable insomnia disorder [17].

The **Pittsburgh Sleep Quality Index (PSQI)** [18] also assesses perceived sleep quality. From the PSQI we selected two sub-components (total sleep time [hrs/mins]; sleep efficiency), reflecting clinically important aspects of sleep not measured by the SCI. Sleep efficiency reflects the proportion of time in bed spent asleep ([# of hours asleep/# of hours in bed] × 100). Scores can range from 0 to 100% with higher scores indicating better sleep efficiency.

Sleep item from the CORE-10 [19]: The CORE-10 is a 10 item measure of mood disturbance that is used in routine clinical practice. It includes a sleep item ("I have had difficulty getting to sleep or staying asleep"), which was used to assess subjective sleep quality in our clinical cohort. Responses to this item are made on a four-point scale from 0 ("Not at all") to 4 ("Most or all the time").

2.2.2. Functional impairment

The **Work and Social Adjustment Scale (WSAS)** [20] is a 5-item measure of impairment in activities of daily living specifically ascribed to a condition (here FND). Scores range from 0 to 40, with a higher score indicating greater functional impairment.

2.2.3. Mood

The **Generalised Anxiety Disorder 7-item Scale (GAD-7)** [21] is a 7 -item measure of anxiety (Lowe et al.,2008). The possible range is 0–21, and higher scores indicate greater anxiety severity.

The **8-item version of the Patient Health Questionnaire (PHQ-8)** [22] is a redacted (for online use) version of the PHQ-9 (suicidal plans item removed), which retains good psychometric properties. Scores can range from 0 to 24, with higher scores indicating more severe depression. To prevent confounds with sleep measurement we removed the sleep item from this measure.

Table 1
Description of the included samples.

	Online sample (% or SD)	Clinical Sample (% or SD)
Symptoms		
Non-epileptic seizures	105/205 (51.2%)	7/20 (35%)
Tremor	117/205 (57.1%)	4/20 (20%)
Dystonia	70/205 (34.1%)	6/20 (30%)
Visual symptoms	86/205 (42.0%)	2/20 (10%)
Other	80/125 (39%)	4/20 (20%)
Age	40.42 (10.83)	37.85 (15.96)
Years diagnosed	3.42 (5.00)	–
% Female	87.8%	70%
Location		
United Kingdom	156/205 (76.1%)	20/20 (100%)
North America	35/205 (17.1%)	–
Mainland Europe	5/205 (2.4%)	–
Australia &New Zealand	9/205 (4.4%)	–
Co-morbidity		
Co-morbid illness (e.g. asthma, diabetes, arthritis)	118/205 (57.6%)	–
Pain	163/205 (79.5%)	–
Fatigue	182/205 (88.8%)	–
Medications		
Anti-depressants (e.g. sertraline, citalopram)	108/205 (52.7%)	–
Pain medication (e.g. paracetamol, tramadol)	65/205 (31.7%)	–
Benzodiazepines (e.g. diazepam, alprazolam)	19/205 (9.3%)	–
Anti-epileptic medication, in those with seizures (e.g. gabapentin, pregabalin)	32/105 (30.5%)	–
Vocation		
Employed	48/205 (23.4%)	–
Unemployed not due to health	2/205 (1.0%)	–
Unemployed due to ill health	121/205 (59.0%)	–
Retired	2/205 (1.0%)	–
Student	12/205 (5.9%)	–
Other	20/205 (9.7%)	–
General functioning and mood		
FND-related Functional impairment (WSAS)	28.31/40 (10.46)	–
Depression (PHQ-8)	15.17/24 (5.89)	–
Anxiety (GAD-7)	10.21/21 (6.48)	
CORE-10 total score		−21.00/40 (7.02)
Sleep		
Sleep condition (SCI total)	3.11/10 (1.78)	–
Sleep efficiency (PSQI)	65.40% (20.44)	–
Average total sleep time (per night; PSQI)	6.05 h (2.39)	−2.9/4 (1.25)
CORE-10 Sleep item	–	

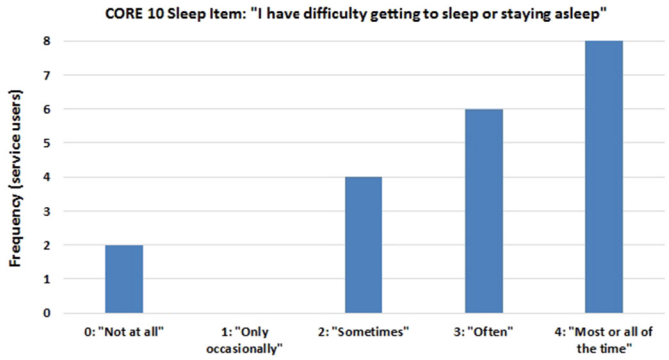

Fig. 1. The frequency of reported sleep disturbances on the CORE-10 Sleep Item in the clinical sample (N = 20).

2.3. Analyses

Statistical analyses were undertaken with the SPSS programme [23]. Data did not meet the assumptions for parametric statistical procedures. Thus, non-parametric tests were used throughout: robust regression procedures involving bootstrapping (1000 samples) and group comparisons via Mann-Whitney U tests.

3. Results

The clinical sample comprised $N = 20$; the online sample was larger ($N = 205$). In both samples a range of FND symptoms were described, most commonly non-epileptic attacks, tremor and dystonia (Table 1). In line with other cohort studies [8], the majority of both samples were female and both samples showed mood disturbance. Considerable proportions of the online sample were taking antidepressant or pain medication (Table 1).

Questionnaire measures demonstrated adequate internal consistency (SCI: $\alpha = 0.69$; GAD-7: $\alpha = 0.92$; WSAS: $\alpha = 0.90$; PHQ-8: $\alpha = 0.82$), where this could be calculated. Removal of the sleep item from the PHQ-8 did not affect internal consistency, which remained at $\alpha = 0.82$.

3.1. The extent and nature of sleep disturbance

Poor sleep was common in the clinical sample, with most at the extreme pole on the CORE sleep item (Fig. 1). Similarly, in the online sample, 89% were below the SCI cut-off indicating the probable presence of clinically-significant sleep disturbance. Average sleep quality (SCI) was very poor ($M = 3.11$, $SD = 1.78$); much lower ($p \leq 0.001$, $d = 0.65$) than a normative online sample ($N = 10,625$; $M = 5.07$, $SD = 2.52$) [24]. The average pattern of sleep disturbance reflected both short ($M = 6.05$ h, $SD = 2.39$ h) and inefficient sleep ($M = 65.40\%$, $SD = 20.44\%$; Table 1). Of the online sample, 79.50% reported problematic sleep for over one year, with 34.60% taking sleep medication at least once a week (PSQI).

3.2. The relationship between sleep disturbance and functional impairment

In the online sample, those with an SCI score below the cut-off indicating the probable presence of insomnia disorder had significantly worse functional impairment ($Z = -3.28$, $p = 0.001$) compared to those above this cut-off ($M = 29.02$, $SD = 10.41$; $M = 22.41$, $SD = 9.16$). In addition, sleep parameters accounted for significant proportions of variance (16%) in functional impairment after controlling for demographics (Table 2.) This relationship remained significant (SCI) after the inclusion of anxiety and depression in the analyses ($\beta = -1.23$ [−2.04, −0.37], $t = -2.68$, $p = 0.005$).

4. Discussion

This study suggests that significant sleep disturbance is a feature of FND, characterised by inefficient and short sleep. While the extent of sleep disturbance apparent in our online sample is likely to be an over-estimation (self-selection bias), we suggest that this finding remains meaningful because: a) when compared to a large ($N = 10,625$) normative online sample, subject to many of the same biases [24], those with FND had significantly worse sleep on average; b) the high frequency and extent of sleep disturbance was broadly comparable to the results of the consecutive clinical sample – offering cross-validation, albeit it with a different measure (CORE-10).

In addition, commensurate with other conditions [14,15], sleep quality was associated with FND-related functional impairment – accounting for 16% of the variance. The prevalence and impact of poor sleep suggests sleep as a potential treatment target in FND. Multicomponent Cognitive Behavioural Therapy for Insomnia (CBT-i) is the first choice for improving chronic poor sleep. It has shown to be effective for improving a range of outcomes in many different clinical populations [16]. In FND, sleep treatments may offer some pragmatic benefits. For example, they may enhance existing FND treatments, such as

Table 2
Hierarchical regression analyses: The proportions of variance in FND-related functional impairment (WSAS) explained by demographics, sleep and mood.

Step	Variable	B (95% CI)*	*t*	*P**	R^2	ΔR^2	ΔF	*p*
1	Age	−0.02 (−0.15, 0.11)	−0.27	0.763	0.02	0.02	1.62	0.202
	Years diagnosed	−0.33 (−0.72, 0.04)	−1.75	0.080				
2	Age	0.06 (−0.06, 0.18)	0.83	0.354	0.17	0.16	17.23	<0.001
	Years diagnosed	−0.18 (−0.55, 0.20)	−1.03	0.308				
	Sleep quality (SCI)	−2.50 (−3.34, −1.72)	−5.59	0.001				
	Sleep efficiency (PSQI)	0.03 (−0.04, 0.11)	0.83	0.362				
3	Age	0.07 (−0.06, 0.19)	0.93	0.315	0.18	0.01	1.52	0.220
	Years diagnosed	−0.18 (−0.54, 0.20)	−1.00	0.326				
	Sleep quality (SCI)	−2.29 (−3.11, −1.42)	−4.81	0.001				
	Sleep efficiency (PSQI)	0.03 (−0.04, 0.11)	0.0.88	0.333				
	Anxiety (GAD-7)	0.15 (−0.10, 0.41)	1.23	0.242				
4	Age	0.06 (−0.05, 0.18)	0.88	0.382	0.34	0.16	42.95	<0.001
	Years diagnosed	−0.03 (−0.37, 0.34)	−0.18	0.869				
	Sleep quality (SCI)	−1.23 (−2.04, −0.37)	−2.68	0.005				
	Sleep efficiency (PSQI)	−0.03 (−0.4, 0.10)	0.76	0.412				
	Anxiety (GAD-7)	−0.43 (−0.70, −0.15)	−3.05	0.001				
	Depression (PHQ-7)[a]	1.26 (0.87, 1.67)	6.55	0.001				

Method: Enter (*taken from robust regression = 1000 bootstrapped samples).
SCI = Sleep Condition Indicator; PSQI = Pittsburgh Sleep Quality Inventory; GAD-7 = 7-item General Anxiety Disorder questionnaire; PHQ-9 = 9-item Patient Health Questionnaire.
[a] Sleep Item removed from the PHQ-8; thus, PHQ-7.

psychotherapy or physiotherapy, and may be applicable to those who do not require, or want, existing treatments.

Although use of antidepressant and pain medication is one possible contributory factor, the exact reasons for the impact/extent of sleep disturbance were difficult to ascertain within the utilised research design. Nonetheless, the parsimonious explanation that the association between sleep and FND-related functional impairment is fully explained by depression was countered by the fact that sleep quality predicted proportions of variance even with depression in the analysis. One hypothesis for future study is that sleep dysfunction worsens dissociation which consequently worsens FND symptoms. Dissociation is a feature of FND, in particular non-epileptic seizures [25]. A functional imaging study with people experiencing non-epileptic seizures observed that the extent of the connectivity between areas differentially implicated in non-epileptic seizures (insula, inferior frontal gyrus and precentral sulcus), was significantly associated with scores on a measure of dissociation [25]. It is possible that sleep influences such pathways. This notion is supported by empirical studies from other populations that have, a) observed sleep dysfunction to influence dissociative states [26,27] and; b) reported an association between dissociation and the number of reported somatic symptoms [28,29].

4.1. Limitations

The cross-sectional design precluded comment on the direction of influence between variables. One sample was recruited online; therefore, although several steps were taken to attenuate this issue, it remains possible that some without a gold-standard FND diagnosis participated. While some variables were directly calculated by the researchers from participant data (e.g. sleep efficiency), all variables included here are subjective. Thus, studies involving direct sleep/behaviour monitoring would be of benefit. Finally, we did not assess for sleep disorders beyond insomnia-related symptoms (e.g. restless legs syndrome, circadian rhythm sleep disorders).

5. Conclusion

Poor sleep appears common in FND and is associated with FND-related functional impairment, independent of mood. Longitudinal and experimental studies are required to confirm and extend these findings.

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