Chapter 4
Disturbed sleep as a risk factor for aggression in prisoners with a psychotic illness: a brief report

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ABSTRACT

The objective of the present study is to examine whether a relationship exists between disturbed sleep and aggression in nineteen male prisoners with a psychotic illness, incarcerated in the Penitentiary Psychiatric Centre (PPC) in Amsterdam, the Netherlands. The sleep-wake rhythm was indirectly assessed by means of actigraphy. The results show that nocturnal restlessness was a significant predictor of aggression/agitation with a large effect size ($R^2 = .639$, Adjusted $R^2 = .536$). It was concluded that future research should focus on nocturnal restlessness as a possible cause of aggression in this population.
INTRODUCTION

Mental disorders are more common in the prison population than in the general population. Psychosis and schizophrenia, for example, were found to be highly prevalent in prisons. A prevalence of 4% was found for psychotic illnesses (e.g. schizophrenia, schizophreniform disorder, psychosis and delusional disorder), against 1% in the general population. There is also a high prevalence of other disorders, such as major depression (10-12%) and rates as high as 40-70% for various personality disorders.

In several prisons around the world, separate wards have been created for prisoners with psychiatric disorders. In the Netherlands, these wards are known as Penitentiary Psychiatric Centres (PPC). A major reason for confining prisoners to PPCs is severe problematic and disturbed behavior due to psychiatric disorders. Most of the prisoners in the PPCs exhibit aggressive behavior and suffer from psychoses or schizophrenia, which are disorders that can give rise to aggressive behavior.

In addition to the above suggested relationship between psychotic disorders and aggression, some known risk factors for aggression in this population include demographic or social factors, comorbid antisocial personality disorder and substance abuse. Furthermore, aggressive behavior may result from a decline in impulse control, which is a clinical hallmark of psychosis and schizophrenia. A decline in impulse control is closely related to nocturnal restlessness, and it is argued that disturbed sleep may be a causal factor in violence and aggression. A disturbed rest-activity rhythm, for example expressed in nocturnal restlessness, is indeed found in schizophrenia.

While many risk factors for violence in psychotic illnesses have been identified, studies focusing on sleep disturbances as potential risk factors for violence in this population are currently lacking. The goal of the present pilot study is therefore to examine the relationship between sleep disturbances and aggression in prisoners suffering from a psychotic illness. We hypothesize that a positive relationship exists between disturbed sleep and aggression in this population.
METHODS

Participants
In 2012, participants were recruited at the Penitentiary Psychiatric Centre Amsterdam (PPCA), which houses 140 patients, of which, in general, 60% is suffering from a psychotic illness (unpublished data from PPCA’s internal annual report 2011). Nineteen of these patients were willing and able to participate. These nineteen patients (age range: 19 to 54; M = 33.2, SD = 9.4) were diagnosed with schizophrenia (N = 9), psychotic disorder NOS (N = 9) and schizoaffective disorder (N = 1). Participants used antipsychotics (n = 10), benzodiazepines (n = 1) and antidepressants (n = 1). Comorbidities included substance abuse (n = 2), antisocial personality disorder (n = 2) and diabetes (n = 1).

The study was approved by the Scientific and Ethical Committee (VCWE) of the Faculty of Psychology and Education of VU University. All participants signed a written informed consent. The Custodial Institutions Agency did not allow us to offer any compensation for participation. Data used for analysis was anonymised.

Material

Sleep-wake rhythm
An Actiwatch, worn on the wrist like a watch for seven consecutive days, assessed the rest-activity rhythm (Cambridge Neurotechnology Ltd., Cambridge, England). It assesses the (in)stability of the rhythm between days (Inter-daily Stability; IS), the fragmentation of the rhythm within the day (Intra-daily Variability; IV), the difference between maximal activity and maximal rest (Relative Amplitude; RA), the 10 most active hours (M10), and the 5 least active hours (L5). For more information on these measures, see van Someren et al.7 Furthermore, an average counts-per-minute (CPM) value was calculated, as an indication of average activity for a chosen time window. Lastly, sleep efficiency (quality of sleep) was analysed.

Aggression
The Social Dysfunction and Aggression Scale (SDAS)8 is a behaviour observation scale that was filled in by the staff and was used to assess aggressive
behaviour in the participants. The SDAS contains 13 items, 9 of them focus on aggression (for further details, see Wistedt et al.⁸) It was possible to create a single aggression variable ('aggression domain'; Cronbach’s alpha = 0.90), with a minimum score of 0 and a maximum of 36.

**Procedure**

The Actiwatch was worn for 7 consecutive days. Thereafter, the staff, as a team, filled in the SDAS, being instructed to base their answers on the past week. The staff was blind to the Actiwatch data.

**Statistical analyses**

Version 7.23 of the Actiwatch Activity & Sleep Analysis 7 (Cambridge Neurotechnology Ltd.) was used for Nonparametric Circadian Rhythm Analyses (NCPRA) and for sleep analysis, resulting in a sleep efficiency percentage.⁷ As we, as well as the prison staff, considered this population incapable of reliably keeping a sleep diary, it was not possible to compute common actigraphy variables such as Total Sleep Time and Wake After Sleep Onset, etc. As an alternative, a custom method was devised based on the work of (and in cooperation with) van Someren et al.,⁷ to compute the 5 consecutive least active hours (L5) for each night, of which the start and end time were used to compute e.g. sleep efficiency. As a consequence, variables from sleep analysis thus cannot be compared directly with other studies, but can be used as predictors for aggression, which was our main goal in this study. Additional statistical analyses, i.e. descriptive statistics and regression analysis, were performed with IBM SPSS Statistics version 20.0. Level of significance was set at \( p < .05 \).

**RESULTS**

**Descriptive Statistics**

Descriptive statistics were calculated for the 5 NCPRA variables, average CPM between midnight and 7AM, standard deviation of L5 onset, sleep efficiency and for the aggression domain (Table 1).
Chapter 4

**Prediction of Aggression by Nocturnal Restlessness**

The main regression analysis uses CPM between midnight and 7AM sleep efficiency, standard deviation of L5 onset and antipsychotics as predictors of aggression. Regression analysis resulted in a significant model with a large effect size, $F(4,18) = 6.196$, $R^2 = .639$ (Adjusted $R^2 = .536$), $p = .004$. CPM between midnight and 7AM was the only significant predictor, $t(4, 18) = 3.945$, $p = 0.001$, with Beta = .877 ($B = 0.253$) and a semi-partial correlation of 0.634. The other three predictors were not significant, with all $p$-values > .557 and semi-partial correlations < .1. We used the bootstrap method in SPSS to compute a confidence interval around the B of CPM between midnight and 7AM. Using 20 000 samples, this resulted in $B = 0.253$, $p = .016$, and 95% CI [0.075 – 0.488].

### Table 1. Descriptive statistics

<table>
<thead>
<tr>
<th></th>
<th>L5</th>
<th>M10</th>
<th>IV</th>
<th>IS</th>
<th>RA</th>
<th>CPM(^{a})</th>
<th>SD L5(^{b})</th>
<th>SE(^{c})</th>
<th>AD(^{d})</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>M</strong></td>
<td>1378</td>
<td>24302</td>
<td>0.92</td>
<td>0.58</td>
<td>0.89</td>
<td>40.2</td>
<td>84</td>
<td>87.9</td>
<td>7.6</td>
</tr>
<tr>
<td><strong>SD</strong></td>
<td>1195</td>
<td>9635</td>
<td>0.25</td>
<td>0.13</td>
<td>0.08</td>
<td>26.4</td>
<td>53</td>
<td>5.0</td>
<td>7.6</td>
</tr>
</tbody>
</table>

\(^a\): Average CPM between Midnight and 7AM; \(^b\): Standard Deviation of L5 Onset, expressed in minutes, \(^c\): Sleep Efficiency, expressed in percentages; \(^d\): Aggression Domain
DISCUSSION

The main finding of the present study was the identification of a positive relationship between nocturnal restlessness and aggressive behavior, i.e. the more restless behavior at night, the more aggression/agitation during the day. It has recently been suggested that this relationship might be causal, as sleep deprivation results in reduced functioning of the prefrontal cortex, which is crucial to the inhibition of aggression.6

Sleep can be improved by physical activity,9 an important ingredient of enriched environment.10 Prison, however, is currently a clear example of an impoverished and sedentary environment, as prisoners spend most of their time sedentarily.11-13 Physical inactivity is characteristic for prison in various countries. The present finding of disturbed sleep as a potential risk factor for aggression in psychotic prisoners asks for a reconsideration of the current prison policy.

Limitations of this study include a small sample size, limiting the power of the analyses and the amount of analyses that could be done. As mentioned in the introduction, several risk factors for aggression have already been identified, e.g. demographic and social risk factors. Combining these already-known risk factors with actigraphy in a single study could provide significant insight and could even provide clinically useful knowledge in treatment of aggression in this difficult population, in which antipsychotics are currently the main method in reducing aggression.

A recent study by Vogler et al.14 using self-report measures of sleep and aggression, also found a significant relationship between sleep disturbances and aggression in non-psychiatric prisoners. Although our study is limited by the small sample size and the custom method that was used to compute variables such as sleep efficiency, it appears that the relationship between sleep and aggression is also present in psychiatric patients. In sum, although research in a prison setting using technical equipment with subjects suffering from severe mental illnesses is complicated, the present results warrant further research into the relationship between physical (in)activity, sleep and aggression in prisoners, both with and without psychiatric disorders.
REFERENCES


