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Original Article

Poor sleep quality at baseline is associated with increased aggression over one year in forensic psychiatric patients

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ABSTRACT

Objective: In forensic psychiatric patients, sleep problems as well as impulsivity and aggression are highly prevalent, yet studies on their association over time are lacking. This study investigates the association between sleep quality and changes in impulsivity and aggression in forensic psychiatric patients over one year.

Methods: Data were drawn from an ongoing prospective observational study in adult forensic psychiatric patients admitted to a forensic treatment facility between October 2006 and January 2018. Validated self-reports and observational instruments were used to assess sleep quality, impulsivity and aggression upon admission to the hospital and after one year. Linear regression analyses were performed to examine the association between sleep quality, impulsivity and aggression. All models were adjusted for baseline values of outcome measures, demographic features and general psychopathology.

Results: Data from 83 men (age 37.7 ± 11.7 years) with completed consecutive measurements were analyzed. Poor sleep quality was associated with increased self-reported aggression (β = 1.08; 95% CI, 0.38−1.78). This association was positively confounded by general psychopathology, indicating that sleep quality is specifically related to self-reported aggression instead of being part of general psychopathology (adjusted β = 1.18; 95% CI, 0.39−1.97). Poor sleep quality was not associated with changes in self-reported impulsivity, clinician-rated impulsivity or clinician-rated hostility in this population.

Conclusion: Poor sleep quality was associated with an increase in self-reported aggression over one year in male forensic psychiatric patients. Early evaluation and treatment of sleep problems in (forensic) psychiatric patients may play an important role in reducing the risk of aggressive behavior.

1. Introduction

The importance of sleep for optimal psychological functioning is well established [1], with an abundance of research reporting on the negative impact that poor sleep quality has on cognitive and affective processes [2–4]. Rather than being merely related to psychopathology [5,6], poor sleep quality has been recognized to be a major risk factor for the emergence and relapse of several psychiatric disorders, such as depression, psychosis and substance abuse disorders [7].

Relatively little attention has been given to the role of poor sleep quality in disruptive behavior (eg, aggression). Aggression is defined as behavior intended to inflict harm on another who is motivated to avoid being harmed [8], and is associated with various psychiatric disorders [9,10]. Several processes play a role in the actual occurrence of aggression [11], which are influenced by situational and personal factors such as hostile thoughts, anger and impulsivity [12].

To date, research has demonstrated cross−sectional associations between disturbance in sleep and aggressive behavior [13]. Both poor sleep quality and shorter sleep duration are related to

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enhanced aggression in the general population [14–16] as well as in patients with psychiatric disorders [17–19]. Furthermore, experimental studies showed reduced emotional inhibition, increased hostility and higher tendencies to blame others following sleep deprivation [20,21]. Moreover, treatment of sleep disturbances reduced levels of aggression [22,23].

In forensic psychiatry, sleep problems, impulsivity and aggressive behavior are all highly prevalent [24–26]. The forensic population consisted of patients suffering from a variety of psychiatric disorders, who have previously committed a criminal offense. The association between poor sleep quality and aggression in this high risk population is supported by cross-sectional data from studies in general prison inmates [27–29]. Studies on the association between poor sleep quality and aggression in forensic psychiatric samples were largely absent, until cross-sectional work from our research group linked poor sleep quality to self-reported impulsivity and aggression, clinician-rated hostility and the actual occurrence of aggressive incidents in forensic psychiatric inpatients [30,31].

Reducing the risk of recurring violent behavior is of paramount importance in forensic psychiatric treatment, and poor sleep quality might be a very specific risk factor to target in this population. Thus, a deeper understanding of the temporal association between poor sleep quality and aggressive behavior in the forensic population would be beneficial, however, to our knowledge there are no prospective studies in this field. The aim of the current study was to investigate the association between sleep quality and changes in impulsivity and aggression in male forensic psychiatric patients over one year. We hypothesized that poor sleep quality at baseline would be related to increased impulsivity and aggression over time.

2. Method

2.1. Study design and population

Data were drawn from an ongoing prospective observational study in adult forensic psychiatric inpatients, monitoring treatment outcomes at a forensic psychiatric hospital in the Netherlands. The study design consists of yearly measurements on both self-reported and observational clinical features, starting within three months upon admission and repeated for the duration of stay at the hospital. Data from participants who have completed two consecutive measurements, both at baseline and one-year follow-up, were analyzed. The study has been approved by the local medical ethical committee and written informed consent was obtained from all participants.

The population included all patients admitted to our residential forensic facility between October 2006 and January 2018. Our study was comprised of men and women who committed a crime or were at risk of committing a crime under the influence of mental disorders, and were receiving psychiatric treatment in medium to high secure units. Exclusion criteria for participation in the general study were: 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 (ie, requiring intensive care treatment including measures such as seclusion or restraint). A total of 184 patients were able and willing to participate (response rate 37%). Because less than 5% of patients in the sample were women, compromising the statistical robustness of possible corrections, we excluded them from further analyses. No additional exclusion criteria were present for the current analysis. A number of 83 participants had data at baseline and one-year follow up.

2.2. Measures

2.2.1. Sleep quality

The Pittsburgh Sleep Quality Index (PSQI) was used as a continuous measure of sleep quality at baseline and after one year. The PSQI is one of the most commonly used generic measure of self-reported sleep quality in clinical and research settings, evaluating several characteristics of sleep and sleep-related symptoms over the past month. It has been shown to be valid and reliable in psychiatric populations [32]. The total score ranges from 0 to 21. A higher total PSQI score is associated with worse overall sleep quality, and will be referred to as “poor sleep quality” throughout this paper.

2.2.2. Self-reported impulsivity

The Barratt Impulsiveness Scale (BIS) was used to assess self-reported impulsivity at baseline and after one year. The BIS is a self-report measure of the multi-faceted personality/behavioral construct of impulsivity and widely administered in both research and clinical settings [33]. It has been validated in several populations, including psychiatric patients and prisoners (for a review see Stanford et al., [34]). The BIS consists of 30 items scored on a 4-point scale, which are added up to yield a total impulsiveness score (range 30–120). Higher BIS scores indicate higher impulsivity.

2.2.3. Self-reported aggression

The Aggression Questionnaire (AQ) was used to measure self-reported aggression at baseline and after one year. It is an extensively used instrument tapping into several aspects of aggression (eg, anger, hostility and verbal or physical aggression) [35], and has been validated in different populations [36], including offenders [37]. The AQ consists of 29 items scored on a 5-point scale, which are added up to yield a total aggression score (range 29–145). A higher total AQ score indicates higher aggressiveness.

2.2.4. Clinician-rated impulsivity and aggression

The Historical Clinical Future-30 (Dutch abbreviation: HKT-30) was used to obtain a clinician-rated measure of impulsivity and aggression at baseline and after one year. The HKT-30 is comparable to the Historical Clinical Risk-20 [38]. It is used to assess the risk of future violence in adult mentally-disordered offenders and is validated in Dutch forensic psychiatric patients [39,40]. The HKT-30 is filled out yearly by the responsible clinicians, based on their patient observations during the preceding months. It comprises 11 static and 19 dynamic risk factors that are scored from 0 to 4, with higher scores indicating higher risk. In this study, two single items representing dynamic risk factors were used: impulsivity and hostility. There are several pros and cons to consider regarding the (non-) normal distribution of 5-point scales [41], after careful deliberation we decided to treat both HKT-30 items as continuous variables because transformation and other possible analysis adjustments usually do not ameliorate the reliability of results [42].

2.3. Possible confounders

Information concerning age, marital status, ethnicity, education level, offense type and mental health status (DSM classification) was obtained from the medical file at baseline. Age (continuous), marital status (single or divorced/married or living together), ethnicity (Western European/other), education level (elementary school only/higher education) and general psychopathology score (continuous) were used as covariates to correct for possible confounding, as they are often identified in literature influencing sleep quality, impulsivity and aggression.

2.3.1. General psychopathology

The Symptom Checklist (SCL-90) [43] was used to measure general psychopathology at baseline. The SCL-90 has been validated for treatment evaluation in psychiatric populations [44]. It is a self-report symptom inventory consisting of 93 items, scored on a 5-point Likert scale, which sum up to a total score indicating general psychological symptom severity. Factor analyses generated eight subscales: anxiety, agoraphobia, depression, somatization, insufficient thinking and handling, distrust and interpersonal sensitivity, hostility and sleep problems. As the subscales hostility and sleep problems correspond with the other variables of interest in the current study, we chose to exclude these subscales and used an adjusted SCL-90 score in our analyses to indicate the level of general psychopathology. We explored the possible influence of this adjustment, and found no relevant differences in results by using either the adjusted or original SCL-90 score. Because both poor sleep and aggression are highly correlated with psychopathology in general [7,45,46], general psychopathology score was added to the analyses to correct for possible confounding.

2.4. Statistical analyses

Descriptive analyses were performed to describe the study population. Differences between participants with and without one-year follow up were evaluated by t-tests to assess possible selection bias. The amount of single missing items in the completed questionnaires was minimal (<0.1%) and replaced by non-missing subscale means. The distributions of all continuous outcome variables were checked for normality and found to be acceptable.

To assess the association between sleep quality and change in measures of impulsivity and aggression, sleep quality at baseline and level of each outcome variable at baseline were added as continuous independent variables to a linear regression model with each continuous outcome variable at one year follow up, separately. A stepwise approach was taken, first generating results for crude models, then models adjusted for age, marital status, ethnicity and education level, and finally models adjusted for age, marital status, ethnicity, education level and general psychopathology. All independent variables were tested for a linear association with the accompanying dependent variables. Those who did not meet the linearity assumption were added to the regression models as dummy variables representing tertiles. All statistical analyses were performed with IBM SPSS Statistics for Windows, version 23.0 (Armonk, NY: IBM Corp), and P values < 0.05 were considered to indicate statistical significance.

3. Results

Several significant differences were observed between those with (n = 83) and without (n = 87) one-year follow up (t-tests). The group without follow up data was younger, reported poorer sleep quality and more aggression, and were rated by clinicians as more impulsive (data not shown). Sociodemographic characteristics and clinical characteristics of the study sample with one-year follow up are described in Table 1. Many participants were diagnosed with more than two different psychiatric disorders (n = 54, 65.1%). The majority was sentenced by the criminal court for several types of sexual crimes (n = 45, 54.2%) and a large proportion for a violent offense (n = 30, 36.1%), such as (attempted) murder or assault.

Mean sleep quality score, self-reported impulsivity, self-reported aggression and general psychopathology all decreased over one year time: −0.39 ± 2.42 (range -7 − 9); −5.84 ± 8.35 (range -31 − 16); −3.53 ± 13.16 (range -43 − 32) and −16.52 ± 36.13 (range -109 − 94), respectively. Changes in mean clinician-rated impulsivity (−0.12 ± 0.8 (range -3 − 2)) and mean clinician-rated hostility (0.06 ± 0.9 (range -1 − 4)) were minimal.

Table 1
Descriptive characteristics of the study population of forensic psychiatric inpatients (n = 83)[a].

Variable	
Male sex	83 (100)
Age (years, range 18–63)	37.7 ± 11.7
Western European origin	79 (95.2)
Marital status single	74 (89.1)
No high school degree	24 (28.9)
Antisocial personality disorder	8 (9.6)
Personality disorder not otherwise specified, antisocial traits	35 (42.2)
Borderline personality disorder	7 (8.4)
Personality disorder not otherwise specified, borderline traits	14 (16.9)
Substance abuse disorder	46 (55.4)
Psychotic disorder	3 (3.6)
Autism spectrum disorder	10 (12.0)
Attention deficit hyperactivity disorder	11 (13.3)
Any mood or anxiety disorder	10 (12.0)
Mental retardation	5 (6.0)
Paraphilia	35 (42.2)
Sleep quality (PSQI score, range 0–20)	5.5 ± 3.9
Self-reported impulsivity (BIS score, range 42–109)	63.9 ± 12.2
Self-reported aggression (AQ score, range 42–121)	75.0 ± 18.4
Clinician-rated impulsivity (HKT-30 item K4 score, range 0–4)	1.5 ± 1.1
Clinician-rated hostility (HKT-30 item K6 score, range 0–4)	1.2 ± 0.9
General psychopathology (SCL-90 score, range 6–211)	61.0 ± 44.0

Abbreviations: PSQI = Pittsburgh Sleep Quality Index, BIS = Barratt Impulsiveness Scale, AQ = Aggression Questionnaire, HKT-30 = Historical Clinical Future-30. SCL-90 = Symptom Checklist 90 (adjusted).
[a] Categorical data are presented as n (%), continuous data are presented as mean ± SD.

3.1. Associations between sleep quality at baseline and change in self-reported impulsivity and aggression

Poor sleep quality at baseline was significantly associated with the change in self-reported aggression over one year (β = 1.08; 95% CI, 0.38–1.78) (Table 2). This result suggests that with lower sleep quality participants experienced themselves as more aggressive over time. The association between sleep quality and self-reported aggression was not confounded by age, marital status, ethnicity or education level, but the association strengthened when correcting for general psychopathology (adjusted β = 1.18; 95% CI, 0.39–1.97). Poor sleep quality at baseline was not associated with the change in self-reported impulsivity over one year.

3.2. Associations between sleep quality at baseline and change in clinician-rated impulsivity and hostility

The association between sleep quality and clinician-rated impulsivity and hostility was not linear; consequently sleep quality was added to the regression models as dummy variables representing tertiles. Poor sleep quality at baseline was not associated with the change in clinician-rated impulsivity or hostility over one year (Table 2). These results suggest that observational measures of impulsivity and hostility were not linked to self-reported sleep quality.

4. Discussion

The aim of our study was to investigate the association between sleep quality and changes in impulsivity and aggression in male forensic psychiatric patients over one year. This study is the first to assess the longitudinal association between poor sleep and several measures of impulsivity and aggression in a forensic population.

Table 2
Linear regression models predicting self-reported (A) and clinician-rated (B) impulsivity and aggression after 1 year.

A	Model		Self-reported impulsivity	Self-reported aggression
	1	Sleep quality PSQI	0.06 (−0.30–0.43)	**1.08 (0.38–1.78)**
	2	Sleep quality PSQI	−0.01 (−0.37–0.36)	**1.02 (0.30–1.74)**
	3	Sleep quality PSQI	0.15 (−0.23–0.53)	**1.18 (0.39–1.97)**
B	Model		Clinician-rated impulsivity	Clinician-rated hostility
	1	Lowest tertile sleep quality PSQI	Reference	Reference
		Middle tertile sleep quality PSQI	−0.09 (−0.50–0.32)	−0.17 (−0.59–0.26)
		Highest tertile sleep quality PSQI	0.08 (−0.33–0.50)	0.13 (−0.30–0.55)
	2	Lowest tertile sleep quality PSQI	Reference	Reference
		Middle tertile sleep quality PSQI	−0.06 (−0.48–0.37)	−0.29 (−0.70–0.15)
		Highest tertile sleep quality PSQI	0.13 (−0.31–0.57)	−0.02 (−0.44–0.40)
	3	Lowest tertile sleep quality PSQI	Reference	Reference
		Middle tertile sleep quality PSQI	−0.06 (−0.49–0.38)	−0.27 (−0.69–0.15)
		Highest tertile sleep quality PSQI	0.13 (−0.40–0.65)	0.04 (−0.46–0.54)

Model 1: adjusted for baseline value of outcome variable.
Model 2: adjusted for baseline value of outcome variable, age, marital status, ethnicity and education level.
Model 3: adjusted for baseline value of outcome variable, age, marital status, ethnicity, education level and general psychopathology.
Abbreviations: PSQI = Pittsburgh Sleep Quality Index.
Results presented as β-estimates (95% CI).
$P < 0.01$ in bold.

Poor sleep quality at baseline was found to be associated to an increase in self-reported aggression over one year. This association was strengthened by correcting for general psychopathology, which indicates that sleep quality is in itself is associated to self-reported aggression, rather than it simply being part of general psychopathology. For the reported changes in self-reported impulsivity, clinician-rated impulsivity and clinician-rated hostility, no robust associations with poor sleep quality at baseline were observed.

Our findings are in line with previous longitudinal studies in children [15,47–50], which showed that sleep problems at an early age predict emotional and behavioral problems in adolescence, including aggression and delinquency. Although caution must be taken to compare these findings in children to those in adults, the direction and extent of the association between poor sleep and increased aggression over time were similar to our results. In contrast, we did not observe longitudinal associations of sleep quality with self-reported impulsivity, clinician-rated impulsivity or clinician-rated hostility. We are not aware of any longitudinal studies in adults focused on impulsivity in relation to poor sleep, but several studies in children and adolescents link sleep problems to an increase in impulsive behavior, including sensation seeking and substance abuse [48,51,52]. In light of our negative results, we believe there are three important psychometric aspects to consider. First, previous publications have linked aspects of impulsivity (eg, risk taking, emotional inhibition, self-control) to poor sleep quality in both experimental and cross-sectional studies [14,21,27,53–55]. The outcome measures used in these studies cover both state and trait impulsivity, depending on the type of study. In our study, we used the BIS which can be regarded as a measure of trait, rather than state, impulsivity [33]. Although we have shown poor sleep quality to be associated to self-reported trait impulsiveness in cross-sectional studies [30,31], the BIS may not be the optimal instrument to assess changes in impulsivity in relation to sleep quality, because of limited variability over time. Second, long-term hospitalization in this forensic patient group might also affect BIS variability, considering the fact that questions addressing behavior predominantly associated with active societal involvement (eg, "I plan trips well ahead of time, I change jobs/residencies, I plan for job security) may be scored consistently low. Third, we used observational measures of impulsivity and hostility to complement the self-report measures. The HKT-30 is well validated to assess changes in general recidivism risk, but we used two single items representing our variables of interest instead of the total risk assessment score. The negligible mean change in these two items over one year reduced the possibility of detecting an association with poor sleep.

The association between sleep quality and impulsive or aggressive behavior is hypothesized to be bidirectional [2,56]. Poor sleep influences emotion regulation and self-control, and reversely, impulsive or aggressive behavior during the day might result in elevated stress, leading to disturbed sleep [57,58]. This will further deteriorate the ability to regulate emotions and behavior during the subsequent day. However, the evidence for aggressive behavior influencing sleep quality is much less pronounced than vice versa [47,51]. Future longitudinal studies could shed more light on specific aspects and direction of causality between poor sleep quality and aggression, regarding both day-to-day and more persistent effects. Furthermore, theories integrating the factors that influence aggressive behavior, such as I^3 theory [11], provide a framework to elaborate on the possible pathways linking poor sleep and aggression. The amplification of negative affect, the increase of hostile cognitions and perceptions, and the impairment of self-inhibitory mechanisms have been proposed as different routes through which disturbed sleep could be associated to aggressive behavior [56], but have not yet been researched extensively. Our results provide strong support for at least two of such pathways; namely an increase in anger and hostility as measured by the AQ in relation to poor sleep quality.

The main strengths of this study are the longitudinal design, appropriate adjustment for confounding and its naturalistic quality, including a forensic patient population with a diversity of mental health problems and ongoing treatments. However, several limitations of this study should be noted, apart from the relatively small sample size. First, although the study design is longitudinal in nature, to date we only had sufficient data on two consecutive measurements, one year apart. A longer follow-up period or more frequent measurements within one year could provide more detailed insight in the temporal relation between poor sleep and impulsivity and aggression. Second, there is a selection bias in the sample used in the current longitudinal analyses. Participants without follow-up data were slightly younger and had higher average scores on sleep quality and several measures of impulsivity and aggression, which might indicate more severe pathology. The

effects of this bias on the generalizability of our results to the entire forensic population are hard to predict, considering the multitude of reasons for lack of follow-up eg, withdrawal of consent, early transfer to another facility or alterations in severity of concurrent mental disorders. Third, the use of different types of psychoactive medication might affect the association between sleep and aggression, for example by promoting or disrupting sleep, or impacting aggression levels. We were not able to retrospectively obtain information on medication use for individual participants and thus could not control for medication. As medication is often used in this population, including hypnotics or antipsychotics, which may improve sleep quality or aggression levels, this would suggest that our results might even be an underestimation of the association. Finally, we used a very general measure of sleep quality and cannot discern the possible impact of specific sleep disorders, such as insomnia or sleep apnea, on impulsivity and aggression over time. The PSQI evaluates several characteristics of sleep and sleep-related symptoms, including symptoms of insomnia, snoring, breathing difficulties and daytime fatigue. Symptoms of any specific sleep disorder would therefore contribute to a higher total PSQI score and, considering our results, be a risk factor for increased aggression. Rather than excluding comorbid sleep disorders as risk factors, we (at least partly) included them as a cause of low sleep quality. We expected poor sleep quality to be associated to increased aggression and impulsivity over one year, irrespective of the possible cause or causes of poor sleep quality.

Because of its clear association with increased self-reported aggression, our results provide a solid foundation for diagnosing and treatment of poor sleep quality in forensic psychiatric patients. Sleep quality could be an important and tangible factor to target in reducing the risk of violent behavior. The fact that several small studies in healthy volunteers [59] and (forensic) psychiatric patients [22,23] indicate an improvement in emotional regulation and aggression following treatment of sleep problems seems promising and calls for larger randomized trials.

Conflict of interest

No potential conflict of interest was reported by the authors.

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: https://doi.org/10.1016/j.sleep.2019.11.1183.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.sleep.2019.11.1183.

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