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Data availability statement

The data that support the findings of this study are available upon reasonable request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Author contributions

IH and KM designed the study, analyzed the data, and wrote the initial draft of the paper. KB and AG collected and verified the data. PG, KB, AG, AR and PW contributed to the interpretation of results and revising the manuscript. All authors have contributed to, and have read and approved the final version of the manuscript.

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Abstract

Sleep disturbance has been associated with adverse incidents among male forensic inpatients. This study examined relationships between sleep quality and the occurrence/severity of adverse incidents among male and female patients in a secure (forensic) psychiatric hospital setting. Sleep disturbance was assessed in 756 (361 female) patients at baseline (assessment 1), with 476 (253 female) patients followed up ≥1 month later (assessment 2). The occurrence and severity of adverse incidents (involving aggression, self-harm, or hospital security) was extracted from health records. Risk associated with sleep disturbance was assessed in adjusted binary logistic regression models with the occurrence of at least one adverse incident during the 7-day baseline period, or during the subsequent 30-day follow-up period as dependent. Prospective associations with adverse incidents among new cases of sleep disturbance (reporting sleep disturbance only at assessment 2) and 'good sleepers' (reporting no sleep disturbance at either assessment), were analysed using X^2. At baseline 316 (179 female) patients were categorised as seriously sleep disturbed. Sleep disturbance and female gender were independently associated with a significantly elevated risk of adverse incidents in the baseline models. In the follow-up models, sleep disturbance and gender significantly interacted to elevate incident risk. At follow-up, new cases of sleep disturbance showed the highest level of participation in adverse incidents, while 'good sleepers' showed both the lowest participation in, and the lowest impact scores resulting from adverse incidents. The management of sleep quality could help reduce participation in adverse incidents among inpatients in secure psychiatric environments.

Introduction

Insomnia is a prevalent transdiagnostic feature of psychiatric disorder (Harvey, 2008; Dolsen et al, 2014; Doghramji et al, 2018) and independently predicts the onset of depression, anxiety states and psychosis (Hertenstein et al, 2019). Insomnia symptoms have also been linked to disruptive and hostile behaviours presumed to arise from the increased impulsivity and emotional dysregulation which can follow sleep deprivation (Kamphuis et al, 2012; Langsrud et al., 2018; Dorrian et al, 2019). Such links have particular relevance for patients in secure (forensic) psychiatric settings. Research conducted among forensic psychiatric inpatients, for example, has demonstrated clear relationships between poor sleep quality and feelings of aggression, with sleep disturbed patients significantly more likely to report irritability and frustration, and to be rated 'hostile' by clinicians (Kamphuis et al, 2014; Van Veen et al, 2020[a]). However, relationships between sleep quality and the actual occurrence of disruptive or aggressive behaviours among patients in secure psychiatric settings has been less well demonstrated. In their detailed cross-sectional study of forensic treatment facilities in the Netherlands, for example, Kamphuis et al (2014) did find that poorer sleep quality and chronic insomnia symptoms significantly predicted the 6-month prevalence of aggressive incidents reported for a sample of 96, mostly male forensic patients. Nevertheless, the authors concluded that the finding may not be reliable since the number of patients recorded as acting aggressively (n = 17) was low and probably under-reported. This limitation can be overcome where the reporting of adverse patient events is required by health policy and embedded in clinical practice. The use of routinely collected 'adverse incident' data in UK secure forensic psychiatric facilities (where 'incidents' are broadly defined to include a range of disruptive and safety-related behaviours, including aggression and self-harm) has been shown to provide a sensitive index of patient outcomes in research studies (Braham et al, 2013; Chu et al, 2015). It is also the case that insomnia symptoms fluctuate over time

(Vallieres et al, 2005; Perlis et al, 2014), and that prospective studies which record the emergence of, and remission from insomnia symptoms may be more suitable for detecting the behavioural correlates of disturbed sleep. Further research, involving analyses of the prevalence and incidence of sleep disturbances within secure psychiatric settings, and including large mixed-gender samples, is therefore needed to clarify these relationships. In assessing the possible impact of sleep disturbance on aggressive and disruptive behaviours, analyses should also recognise the potential confounding effects of psychotropic drugs, including those used to treat insomnia. Benzodiazepines, as both anxiolytics and hypnotics, have been associated with the disinhibition of anger and hostility, particularly in those with pre-existing poor impulse control (Bond,1998; Albrecht et al, 2014).

The aim of the present study, therefore, was to describe the natural history of disturbed sleep in a secure psychiatric care setting, and to assess cross-sectional and prospective relationships between sleep quality and the occurrence and impact of disruptive and aggressive patient events. In this context, analyses specifically addressed three objectives:

1. To assess the prevalence of sleep disturbance and insomnia symptoms overall, and within gender and diagnostic groups;

2. To assess relationships between prevalent sleep quality and the occurrence and seriousness of reported adverse incidents; and

3. In prospective analyses, to assess chronicity, incidence, and remission rates of sleep disturbance in relation to the occurrence and seriousness of reported adverse incidents.

METHODS

Setting and Design

The research was conducted in a UK hospital offering low and medium secure mental health care services to adults and older people. Ethical approval for a secondary analysis of routinely collected clinical data was obtained from the hospital research centre, and Loughborough University Ethics Approvals (Human Participants) Sub-Committee. In July 2017, a programme of serial assessment which included the 20-item 'Recovering Quality of Life' questionnaire (ReQol-20:) was commenced for all inpatients (baseline assessment). ReQol-20 assesses the frequency of a patient's "…thoughts, feelings, and activities over the last week" in response to 20 statements, categorising responses as: 'None of the time'; 'Only occasionally'; 'Sometimes'; 'Often'; and 'Most or all of the time'. Among mental health service users ReQoL has shown high levels of reliability, internal consistency (Cronbach alphas for the 20-item version: 0.93-0.96) and construct validity (Keetharuth et al, 2018). In their 2-factor model identified through confirmatory factor analyses of all ReQol items (Keetharuth et al, 2019), the standardised factor loading for ReQol item 18 ("I had problems with my sleep") was 0.656. In the present study, sleep quality was informed by ReQol item 18, and by routine patient records of hypnotic drug use. From this information 3 indicators of sleep disturbance were derived: 1) reported problems with sleep 'Often' or 'Most or all of the time'; 2) hypnotic drug use during the 7-day ("…the last week") period captured by ReQol; and 3) 'serious sleep disturbance', defined as the presence of indicator (1) and/or indicator (2). Follow-up assessments were conducted at least one month (30 days) after baseline with 90% completed in 7 months, and 100% completed in 9 months. To assess prospective trends, 4 sleep quality outcome categories were computed from the baseline and follow-up data: 1) persistent sleep disturbance (serious sleep disturbance at baseline and follow-up); 2) remitting sleep disturbance (serious sleep disturbance at baseline but not at follow-up); 3) good

sleepers (no serious sleep disturbance at baseline or follow-up); and new sleep disturbance (serious sleep disturbance absent at baseline but present at follow-up).

Baseline and follow-up ReQol data were augmented by daily electronic records of medication use and the occurrence and impact of 'adverse incidents'. Adverse incidents are patient-related untoward events involving aggression (verbal or physical), self-harm, or hospital security (absconding, unexpected absences). The degree of harm resulting from each incident is recorded as: Level 1) No harm; Level 2) Low harm; Level 3) Moderate harm; or Level 4) Serious harm. Three possible consequences of adverse patient incidents are also recorded: restraint; sedation; and seclusion. Using this routinely collected information, patients were categorised as: 1) involved in at least 1 adverse incident (yes/no); and 2) involved in at least 1 adverse incident resulting in low to severe harm (yes/no). For each patient involved in at least 1 adverse incident a single overall 'incident impact score' was calculated for that patient as: ((number of Level 1 incidents) x 1) + ((number of Level 2 incidents) x 2) + ((number of Level 3 incidents) x 3) + ((number of Level 4 incidents) x 4) + 1 (if patient restrained) + 1 (if patient sedated) + 1 (if patient secluded). Incident impact scores were negatively skewed (with a modal score of zero) and were compared using the Kruskal-Wallis one way ANOVA for ranks.

Diagnostic information was extracted from the electronic health record (RiO) at baseline assessment and clustered into four mutually exclusive 'primary diagnosis' categories: Schizophrenia/Psychosis (including paranoid schizophrenia, schizoaffective disorder, and unspecified nonorganic psychosis); Mood Disorders (principally bipolar affective disorder); Personality Disorders (including emotionally unstable personality disorder, and mixed and other personality disorders); and Developmental Disorders (including Asperger syndrome, autistic spectrum disorders, and pervasive developmental disorders). Psychotropic drugs

used consistently (on at least 5 days) during the 7-day baseline assessment period were clustered into the categories: hypnotics; anxiolytics; neuroleptics; and antidepressants.

Statistical analysis

Analyses were designed to capture events (adverse incidents) which were contemporaneous across the time-frame of the baseline sleep assessment (i.e. 7-days), or which were statistically predicted across a period following the baseline assessment. Adverse incidents resulting in at least low harm were aggregated across 2 periods: the 7-day period covered by ReQol at baseline (for cross-sectional analyses); and the 30-day period immediately after the ReQol assessment at follow-up (for prospective analyses). Bivariate relationships between sleep quality and adverse incidents were explored using chi-square and independent samples t-tests. To evaluate risks associated with sleep disturbance 4 binary logistic regression models were then fitted to the 7-day baseline (models 1 and 2) and 30-day follow-up (models 3 and 4) data, each with involvement in adverse incidents as dependent. In all models covariates included: serious sleep disturbance; gender; quintile age-group (18-24; 25-29; 30-36; 37-46; 47+); and interaction terms for age by serious sleep disturbance, and gender by serious sleep disturbance. In addition, models 2 and 4 included the covariates: anxiolytic use; neuroleptic use; and antidepressant use (while Models 1 and 3 were unadjusted for medication use). Data were analysed using SPSS v.27 (IBM Corp., USA); alpha was set at 0.05 throughout.

Results

A total of 756 (361 female and 395 male) patients were assessed at baseline. For each assessed patient, full information was available from electronic records, with the single

exception of principal diagnosis, which was incomplete for a large minority (37%) of the most recently admitted patients. Descriptive and inferential statistics involving diagnostic categories at baseline, therefore, are based on 475 patient records.

Sleep disturbance Across the baseline 1-week sleep assessment period 255 patients (33.7%) reported sleep problems at least 'often', while 130 (17.2%) were administered hypnotics. Combining these 2 variables, 316 patients (41.8%) were categorised as 'significantly sleep disturbed' (i.e. patients reporting sleep problems at least 'often' and/or administered hypnotic drugs in the 7-day assessment period). Patient characteristics for each sleep disturbance indicator are shown in Table 1. All indicators of sleep disturbance were significantly more prevalent among female patients (Table 1). Paired comparisons of indicator sub-groups (present v absent) showed no significant differences in mean age (Table 1). Of the three sleep disturbance indicators (sleep problems 'often'; hypnotic use; serious sleep disturbance), only hypnotic drug use showed a significant association with diagnostic groups, with hypnotics administered to 25% of those with mood disorders, but only 4.2% of those with developmental disorders ($X^2 = 13.5$, df = 3, $p<0.01$). Most (78%) follow-up assessments were completed within 6 months of baseline (median = 3 months), and included 476 patients. Of these, 133 (27.9%) reported sleep problems at least 'often', 81 (17%) were administered hypnotics, and 181 (38%) were categorised as 'seriously sleep disturbed'.

Adverse incidents During the 7-day baseline assessment period, 144 patients (19.0%) were involved in adverse incidents, with 84 (11.1%) of these patients involved in events associated with at least low-level harm. For the 30-day period immediately after the follow-up assessment, 118 patients (15.6%) were involved in adverse incidents, with 87 (11.5%) involved in at least low-level harm events. At both periods of assessment female patients were approximately 3 times more likely than males to be involved in any adverse incidents (baseline: $X^2 = 37.9$, df = 1, $p<0.001$; follow-up: $X^2 = 42.9$, df = 1, $p<0.001$), or incidents

associated with at least low harm (baseline: $X^2 = 35.9$, df = 1, $p<0.001$; follow-up: $X^2 = 31.1$, df = 1, $p<0.001$). Across the same baseline and follow-up (7-day and 30-day respectively) periods of assessment, female patients were also significantly more likely to be involved in adverse incidents involving aggression (baseline: $X^2 = 21.3$, df = 1, $p<0.001$; follow-up: $X^2 = 42.3$, df = 1, $p<0.001$) or self-harm (baseline: $X^2 = 18.9$, df = 1, $p<0.001$; follow-up: $X^2 = 47.8$, df = 1, $p<0.001$). Patient involvement in adverse incidents for each sleep disturbance indicator is shown in Table 2. Across both assessment periods levels of involvement in any adverse incidents were significantly higher among patients receiving hypnotic drugs (7-day: $X^2 = 22.3$, df = 1, $p <0.001$; 30-day: $X^2 = 6.4$, df = 1, $p <05$), and patients categorised as 'seriously sleep disturbed' (7-day: $X^2 = 10.0$, df =1, $p < 0.01$; 30-day: $X^2 = 3.99$, df = 1, $p <0.05$). Levels of patient involvement in incidents resulting in at least low harm were also significantly higher in the hypnotic drug use category across both periods (7-day: $X^2 = 5.4$, df = 1, p = 0.02); 30-day: $X^2 = 5.2$, df = 1, $p<0.05$), and for the seriously sleep disturbed category during the baseline 7-day ($X^2 = 5.4$, df = 1, p = 0.02), but not during the follow-up 30-day period ($X^2 = 2.1$, df = 1, p = .20). Where significant, gender associations with sleep quality indicators reflected higher levels of female involvement (Table 2).

Results from the logistic regression models unadjusted for medication use (models 1 and 3) indicated that adverse incidents are consistently influenced by gender and sleep disturbance, with both the baseline (OR = 9.86; 95% CI = 3.41-28.49; $p<0.001$) and follow-up (OR = 5.48; 95% CI = 2.10-14.30; $p<0.001$) models showing a significantly elevated risk of involvement among women (Table 3). While model 1 showed no significant main effect for sleep disturbance, the gender x sleep disturbance interaction was significant (OR = 0.23; 95% CI = 0.07-0.83; $p<0.03$), while sleep disturbance emerged as a main effect in model 3 (OR = 5.94; 95% CI = 1.12-31.49; $p<0.04$; Table 3). Values for the gender x sleep disturbance interaction (model 1) are illustrated in Figure 1, with women clearly predominating in the

sleep disturbance/adverse incidents cell, while men predominate in the no sleep disturbance/no adverse incidents cell). Neither of the models unadjusted for medication use showed a significant main effect for age, but at follow-up, the age-group x sleep disturbance interaction was significant for both the 30-36 group (OR = 0.13; 95% CI = 0.02-0.83; p=0.03), and the 37-46 group (OR = 0.03; 95% CI = 0.003-0.29; p=0.002). Examination of cell values in both groups showed that involvement in adverse incidents was highest among the sleep disturbed (of total events reported for those aged 30-36, 77% were sleep disturbed, and for those aged 37-46, 60% were sleep disturbed). Anxiolytic, neuroleptic and antidepressant use (models 2 and 4) was not significantly associated with adverse incidents, and did not change the overall pattern of results shown in models 1 and 3.

Prospective sleep quality outcomes Relationships between prospective sleep outcome categories and the occurrence and impact of adverse incidents are shown in Table 4. Overall, levels of persistent sleep disturbance were significantly higher among women, who also showed higher levels of new sleep disturbance ($X^2 = 11.48$, df = 3, $p<0.01$). Comparisons between the mean age of patients in each sleep outcome category showed no significant differences ($p = 0.91$; Table 4). Involvement in adverse incidents was lowest among 'good sleepers', but highest among those showing 'new sleep disturbance' ($X^2 = 10.0$, df = 3, $p<0.05$). Patterns of self-harming also showed a significant association with sleep outcomes, with levels highest among cases of 'new sleep disturbance', and lowest among 'good sleepers' ($X^2 = 8.45$, df = 3, $p<0.05$). While a similar pattern was seen for events involving aggressive behaviour, this association was not significant ($X^2 = 6.48$, df = 3, $p = 0.09$).

Differences between event impact scores across all sleep outcome categories using the Kruskal-Wallis test were significant overall ($H = 10.47$, df = 3, $p = 0.02$), with Bonferroni adjusted paired comparisons showing significantly lower ranked impact scores among those categorised as 'good sleepers' relative to cases of 'new sleep disturbance' ($p<0.05$).

Discussion

The baseline prevalence of serious sleep disturbance (41.8%) found here broadly aligns with the level of "poor sleep quality" (49.1%) reported for predominantly male inpatients in a similarly secure hospital setting (Kamphuis et al, 2013). That levels of sleep disturbance in the present study were also high across age groups and all 4 diagnostic clusters (ranging from 33.8% - 41.7%; Table 1) is consistent with Harvey et al's (2011) proposition that sleep dysfunction is a transdiagnostic feature of psychopathology. While symptoms of insomnia show a robust increase with age in the general population (e.g. Morgan, 2012), the absence of such age differences has previously been reported for psychiatric inpatients (Talih et al, 2018). Nevertheless, secular trends in the present findings can also be inferred. Gender differences in 'serious sleep disturbance' (Table 1), for example, mirror those found in population samples, where both insomnia symptoms (e.g. Calem et al, 2012) and hypnotic drug use (e.g. Abolhassani et al, 2019) are greater among females. The finding (Table 1) that patients with the longest durations of stay showed significantly higher levels of subjective sleep disturbance, but significantly lower levels of hypnotic use is substantially due to diagnostic cluster; 80% of patients with developmental disorders (who showed the lowest levels of hypnotic use) also recorded durations of stay ≥24 months.

Against this background of prevalent sleep disturbance across all diagnostic clusters, bivariate analyses (Table 2) showed a clear relationship between indicators of sleep disturbance, and adverse incidents. Hypnotic users and those categorised as significantly sleep disturbed were significantly more likely to be involved in any adverse incidents, and incidents involving at least low-level harm, in the 7-day baseline period (Table 2). From the controlled models (Table 3), however, it is clear that the dominant risk factors for adverse incidents generally are sleep quality and female gender, with these factors operating interactively in the baseline models 1 and 2, and independently in follow-up models 3 and 4.

The interactive contribution of gender and sleep quality to adverse incidents is clearly shown in Figure 1, where incidents reported for those with serious sleep disturbance predominate among female patients.

Importantly, the significant contribution of sleep quality to an increased risk of adverse incidents emerged from models adjusted for the major psychotherapeutic drug groups. Such a result accords with the findings of Van Veen et al (2020a), who concluded that the influence of sleep on aggressive behaviour is not better accounted for by general psychopathology. The interactive contribution of gender, however, has not previously been reported. Studies examining relationships between sleep quality and adverse incidents in secure hospital settings, for example, have focussed on aggressive behaviours mainly (Kamphuis et al, 2014) or exclusively (Van Veen et al, 2020a; Van Veen et al, 2020b) in male inpatients. From baseline and follow-up analyses the present findings identify female gender as a significant risk factor for both adverse incidents per se, and sleep-related adverse incidents, with female patients predominating in the incident categories involving both aggression and self-harm.

Of the 3 indicators of sleep disturbance analysed, hypnotic drug use showed the most consistent association with adverse incidents in general, and those associated with at least low-level harm at both periods of assessment. While this finding may reflect a causal role for hypnotics in the genesis of impulsive behaviours through physiological mechanisms of disinhibition, it is also likely that hypnotic use served to identify patients with more severe insomnia symptoms. Such a conclusion would be consistent with the finding that the combined 'seriously sleep disturbed' indicator showed a stronger pattern of associations with adverse incidents than reported sleep disturbance alone. It is also the case that among the covariates included in models 2 and 4, anxiolytic drugs (which share the pharmacological properties of hypnotics), were not significantly associated with adverse events. While we

acknowledge a potential confound between hypnotic use and sleep disturbance (since hypnotics were used to define sleep disturbance) it is relevant to note that most of those prescribed hypnotics at night (54%) were also prescribed anxiolytics during the day.

The prospective results (Table 4) confirm the association between sleep disturbance, adverse incidents, and gender seen in the cross-sectional analyses, and emphasize the value of maintaining good sleep quality in secure hospital settings. Being a 'good sleeper' (i.e. reporting no sleep disturbance at both assessments) was significantly associated with the lowest level of participation in adverse incidents, and the lowest impact scores for incidents which did occur in this sub-group. Poor sleep quality, on the other hand, showed high levels of chronicity, with over a quarter (27.5%) of all patients meeting criteria for serious sleep disturbance at both assessments. In addition, the 'persistent' and 'remitting' cases of sleep disturbance (Table 4) both showed higher levels of involvement in adverse incidents relative to the good sleepers, suggesting that the baseline categorisation of poor sleep quality remained a marker for elevated risk. However, the greatest risk was among the new cases of serious sleep disturbance, who showed the highest levels of, and the highest impact scores resulting from participation in adverse incidents. A similar, and significant sleep-related 'gradient' was also present for self-harming behaviour. Those categorised as 'good sleepers' showed the lowest levels of involvement in self harm, while cases of new sleep disturbance showed the highest.

While van Veen et al (2020) report that mean sleep quality scores declined over a 1 year period in their study of male forensic inpatients, no previous study has estimated the incidence rate or impact of new sleep disturbance in secure hospital settings. The present findings strongly suggest that the emergence of sleep disturbance in patients who previously slept better can be a stronger marker for increased behavioural risk than the presence of chronic sleep symptoms. These conclusions have direct implications for the expression of

gender differences, since women were both more likely to experience chronic and new sleep disturbances, while men showed a greater proportion of 'good sleepers'.

These results indicate that sleep management initiatives in secure hospital settings could deliver significant benefits to patient wellbeing. Specifically, the present outcomes identify three overlapping, but clinically distinct targets for such initiatives: 1) the maintenance of good sleep quality; 2) the prevention of new sleep disturbances in vulnerable patients; and 3) the direct management of sleep symptoms in cases of persistent sleep disturbance. Recent trials, mainly employing the principles of cognitive behavioural therapy for insomnia (CBTI), have demonstrated the feasibility and potential utility of sleep management programmes delivered in acute psychiatric hospital settings (Sheaves et al, 2018a; Sheaves et al, 2018b; Novak et al, 2020; Paterson et al, 2021). To date, however, such approaches have not been trialled among secure hospital inpatients. While vulnerability to sleep disturbances is certainly amplified by psychopathology, such disturbances can be exacerbated and maintained by institutional schedules and practices. Sleep management programmes in the context of secure hospitals, therefore, should include attention to sleep schedules and environmental factors impacting sleep hygiene, as well as serial assessments of patient sleep quality, staff and patient sleep education, and the targeted deployment of effective CBTI therapies.

The strengths of the present study include the large initial samples of both male and female patients, the standardised event recording procedures, and a high level of follow-up assessments. Given this, our analyses offer a robust evaluation of relationships between sleep quality and adverse incidents among patients in secure hospital settings. Two limitations of the present study, however, should be acknowledged: the blunt categorisation of 'sleep disturbance' (made on the basis of a single Likert rating, and hypnotic drug use); and the absence of information on the changing clinical status of patients in our prospective analyses.

While the ReQol item "I had problems with my sleep" would have been sensitive to insomnia symptoms, it lacked specificity and may have reflected patient experiences from a range of sleep disorders. Nevertheless, the "hypnotic drug use" and "seriously sleep disturbed" categories used in the present analyses did discriminate between patients satisfied and dissatisfied with their sleep quality, delivering prevalence rates, and interrelationships among variables broadly in line with earlier research using similarly non-specific 'quality of sleep' and 'presence/absence of sleep disorders' metrics (KIamphuis et al, 2013). Collectively, such results are consistent with the hypothesis that relationships between sleep quality and incidents are mediated, at least in part, by the final common pathways of fatigue and/or sleepiness which can result from many sleep disorders, whether organic or psychological in origin. While the prospective findings are also consistent with this assumption, the interpretation of causal ordering, and the stability of health states between points of measurement, remain a challenge. It is possible, for example, that both sleep quality and adverse incidents could be influenced by new or deteriorating psychopathology (which wasn't captured in the present analyses). It is also possible that sleep quality could have varied between ReQol-20 assessments. Regarding future research, then, the present findings could be extended by prospective analyses which included more frequent assessments and monitored both sleep quality and the clinical status of patients in relation to adverse incidents. Sleep quality monitoring may also have a part to play in risk assessment in secure care, though such a move would require adjustment to current protocols. At present, sleep quality is not a dedicated item in many of the instruments used to assess risk in forensic patients (for example: the Short Term Assessment of Risk and Treatability (Webster et al, 2004); the Broset Violence Checklist (Almvik, 2000); the Dynamic Appraisal of Situational Aggression (Ogloff and Daffern, 2006) or the HCR-20 V3 (Douglas et al, 2014).

Table 1. Patient characteristics within categories indicative of sleep disturbance at baseline

Patient Characteristics		Sleep disturbance indicators at baseline		
		Sleep problems at least 'often'	Hypnotic drug use	Serious sleep disturbance*
All patients (N = 756): n (%)		255 (33.7)	130 (17.2)	316 (41.8)
Female: n (%)		146 (40.4)	74 (20.5)	179 (49.6)
Male: n (%)		109 (27.6)	56 (14.2)	137 (34.7)
	p-value [a]	(p<0.001)	(p=0.02)	(p<0.001)
Age: mean (SD)	Indicator present	34.3 (12.7)	35.4 (12.0)	34.6 (12.7)
	Indicator absent	36.1 (13.3)	35.5 (13.4)	36.1 (13.4)
	t-value (p)	1.9 (p=0.6)	0.1 (p=0.94)	1.6 (p=0.11)
Diagnostic clusters: n (% within cluster)**	Schizophrenia/ Psychosis	62 (27.1)	32 (14.0)	78 (34.1)
	Mood Disorders	11 (30.6)	9 (25.0)	15 (41.7)
	Personality Disorders	51 (36.7)	10 (7.2)	54 (38.8)
	Developmental Disorders	22 (31)	3 (4.2)	24 (33.8)
	p-value [a]	(p=0.29)	(p=0.004)[b]	(p=0.68)
Duration of stay: n (%)	1-12 months	63 (24.7)	63 (48.5)	96 (30.4)
	13-24 months	76 (29.8)	42 (32.3)	94 (29.7)
	>24 months	116 (45.5)	25 (19.2)	126 (39.9)
	p-value [a]	(p=0.52)	(p<0.001)	(p<0.001)

* Sleep problems at least 'often' and/or hypnotic drug use in the 7-day assessment period.

** Based on 475 patients with principal diagnoses

[a] p-value for X^2 (unless indicated otherwise); [b] Fisher's exact test

Table 2. Patient involvement in adverse incidents within categories indicative of sleep disturbance at baseline and follow-up

		Sleep disturbance indicators		
		Sleep problems at least 'often'	Hypnotic drug use	Serious sleep disturbance*
Patients (N=144) involved in any adverse incident during the 7-day period at baseline: n (%)**	Female	47 (46.1)	28 (27.5)	58 (56.9)
	Male	11 (26.2)	16 (38.1)	19 (45.2)
	p-value [a]	<0.05	p=0.21	p=0.20
	Indicator present	58 (22.7)	44 (33.8)	77 (24.4)
	Indicator absent	86 (17.2)	100 (16)	67 (15.2)
	p-value [a]	p=0.07	<0.001	p=0.002
Patients (N=84) involved in adverse incidents resulting in at least low harm during the 7-day period at baseline: n (%)**	Female	32 (48.5)	19 (28.8)	41 (62.1)
	Male	3 (16.7)	3 (16.7)	4 (22.2)
	p-value [a]	<0.02	0.24[b]	<0.01[b]
	Indicator present	35 (13.7)	22 (16.9)	45 (14.2)
	Indicator absent	49 (9.8)	62 (9.9)	39 (8.9)
	p-value [a]	p=0.10	p=0.02	p=0.02
Patients (N=118) involved in any adverse incident during 30-day period at follow-up: n (%)**	Female	41 (46.1)	22 (27.7)	51 (57.3)
	Male	9 (31.0)	2 (6.9)	10 (34.5)
	p-value [a]	p=0.16	p=0.06 [b]	p<0.05
	Indicator present	38 (28.6)	29 (35.8)	54 (29.8)
	Indicator absent	80 (23.3)	89 (22.5)	64 (21.7)
	p-value [a]	p=0.23	p=0.012	p=0.046
Patients (N=87) involved in adverse incidents resulting in at least low harm during the 30-day period at follow-up: n (%)**	Female	33 (50.0)	18 (27.3)	40 (60.6)
	Male	7 (33.3)	1 (4.8)	7 (33.3)
	p-value [a]	0.18	<0.05 [b]	<0.05
	Indicator present	26 (19.5)	22 (27.2)	39 (21.5)
	Indicator absent	61 (17.8)	65 (16.5)	48 (16.3)
	p-value [a]	p=0.66	p=0.02	p=0.15

* Sleep problems at least 'often' and/or hypnotic drug use during the 7-day ReQol assessment periods; ** Row percentages

[a] p-value for X^2 (unless indicated otherwise); [b] Fisher's exact test

Table 3. Sleep disturbance and the risk of involvement in adverse incidents at baseline and follow-up

	Involvement in adverse incidents resulting in at least low harm during the 7-day period at baseline (N=756)				Involvement in adverse incidents resulting in at least low harm during the 30-day period at follow-up (N=476)			
	Model 1 (Baseline)		Model 2 (Baseline adjusted for medication use)		Model 3 (follow-up)		Model 4 (follow-up adjusted for medication use)	
Covariates	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p
Serious sleep disturbance*	1.17 (0.15-8.82)	0.88	1.23 (0.16-9.33)	0.84	5.94 (1.12-31.49)	0.04	6.02 (1.12-32.22)	0.04
Female gender	9.86 (3.41-28.49)	0.001	8.77 (2.99-25.68)	0.001	5.48 (2.10-14.30)	0.001	4.65 (1.75-12.36)	0.002
Gender x sleep disturbance	0.23 (0.07-0.83)	0.03	0.24 (0.07-0.85)	0.03	0.39 (0.12-1.28)	0.12	0.41 (0.12-1.36)	0.15
Quintile age-group (reference 46+)**		0.21		0.17		0.09		0.08
Quintile age-group x sleep disturbance**		0.27		0.26		0.02		0.02
18-24	.2.79 (0.40-19.37)	0.3	2.51 (0.36-17.50)	0.36	0.31 (0.06-1.58)	0.16	0.31 (0.06-1.62)	0.17
25-29	3.67 (0.48-27.96)	0.2	.3.73 (0.49-28.67)	0.21	0.46 (0.07-2.90)	0.41	0.47 (0.07-3.01)	0.42
30-36	1.10 (0.15-8.10)	0.93	1.03 (0.14-7.61)	0.98	0.13 (0.02-0.83)	0.03	0.14 (0.02-0.89)	0.04
37-46	0.87 (0.09-8.43)	0.90	0.81 (0.08-7.87)	0.85	0.03 (0.003-0.29)	0.002	0.03 (0.003-0.28)	0.002
Anxiolytic use	-		0.84 (0.52-1.36)	0.48	-		1.05 (0.63-1.75)	0.85

Neuroleptic use	-	2.14 (0.93-4.95)	0.08	-	1.80 (0.78-4.15)	0.17
Antidepressant use	-	1.21 (0.73-1.99)	0.47	-	1.36 (0.80-2.32)	0.26

OR = odds ratio; CI = 95% confidence interval.

* Sleep problems at least 'often' and/or hypnotic drug use during the 7-day ReQol assessment periods at baseline or follow-up

** Significance of Wald test

Table 4. Sleep quality outcomes at follow-up assessment: relationships with adverse incidents

	Sleep Quality Outcome Categories*				
Variables assessed during the 30-day follow-up period	Persistent sleep disturbance	Remitting sleep disturbance	Good sleepers	New sleep disturbance cases	p-value
All patients (row %)	131 (27.5)	90 (18.9)	205 (43.1)	50 (10.5)	
Female: n (%)	76 (30.0)	56 (22.1.)	91 (36.0)	30 (11.9)	
Male: n (%)	55 (24.7)	34 (15.2)	114 (51.1)	20 (9.0)	0.009[a]
Age: mean (SD)	35.3 (12.9)	35.4 (13.7)	36.3 (13.6)	36.0 (14.1)	0.91[b]
Patients involved in at least 1 adverse incident: n (%)	35 (26.7)	26 (28.9)	38 (18.5)	19 (38.0)	0.02[a]
Patients involved in at least 1 self-harming event: n (column %)	20 (15.3)	13 (14.4)	17 (8.3)	11 (22.0)	0.02[a]
Patients involved in at least 1 aggressive event: n (column %)	26 (19.8)	21 (23.3)	27 (13.2)	12 (24.0)	0.09
Overall incident impact scores: mean (interquartile range)	3.44 (2.0)	3.52 (3.0)	1.61 (0)[c]	4 (3.0)[c]	0.02[d]

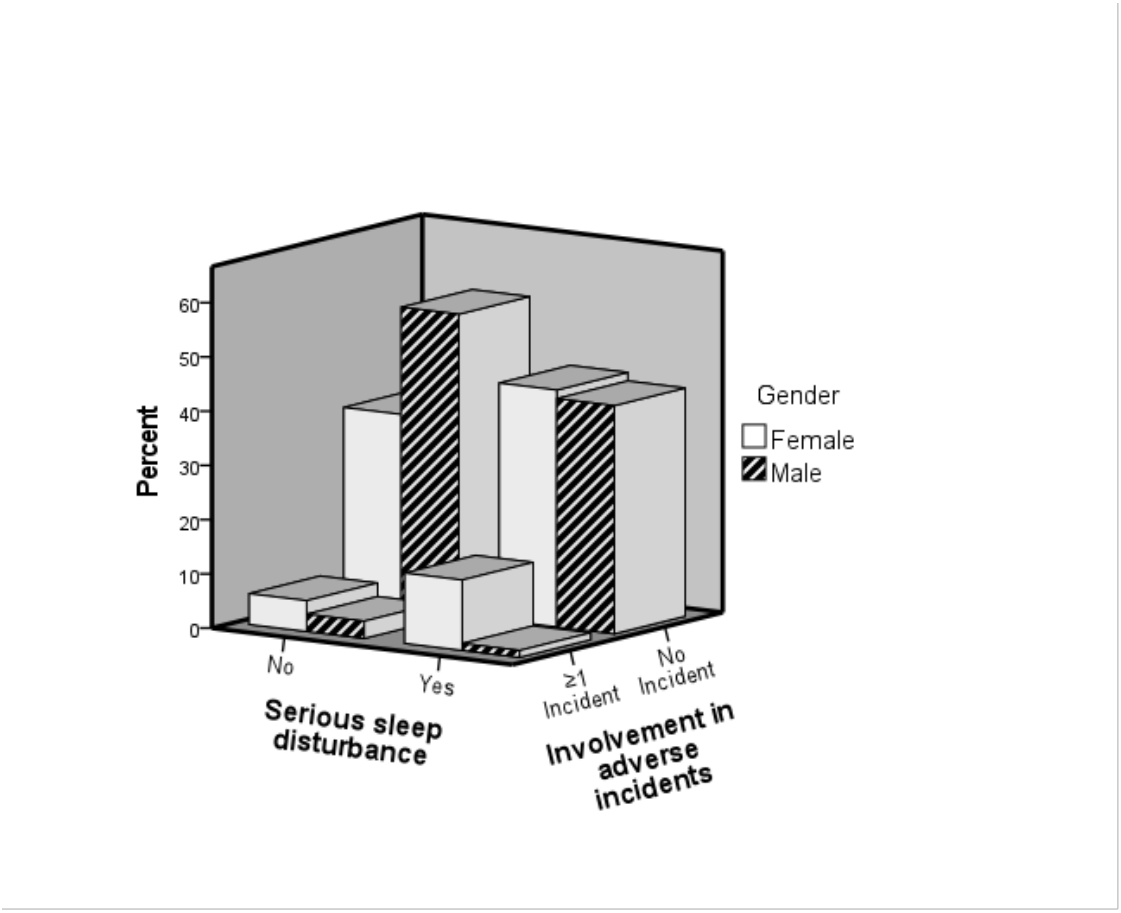
* Persistent sleep disturbance = serious sleep disturbance at baseline and follow-up assessments; Remitting sleep disturbance = serious sleep disturbance at baseline but not at follow-up; Good sleepers = no serious sleep disturbance at baseline or follow-up; New sleep disturbance = serious sleep disturbance absent at baseline but present at follow-up.

[a] for X^2 analyses: df = 3

[d] for F value from 1-way ANOVA

[c] values differ at $p<0.05$ (after Bonferroni adjustment)

[d] for the Kruskal-Wallis test



Sleep disturbance = sleep problems at least 'often' or hypnotic drug use during the 7-day baseline assessment period.

Adverse incidents = aggressive and/or self-harming event resulting in low-severe harm reported during the 7-day baseline assessment period.

Figure 1. Distribution of male/female participants by sleep disturbance and involvement in adverse incidents at baseline.

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