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Sleep quality is associated with aggression in forensic psychiatric patients, independent of general psychopathology

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ABSTRACT

Several studies found associations between poor sleep quality and aggression in general and (forensic) psychiatric populations. Both poor sleep and aggression have been related previously to general psychopathology, but studies rarely have addressed this possible confounding factor appropriately. The current study aimed to replicate the association between sleep quality and aggression in a forensic psychiatric sample, including adjustment for psychopathology. We used cross-sectional data from an observational study in forensic psychiatric inpatients ($n = 166$). Poor sleep quality was significantly associated with higher self-reported aggression, independent of general psychopathology. Poor sleep quality accounted for a substantial part of the variance in aggression. This was observed for self-reported physical aggression, verbal aggression, anger, and hostility, all showing relations with poor sleep quality that were not better accounted for by general psychopathology. Poor sleep quality was related to higher clinician-rated hostility as well, however, this association was weak and the explained variance low. These results confirm and substantiate previously found associations between sleep quality and aggression in forensic psychiatric patients. They highlight the importance of targeting sleep problems as part of the treatment of psychiatric patients with disruptive behavior and encourage further research aimed at unraveling the relation between sleep and aggression.

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KEYWORDS Sleep; insomnia; aggression; hostility; anger; forensic psychiatry

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Introduction

The critical role of sleep in psychological well-being has been gaining attention in research over the last decades (Wulff et al., 2010). Sleep disturbances impair both cognitive and affective functioning (Fortier-Brochu et al., 2012; Walker, 2009) and are closely related to psychiatric disorders (Baglioni et al., 2016; Harvey et al., 2011). Not only does disturbed sleep alter the experience of positive and negative emotions, it also influences the capacity to regulate them (Palmer & Alfano, 2017). These findings have predominantly driven the focus of research to the association of poor sleep with internalizing psychopathology, especially mood disorders (Staner, 2010). However, a growing body of research has demonstrated relationships between various sleep disturbances and externalizing behavior as well, such as aggression (Kamphuis et al., 2012; Krizan & Herlache, 2016). Several epidemiological studies found that poor sleep quality and shorter sleep duration are associated with higher levels of aggression in the general population (Grano et al., 2008; Vaughn et al., 2015) and in patients with psychiatric disorders (Langsrud et al., 2018; Simor & Horvath, 2013). In addition, forced sleep deprivation in experimental conditions has been related to several aspects of aggression, such as reduced emotional inhibition, increased hostility and higher tendencies to blame others (C. Anderson & Platten, 2011; Kahn-Greene et al., 2006; Kamphuis & Lancel, 2015). This might be highly relevant for psychiatric patients, for whom sleep problems could enhance both behavioral and emotional disturbances.

Sleep problems as well as aggressive behavior are highly prevalent in forensic psychiatric patients (Kamphuis et al., 2013; Maguire et al., 2017). Cross sectional data from both forensic samples (Lindberg et al., 2003; Semiz et al., 2008) and prison inmates (Harty et al., 2010; Ireland & Culpin, 2006; Vogler et al., 2014) show positive associations between disturbed or short sleep and aggression. Our research group showed a link between poor sleep and self-reported aggression, clinician-rated hostility and the actual occurrence of aggressive incidents in a sample of forensic psychiatric patients (J. Kamphuis et al., 2014). Studying the correlation of sleep problems and aggression is especially relevant in forensic psychiatric patients, as aggression is linked to violent behavior and crime. However, most studies do not control for general psychopathology. Controlling for psychopathology is necessary when disentangling the unique relationship between poor sleep and aggression, as both are highly correlated with psychopathology in general (Dack et al., 2013; Hertenstein et al., 2018; Judd et al., 2013). A better understanding of specific characteristics of the relationship between poor sleep and aggression could support targeted treatment of poor sleep, thereby contributing to reducing the risk of recurring violent behavior.

The aim of this study is to investigate the interrelation of poor sleep quality and self-reported as well as clinician-rated measures of aggression in a sample of male forensic psychiatric inpatients. More specifically, we will attempt to discriminate the specific association between sleep and aggression from the associations of general psychopathology with both sleep and aggression. Furthermore, we explore the relationship between poor sleep and several components of self-reported aggression. Based on earlier research, we hypothesize that poor sleep quality is related both to higher self-reported aggression and higher clinician-rated hostility, and that these relationships are not exclusively explained by psychopathology in general.

Method

Participants and procedure

Data were drawn from an ongoing prospective observational study in male adult forensic psychiatric inpatients, monitoring treatment outcomes at the Forensic Psychiatric Hospital in Assen, the Netherlands. The project has been approved by the local ethics committee (Hospital Ethics Committee, Isala Clinics in Zwolle, the Netherlands) and conducted in accordance with the Declaration of Helsinki.

The study design consists of yearly measurements on both self-reported and clinician-rated features, starting within three months upon admission and repeated for the duration of stay at the hospital. Patients were not approached in any of the following conditions: a minimum expected stay of less than one year, insufficient understanding of the Dutch language, severe mental disability (established or estimated IQ < 70), and severe current psychiatric dysregulation (i.e. requiring intensive care treatment including measures such as seclusion or restraint). Informed consent was obtained from all participants.

One hundred and eighty-four patients, admitted between October 2006 and October 2017, were able and willing to participate. Questionnaires on sleep, aggression, impulsivity and general psychopathology were completed by 166 participants; clinician-rated hostility score was available for 157 participants. Information concerning mental health status (DSM-IV classification: Diagnostic and Statistical Manual of Mental Disorders, 4th Edition) was obtained from the medical file.

Materials

Pittsburgh Sleep Quality Index (PSQI)

Sleep quality was assessed using the PSQI, a widely used self-report measure of overall sleep quality in the past month. It has been shown to be valid and

reliable in psychiatric populations (Buysse et al., 1989). The 19 items yield seven component scores reflecting subjective appreciation of sleep quality, sleep latency, sleep duration, habitual sleep efficiency, presence of sleep disturbing factors, use of sleep medication, and daytime dysfunction. Each component is represented by a value between 0 (no difficulty) and 3 (severe difficulty), summing up to a total score that ranges from 0 to 21. A cutoff total score of 5 (PSQI > 5) is clinically used to distinguish 'poor' from 'good' sleepers (Buysse et al., 1989). A higher total PSQI score is associated with worse overall sleep quality, and will be referred to as 'poor sleep quality' throughout this paper.

Aggression questionnaire (AQ)

Self-reported aggression was measured by the AQ (Buss & Perry, 1992). It consists of 29 items, scored on a 5-point scale ranging from 1 (extremely uncharacteristic for me) to 5 (extremely characteristic for me). Replicated factor analyses yielded four subscales: physical aggression, verbal aggression, anger and hostility. Subscale scores were summed to a total score ranging from 29 to 145, with higher total AQ scores indicating higher aggressiveness.

Historical clinical future-30 (Dutch abbreviation: HKT-30)

A single item of the risk assessment instrument HKT-30 (Projectgroup Risk Assessment in Forensic Psychiatry, 2003) was used to represent clinician-rated hostility. This item is characterized by a negative perception of others, resulting in a tendency to interpret neutral (social) situations with distrust and respond with irritation, anger or aggression. It is scored from 0 to 4, with higher scores indicating higher hostility.

The HKT-30 is based on the Historical Clinical Risk-20 (Douglas et al., 1999) and its total score is used to assess the risk of future violence in adult mentally-disordered offenders, based on observations during the preceding months (Canton et al., 2004).

Symptom checklist (SCL-90)

General psychopathology was measured by the SCL-90 (Derogatis & Melisaratos, 1983), a self-report symptom inventory covering several dimensions of psychiatric symptoms. It consists of 93 items summing up to a total SCL-90 score indicating general psychopathological symptom severity (range 0–372), with higher scores representing more severe complaints. Factor analyses generated eight subscales: anxiety, agoraphobia, depression, somatization, insufficient thinking and handling, distrust and interpersonal sensitivity, hostility and sleeping disorders. Multiple items in the SCL-90 assess symptoms of sleep problems, hostility and aggression, which correspond with the other variables of interest in the current study. We therefore chose to exclude the subscales hostility and sleeping disorders, and used an adjusted SCL-90 score in our analyses to indicate the 'general level of psychopathology'.

Analyses

Descriptive analyses were performed to describe the study population. First, we calculated bivariate correlations between all major variables. Subsequently, linear regression analyses were conducted using sleep quality (total PSQI score) as independent variable, and self-reported aggression (total AQ score) and clinician-rated hostility (item score) as dependent variables, respectively. Age and general psychopathology (adjusted SCL-90 score) were added as continuous variables to the crude models in two steps, to adjust for possible confounding. The relationship between sleep quality on the one hand and different components of self-reported aggression on the other was further explored by generating four separate linear regression models with the subscales of the AQ (physical aggression, verbal aggression, anger and hostility) as dependent variables. All analyses were performed with IBM SPSS Statistics 23.

Results

Descriptives

Sociodemographic characteristics and mental health status of the participants are shown in Table 1. Participants had a mean age of 35.0 ± 11.0 (SD) years, ranging from 19 to 66 years. Many were previously sentenced by the criminal court for a violent offence, such as (attempted) murder, manslaughter or (aggravated) assault. The majority was diagnosed with a history of

Table 1. Descriptive characteristics of the study group (n = 166).

	%
Sociodemographic characteristics	
Western European origin	90.4
Marital status single	92.2
No high school degree	33.7
Index offence	
Aggressive offence with fatal consequences	2.4
Aggressive offence without fatal consequences	32.5
Sexual assault	34.3
Arson	4.8
Property offence with violence	9.6
Property offence without violence	12.7
Mental health status	
Antisocial personality disorder	16.9
Personality disorder not otherwise specified with antisocial traits	41.0
Borderline personality disorder	6.6
Personality disorder not otherwise specified with borderline traits	18.1
Substance abuse disorder	65.1
Psychotic disorder	9.6
Autism spectrum disorder	10.2
Attention deficit hyperactivity disorder	17.5
Any mood or anxiety disorder (including posttraumatic stress disorder)	13.3
Mental retardation	4.2
Paraphilia	30.1

(comorbid) substance abuse disorder (alcohol 40.6%, drugs 47.2%) and/or antisocial personality disorder or traits thereof (57.9%).

Means, standard deviations and bivariate correlations of PSQI (total and subscale scores), AQ (total and subscale scores) and SCL-90 are summarized in [Table 2](#). A total of 80 participants (48%) could be indicated as poor sleepers using the cutoff total score of 5 (PSQI > 5). A substantial proportion reported difficulties falling asleep (27.1%) or waking up during the night (29.5%) for more than three times a week on average. Regular use of sleep promoting medication (> three times a week) was indicated by 24.7% of participants. Overall sleep quality was rated as fairly bad/very bad by 26.5%.

Relationship between sleep quality and aggression

The results of both the crude and adjusted regression models are shown in [Table 3](#). Poor sleep quality significantly predicted higher self-reported aggression, accounting for 14.5% of the variance. A moderately strong partial correlation ($r = 0.26$) between sleep quality and self-reported aggression remained after controlling for age and general psychopathology. As expected, general psychopathology showed a moderately strong partial correlation with self-reported aggression as well ($r = 0.36$).

Poor sleep quality was significantly associated with clinician-rated hostility as well, but sleep quality hardly explained any of the variance in hostility (adjusted $R^2 = 0.021$). The relationship between sleep quality and clinician-rated hostility was preserved, but lost significance when by adding general psychopathology to the model.

Additional exploration of the association of sleep quality score with subscales of self-reported aggression revealed that poor sleep quality was positively associated with all four aggression subscales (physical aggression, verbal aggression, anger and hostility) ([Table 4](#)). All relations remained significant when adjusting the models for age and general psychopathology. Sleep quality accounted for 7.0% of the variance in physical aggression, 5.5% of the variance in verbal aggression, 12.0% of the variance in anger and 11.8% of the variance in hostility.

Discussion

This is the first study in forensic psychiatric patients examining the relationship between sleep quality and measures of aggression while controlling for general psychopathology. Results concerning both self-reported aggression and clinician-rated hostility support the outcomes of previous research in a similar population (Kamphuis et al., 2014), showing that poor sleep quality is linked to both higher self-reported aggression and higher clinician-rated hostility. Importantly, the present study revealed that the association

Table 2. Means, standard deviations and bivariate correlations between (components of) sleep quality, aggression and general psychopathology.

	mean ± SD	PSQI total	Sleep quality	Sleep duration	Sleep latency	Sleep efficiency	Sleep disturbing factors	Sleep medication	Daytime dysfunction	SCL total
AQ total	79.81 ± 20.30	6.23 ± 4.35	1.06 ± 0.88	0.59 ± 0.92	1.29 ± 1.10	0.51 ± 0.90	1.07 ± 0.60	0.83 ± 1.30	0.89 ± 0.80	—
AQ physical	25.69 ± 9.70	0.39**	0.33**	0.27**	0.21**	0.14	0.37**	0.29**	0.24**	0.46**
AQ verbal	14.05 ± 3.18	0.28**	0.17*	0.19*	0.15	0.14	0.28**	0.26**	0.12	0.21**
AQ anger	18.42 ± 5.46	0.25**	0.23**	0.21**	0.10	0.10	0.25**	0.22**	0.10	0.24**
AQ hostility	21.65 ± 6.92	0.35**	0.32**	0.24**	0.21**	0.07	0.32**	0.29**	0.27**	0.41**
Clinician-rated hostility	1.34 ± 0.97	0.17*	0.37**	0.22**	0.20*	0.13	0.33**	0.17*	0.31**	0.61**
SCL total	60.26 ± 45.04	0.37*	0.32**	0.17*	0.27**	0.06	0.14	0.21**	0.03	0.13
							0.44**	0.24**	0.34**	—

* p < 0.05; ** p < 0.01

PSQI = Pittsburgh Sleep Quality Index; AQ = Aggression Questionnaire; SCL = Symptom Checklist-90
n = 166, except for clinician-rated hostility n = 157

Table 3. Linear regression models of the associations of sleep quality with self-reported aggression and clinician-rated hostility.

	Self-reported aggression (n = 166)						Clinician-rated hostility (n = 157)					
	<i>B</i>	SE	β	p	<i>r</i>	adj. R^2	<i>B</i>	SE	β	p	<i>r</i>	adj. R^2
crude model	1.78	0.33	0.39	0.000	0.39	0.15	0.04	0.02	0.17	0.04	0.17	0.02
adj. model ¹	1.72	0.32	0.38	0.000	0.39	0.20	0.04	0.02	0.16	0.04	0.17	0.02
adj. model ²	1.13	0.33	0.25	0.001	0.26	0.30	0.03	0.02	0.14	0.10	0.17	0.02

¹adjusted for age²adjusted for age and general psychopathology*B* = regression coefficient, unstandardized; SE = standard error β = regression coefficient, standardized; p = p-value; *r* = (partial) correlation coefficientadj. R^2 = (adjusted) explained variance

between sleep quality and self-reported aggression remained highly significant when controlled for general psychopathology. In other words, the association between poor sleep and aggression is unique and not better accounted for by the general level of psychopathology. We know of only two studies in other populations, using a similar dimensional approach when assessing the influence of other psychopathology on the association between poor sleep and aggression. A study in jail inmates showed several associations between self-reported sleep problems and symptoms of borderline and antisocial personality disorder, like affect instability, self-harm and antisocial behavior (Harty et al., 2010). When controlling for mutual correlations with symptoms of depressive disorder and substance abuse disorder, only the correlation between sleep problems and symptoms of borderline personality remained significant. Correlations between sleep problems and psychopathic personality characteristics, such as egocentrism and a lack of empathy or remorse, were absent. This is notable as almost all other personality traits have been found to show clear correlations to sleep problems (see for example, Dekker et al., 2017). It may be that low levels of emotional reactivity protect against the development of sleep disturbances. A large population study supports this hypothesis, showing that the relationship between poor sleep quality and externalizing behaviors was moderated by callous-unemotional traits (Denis et al., 2017). Callousness was in itself not related to poor sleep and participants with higher levels of callous-unemotional traits exhibited a weaker association between externalizing behavior and poor sleep quality, apparently because of lower anxiety levels. Different aspects of disruptive behavior (aggression, externalizing behavior, impulsivity, and lack of empathy) might therefore require a different treatment approach, especially in relation to sleep difficulties.

Previous studies repeatedly found relations between poor sleep quality and self-reported hostility (Taylor et al., 2013; Tsuchiyama et al., 2013),



Table 4. Linear regression models of the associations of sleep quality with components of self-reported aggression (n = 166).

	Physical aggression					Verbal aggression					Anger					Hostility				
	B	SE	β	p	r	adj. R^2	B	SE	β	p	r	adj. R^2	B	SE	β	p	r	adj. R^2		
crude model	0.61	0.17	0.28	0.000	0.28	0.07	0.18	0.05	0.25	0.001	0.25	0.06	0.44	0.09	0.35	0.000	0.35	0.12	0.55	
adj. model ¹	0.57	0.16	0.26	0.000	0.28	0.18	0.17	0.05	0.24	0.002	0.24	0.11	0.43	0.09	0.35	0.000	0.35	0.14	0.55	
adj. model ²	0.47	0.17	0.21	0.006	0.22	0.19	0.13	0.06	0.19	0.02	0.18	0.12	0.29	0.09	0.23	0.002	0.24	0.22	0.24	

¹ adjusted for age

² adjusted for age and general psychopathology

B = regression coefficient, unstandardized; SE = standard error

β = regression coefficient, standardized; p = p-value; r = (partial) correlation coefficient

adj. R^2 = (adjusted) explained variance

consistent with our results. Self-reported hostility is even indicated as one of the most important aggression components relating to sleep problems (Ireland & Culpin, 2006). Indeed, sleep quality explained approximately 12% of the variance in both self-reported hostility and anger in our sample. In contrast, only 2% of the variance in clinician-rated hostility was accounted for by sleep quality. This finding may primarily reflect psychometric differences between the self-reported aggression and clinician-rated hostility measures. The AQ score is a full, continuous scale, whereas clinician-rated hostility is a single item scored on a 5-point scale which limits its variability. In other words, the clinician rating is a rather coarse categorization of hostility which is not very sensitive to other influencing variables. This could explain both the difference in the explained variance by sleep quality between the self-reported aggression and clinician-rated hostility measure, as well as the fact that the regression coefficient for clinician-rated hostility was hardly altered by adding age and psychopathology to the model. Future studies including clinician-rated measures should explore the possibilities of using an instrument assessing a broader and more refined scale of hostile and aggressive behavior.

It has been suggested that it is particularly the perception of sleep quality that, as opposed to the more quantitative features of sleep, is strongly related to hostility and aggressive tendencies (Barker et al., 2016; Tsuchiyama et al., 2013). The belief to have slept poorly might subsequently influence cognitions and emotions throughout the day, leading to further negative bias of experiences. Such aspects undoubtedly play a role in our forensic sample, where higher than average levels of hostility and anger are to be expected. However, by adding general psychopathology to the relationship between sleep quality and aggression, we provide some correction for a possible tendency to inflate or over-report symptoms due to negative affect and cognitions.

Strengths and limitations

Overall, this study addresses an essential clinical issue in a representative sample of forensic psychiatric patients with diverse psychopathology. Especially the use of a dimensional approach of sleep and psychopathology, instead of diagnostic categories, can be considered a strength of the study. Several limitations of this study should be noted. First, the cross-sectional design of this study does not allow conclusions with respect to the direction of the relationship between disturbed sleep and aggressive behavior. In other words, the current results do not allow a causal inference. The relation between sleep on the one hand and impulsive or aggressive behavior on the other, is hypothesized to be bidirectional (Kahn et al., 2013; Krizan & Herlache, 2016). As mentioned in the introduction, sleep disturbances

influence emotion regulation and self-control. Reversely, the consequences of hostile thoughts and impulsive or aggressive behavior during the day could result in elevated stress or hyperarousal, leading to disturbed sleep (Kim & Dimsdale, 2007; Wassing et al., 2016). This, in turn, will further deteriorate the ability to regulate thoughts, emotions and behavior during the subsequent day, creating a vicious circle. Future longitudinal designs could shed more light on specific aspects of causality between poor sleep and aggression, regarding both day-to-day and more persistent effects. Second, the process of inclusion – and exclusion inevitably leads to some form of selection bias. Patients with severe current psychiatric dysregulation shortly after admission could not be approached, excluding a subgroup with current aggressive behavior. No detailed information on sleep or behavioral characteristics was available from these subgroups, making it difficult to assume the possible influence on the study outcomes. Third, the use of different types of psychoactive medication might affect the relation between sleep and aggression, for example, by numbing emotional responses, promoting or disrupting sleep or impacting aggression levels. We were not able to retrospectively obtain this information for individual participants and thus couldn't control for the possible influence of medication use. Fourth, we used self-reported sleep quality as a general measure of disturbed sleep. It must be kept in mind that poor or disturbed sleep might encompass a wide array of sleep disorders (such as insomnia, nightmare disorder, or sleep-related movement disorders) and that our results can not be directly extrapolated to the effects of such sleep disorders on aggression.

Implications

There are several important implications considering treatment possibilities and future research. Our results both confirm and expand previous findings on the link between poor sleep and aggression, by specifically looking into how these two variables are intertwined in a clinical psychiatric population. Future studies should focus on further unravelling the pathways through which sleep and aggression are related, for instance, by performing longitudinal (mediation) analyses in clinical samples. Theories integrating the factors that influence aggressive behavior, like the general aggression model (C. A. Anderson & Bushman, 2002) or I³ theory (Slotter & Finkel, 2011), provide a framework to elaborate on the possible pathways linking sleep loss and aggression. Amplification of negative affect, increase of hostile perception and impairment of impulse control have been proposed as different ways in which disturbed sleep could be related to aggression (Krizan & Herlache, 2016). Some of these pathways have already been explored, for instance, self-control has been found to be mediating the relation between poor sleep and marital aggression in a cross-sectional study (Keller et al.,

2017). Special attention should be focused on the course of such pathways in individual patients with more severe forms of psychopathology and behavioral disturbance, such as those with impulse control disorders or psychopathic traits.

Considering the proven association between poor sleep and aggression, we recommend clinicians in forensic (or similar) populations to actively screen for and treat sleep disturbances. Insomnia is very prevalent in forensic populations (Kamphuis et al., 2013; Van Veen et al., 2017) and may be successfully treated by cognitive behavioral therapy for insomnia (CBT-I) (Qaseem et al., 2016). Although larger studies on the effect of treatment of sleep problems on aspects of aggression are lacking, there is some evidence that treatment of poor or short sleep positively affects emotion regulation and aggressive tendencies (Haynes et al., 2006; Motomura et al., 2017). It would be of great value to combine self-report and external assessments of sleep and aggression, like actigraphy and neuropsychological tasks, when conducting research on treatment of sleep problems in forensic psychiatry. Understanding the intricate relationship between poor sleep and aggression can enable more targeted treatment and may thus have an important impact on reducing recidivism risk reduction in forensic psychiatric patients by enhancing affective stability and self-control.

Disclosure statement

No potential conflict of interest was reported by the authors

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