Dissociative Symptoms are Highly Prevalent in Adults with Narcolepsy Type 1

Citation for published version (APA):

DOI:
10.1080/15402002.2021.1888729

Document status and date:
Published: 18/02/2022

Document Version:
Publisher’s PDF, also known as Version of Record (includes final page, issue and volume numbers)

Please check the document version of this publication:

• A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher’s website.
• The final author version and the galley proof are versions of the publication after peer review.
• The final published version features the final layout of the paper including the volume, issue and page numbers.

Link to publication

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

• Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
• You may not further distribute the material or use it for any profit-making activity or commercial gain.
• You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the “Taverne” license above, please follow below link for the End User Agreement:
www.tue.nl/taverne

Take down policy
If you believe that this document breaches copyright please contact us at:
openaccess@tue.nl
providing details and we will investigate your claim.
Dissociative Symptoms are Highly Prevalent in Adults with Narcolepsy Type 1

Laury Quaedackers, Hal Droogleever Fortuyn, Merel Van Gilst, Martijn Lappenschaar & Sebastiaan Overeem

To cite this article: Laury Quaedackers, Hal Droogleever Fortuyn, Merel Van Gilst, Martijn Lappenschaar & Sebastiaan Overeem (2022) Dissociative Symptoms are Highly Prevalent in Adults with Narcolepsy Type 1, Behavioral Sleep Medicine, 20:1, 63-73, DOI: 10.1080/15402002.2021.1888729

To link to this article: https://doi.org/10.1080/15402002.2021.1888729

© 2021 The Author(s). Published with license by Taylor & Francis Group, LLC.

Published online: 17 Feb 2021.

Submit your article to this journal

Article views: 1761

View related articles

View Crossmark data
Dissociative Symptoms are Highly Prevalent in Adults with Narcolepsy Type 1

Laury Quaedackers\textsuperscript{a,b}, Hal Droogleever Fortuyn\textsuperscript{c}, Merel Van Gilst\textsuperscript{a,d}, Martijn Lappenschaar\textsuperscript{c}, and Sebastiaan Overeem\textsuperscript{a,d}

\textsuperscript{a}Center for Sleep Medicine Kempenhaeghe, Heeze, The Netherlands; \textsuperscript{b}Department of Industrial Design, Eindhoven University of Technology, Eindhoven, The Netherlands; \textsuperscript{c}Department of Psychiatry, Radboud University Nijmegen Medical Center, Nijmegen, The Netherlands; \textsuperscript{d}Biomedical Diagnostics Group, Department of Electrical Engineering, Eindhoven University of Technology, Eindhoven, The Netherlands

**ABSTRACT**

**Introduction:** The core symptoms of narcolepsy such as excessive daytime sleepiness and cataplexy are well known. However, there is mounting evidence for a much broader symptom spectrum, including psychiatric symptoms. Disordered sleep has previously been linked with dissociative symptoms, which may imply that patients with narcolepsy are more prone to develop such symptoms.

**Objectives:** To investigate the frequency of dissociative symptoms in adult patients with narcolepsy type 1 compared to population controls.

**Methods:** In a retrospective case control study, sixty adult patients fulfilling the criteria for narcolepsy type 1 and 120 matched population control subjects received a structured interview using the Schedules for Clinical Assessment in Neuropsychiatry (SCAN) to assess dissociative symptoms and disorders.

**Results:** A majority of narcolepsy patients reported dissociative symptoms, and even fulfilled the DSM-IV-TR criteria of a dissociative disorder (62% vs 1% in controls, \( p < .001 \)). Most frequently reported symptoms were “dissociative amnesia” (37% vs 1%, \( p < .001 \)) and “dissociative disorder of voluntary movement” (32% vs 1%, \( p < .001 \)).

**Conclusion:** Dissociative symptoms are strikingly prevalent in adult patients with narcolepsy type 1. Although a formal diagnosis of dissociation disorder should not be made as the symptoms can be explained by narcolepsy as an underlying condition, the findings do illustrate the extent and severity of the dissociative symptoms. As for the pathophysiological mechanism, there may be symptom overlap between narcolepsy and dissociation disorder. However, there may also be a more direct link between disrupted sleep and dissociative symptoms. In either case, the high frequency of occurrence of dissociative symptoms should result in an active inquiry by doctors, to improve therapeutic management and guidance.

**Introduction**

Narcolepsy is a chronic neurologic sleep disorder with an estimated prevalence of 20–50 per 100.000 (Longstreth et al., 2007). It is caused by a deficiency of the hypocretin neuropeptides, most likely through an autoimmune process affecting the producing neurons in the dorsolateral hypothalamus (Kornum et al., 2017; Peyron et al., 2000; Thannickal et al., 2000).

Narcolepsy is primarily characterized by excessive daytime sleepiness and cataplexy. In addition, patients with narcolepsy experience disordered sleep in terms of fragmentation and abnormal
expressions of rapid eye movement (REM) sleep, such as rapid transitions into REM sleep, hypnagogic and hypnopompic hallucinations and sleep paralysis (Dauvilliers et al., 2007; Sturzenegger & Bassetti, 2004). Importantly, besides these “core” symptoms, patients often have other, not sleep-related complaints including obesity, fatigue, and psychiatric signs including anxiety and eating disorder symptoms (Canellas et al., 2014; Fortuyn et al., 2010, 2011, 2008; Lecendreux et al., 2015; Oosterloo et al., 2006).

Narcolepsy affects the life of patients in a broad sense, with a deleterious impact on education, recreation, driving, sexual functioning and personality, which in turn harms psychosocial wellbeing (Raggi et al., 2019). The prevalence of affective disorders in adults with narcolepsy may be as high as 35% (Fortuyn et al., 2010; Ohayon, 2013) and ADHD symptoms are often reported by both pediatric and adult patients (Kim et al., 2020; Plazzi et al., 2018).

The causes of the high prevalence of psychiatric signs and symptoms are still under discussion. First, the hypocretin system might play a direct role in the pathogenesis of psychiatric disorders. For example, most of the mood-related brain regions, such as the amygdala, striatum and prefrontal cortex, are widely innervated by hypocretin neurons and vice versa (Chen et al., 2015). Second, psychiatric symptoms may arise as a result of the burden narcolepsy poses on an individual (Stores et al., 2006).

Over the past two decades, studies have increasingly shown a relationship between disordered sleep and dissociation (Koffel & Watson, 2009; Lynn et al., 2019; Selvi et al., 2015; Van Der Kloet et al., 2013; Van Der Kloet, Giesbrecht et al., 2012; Van Heugten-van Der Kloet et al., 2014). The American Psychiatric Association defines dissociation as “a disruption of the usually integrated functions of consciousness, memory, identity or perception of the environment” (American Psychiatric Association, 2000). Several pathologic dissociative symptoms can be distinguished. These include feeling like everything is unreal (derealization) and feeling disconnected from one’s body or feelings (depersonalization). In addition, they include amnesia for personal information or events that are too extensive to be explained by ordinary forgetfulness (dissociative amnesia). Dissociation may also lead to identity alteration; learning from others of activity of alternate identities, feeling possessed or controlled, and perceiving internal images and voices (identity alteration) (Korzekwa et al., 2009). The DSM-IV-TR lists four diagnoses under the category “dissociative disorder”: dissociative amnesia, dissociative fugue (a sudden, unexpected travel away from one’s home with an inability to recall some or all of one’s past), depersonalization disorder, dissociative identity disorder. Dissociative disorder “not otherwise specified” refers to various forms of dissociation that are not fully covered by any of the specific dissociative disorder (American Psychiatric Association, 2000).

Some authors argue that dissociation is a result of the infiltration of dreamlike mentation during the day which could eventually initiate episodes of derealization or depersonalization (Lynn et al., 2019). In 2009, Koffel & Watson reviewed the relation between unusual sleep experiences and dissociation (Koffel & Watson, 2009). They suggest that dissociation and sleep experiences such as nightmares, vivid dreams and hypnagogic or hypnopompic hallucinations represent a common domain with possibly a shared etiology.

The present study hypothesizes that adult narcolepsy type 1 patients express more dissociative symptoms than population controls. In a retrospective case-control design, dissociative symptoms were assessed using a well-validated, psychiatric semi-structured interview.

Methods

Participants

Sixty adult (≥18 years old) patients with narcolepsy type 1 were recruited from September 1996 till November 2006 at the Center for Sleep Medicine “Kempenhaeghe” (Heeze, the Netherlands) and through the Dutch narcolepsy patient association. Recruitment of patients was relatively low at first, partly due to fear of stigmatization from the patients. However, especially after the hypocretin findings
 sparked interest in underlying mechanisms, the interest in the topic of psychiatric comorbidity increased, and recruitment was restarted. In addition, later on the population control dataset (see below) became available.

Patients were included if they fulfilled the criteria of narcolepsy with cataplexy, and as such all met the criteria of narcolepsy type 1 according to the current standards of the International Classification of Sleep Disorders (ICSD-3) (Medicine, 2014). We only included adult patients, aged eighteen years or older. Patients were excluded when other sleep disturbances were present as a potential cause for excessive daytime sleepiness, such as sleep-related breathing disorders. Diagnoses were confirmed by review of the medical records including clinical notes, overnight sleep studies and multiple sleep latency testing.

Population controls (n = 120) were selected from the cross-sectional population-based Nijmegen-Health-Area-2 study, in which psychiatric symptoms were assessed in 368 people from the Dutch population (Hodiamont et al., 2005). Controls were matched for age, sex and urban environment (living in a community with more or less than 100,000 inhabitants). Nor in the narcolepsy group nor the population control group, participants were excluded based on their mental status.

**Procedure**

After approval from the medical ethical committee of the Radboud University Nijmegen Medical Center, patients were asked by their physician if they were interested to participate in a study, in which a clinical assessment about possible psychiatric complaints would take place. Patients then received further information about the study and were included after informed consent. Patients were also recruited during general information sessions about narcolepsy held by the patient organizations. In case a patient showed interest in participating in the study, they received further information and were included after they gave their written informed consent.

**Measure**

Symptoms of dissociation were assessed in a semi-structured interview guided by the Dutch edition of the Schedules for Clinical Assessment in Neuropsychiatry (SCAN), version 2.1 (Rijnders et al., 2000). The SCAN stems from the “Present State Examination” (PSE) and is a validated diagnostic instrument that is widely endorsed (Brugha et al., 2001; Schützwohl et al., 2007). It is not constructed explicitly for use with either ICD-10 or DSM-IV-TR but can be used for both systems. We described the presence of a variety of dissociative symptoms in patients and controls. To assess whether patients fulfilled the criteria of a dissociative disorder we used the DSM-IV-TR, which was the main reference during the time data collection took place for this study. It should be noted however that a formal diagnosis of dissociative disorder should not be made if there is an underlying somatic/neurological disease, in this case, narcolepsy. Nevertheless, fulfilling the DSM-IV-TR criteria for a dissociative disorder, does illustrate the extent and severity of dissociative symptoms.

All interviews were performed by trained and certified SCAN interviewers. DSM-IV-TR diagnostic classifications were derived from the computerized version of the SCAN 2.1 (Ishell, version 1.0.4.6).

For the current analysis, items were used from Chapter 2 (“Somatoform and dissociative disorders”) augmented with items of Chapter 16 (“Perceptual disorders other than hallucinations”) that contribute to the diagnosis of dissociation. Besides, Chapter 7 items “loss of concentration” and “insufficient thinking” (phrasing as used in the SCAN), were included. Table 1 shows relevant probing questions from the SCAN 2.1 interview.

Individual symptoms were scored using rating scales with the following basic format: 0: a positive rating of absence; 1: symptom occurred but uncommon or transitory; 2: symptom was present, on multiple occasions or for part of the time; 3: symptom was present more or less continuously. Ratings were then dichotomized as “absent” (score 0 or 1) or “present” (score 2 or 3).
Table 1. Key SCAN 2.1 questions probing symptoms of dissociation (Rijnders et al., 2000).

<table>
<thead>
<tr>
<th>Dissociative amnesia:</th>
<th>“You mentioned that you had memory problems, could you tell more about them, please? Are they present all the time or do they come and go?”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amnesia centered around recent stress:</td>
<td>“When did the memory problems start? Were you under any particular stress then? What were your personal relationships like at that time?”</td>
</tr>
<tr>
<td>Dissociative fugue:</td>
<td>“Have you ever found yourself a long way from your usual range of travel without being able to remember how you got there?”</td>
</tr>
<tr>
<td>Dissociative stupor:</td>
<td>“You mentioned that you had lost consciousness or experienced trances or fits, recently. Could you tell me more about that, please?”</td>
</tr>
<tr>
<td>Trance experience:</td>
<td>“Have you experienced being in an altered state of consciousness or trance?”</td>
</tr>
<tr>
<td>Possession experience:</td>
<td>“Have you had the experience of being taken over by some influence or power?”</td>
</tr>
<tr>
<td>Dissociative conversion:</td>
<td>“Have you had any fants or fits or convulsions recently?”</td>
</tr>
<tr>
<td>Dissociative sensory loss or anesthesia:</td>
<td>“Have you had any loss of vision, hearing, vibration, or smell or touch? Can you feel heat and cold normally?”</td>
</tr>
<tr>
<td>Dissociative disorder of voluntary movement:</td>
<td>“Have you been unable to move an arm or a leg, some part of a limb? Have you found your movements uncoordinated and that you could not stand unaided?”</td>
</tr>
<tr>
<td>Association of dissociative symptoms with stress:</td>
<td>“When you experienced this problem were you under any particular stress?”</td>
</tr>
<tr>
<td>Multiple Personality:</td>
<td>(1) Two or more discrete personalities: absent/ present. (2) Each personality is complete (3) Each personality is manifested by discrete periods of control of behavior (4) Extensive forgetfulness with inability to recall important personal information.</td>
</tr>
<tr>
<td>Changing perceptions:</td>
<td>“Do things seem to change in size or shape or color in a puzzling way?”</td>
</tr>
<tr>
<td>Dulled perception:</td>
<td>“Have things looked grey and flat; lacking their usual color and detail?”</td>
</tr>
<tr>
<td>Heightened perception:</td>
<td>“Do sounds seem unnaturally clear or loud or objects look vividly colored or patterns seem particularly detailed and interesting?”</td>
</tr>
<tr>
<td>Changed perception of time, déjà vu, jamais vu:</td>
<td>“Does your experience of time seem to have changed?”</td>
</tr>
<tr>
<td>Derealization (things):</td>
<td>“Have you felt recently as though the world was unreal, or only an imitation of reality, like a stage set, with cardboard cut-outs instead of real houses or trees? What was that like?”</td>
</tr>
<tr>
<td>Derealization (people):</td>
<td>“Did other people seem to be acting a part, like actors in a play or like puppets, or even dead?”</td>
</tr>
<tr>
<td>Depersonalization:</td>
<td>“Have you felt that you yourself were not a real person, not really part of the living world? Like living in a dream? Not really here? Like acting in a play with all the lines laid down?”</td>
</tr>
<tr>
<td>Depersonalization of self:</td>
<td>“Do you seem unreal to yourself when you look in a mirror or on a photograph? Do you find that you seem to be seeing yourself outside your body like a stranger?”</td>
</tr>
<tr>
<td>Unfamiliarity (self):</td>
<td>“Have you felt that part of your body did not belong to you or looked unfamiliar, or the wrong size?”</td>
</tr>
</tbody>
</table>

Statistics

Data are presented as a frequency or as mean ± sd. For each SCAN item, frequencies were determined by considering the first two categories as being a negative score and the other categories as a positive score. Frequencies were then compared between the narcolepsy and control group using Fisher’s exact test. On a symptom level, twenty-two Fisher’s tests were done. In order to decrease the risk of a type I error, a Bonferroni correction was applied, resulting in a significance level of 0.00227. For secondary outcome measures we used a significance level of p < .01. Fisher’s tests were also used to determine whether there was any influence of medication (both overall and per medication group) and gender on dissociative symptoms and disorders.

Results

Demographic characteristics and medication use are listed in Table 2. Narcolepsy patients and controls were well matched for gender, age and urban environment. Patients had a mean age of 43.5 (range 26.9–59.1). About half of the narcolepsy patients used stimulant medication to suppress sleepiness; less than half used antidepressant medication for cataplexy or sodium oxybate. Only 2% of the patients used antipsychotics. Less than one-third did not use any medication.

In Table 3, the symptoms assessed in SCAN Chapter 2 (“Somatoform and dissociative disorders,“) and Chapter 16 (“Perceptual disorders other than hallucinations,“) are summarized in order of prevalence. While only 1% of controls reported dissociative amnesia, more than a third of patients with narcolepsy reported this as a symptom. Dissociative disorder of voluntary movement was present in 32% of the patients. While none of the controls reported having experienced derealization and only
1 of the controls experienced depersonalization, these symptoms were present in respectively 15% (derealization people), 13% (derealization things) and 13% (depersonalization) of the patients. Although the prevalence was lower than the other symptoms, still 10% of narcolepsy patients reported having “2 or more discrete personalities”, compared with only 1 patient in the control group. In almost half of the patients, the reported dissociative symptoms were associated with a significant disruption of their daily activities, in contrast to only 5% of the controls.

As indicated in Table 4, there were significantly more narcolepsy patients fulfilling the criteria of a dissociative disorder according to the DSM-IV-TR criteria, compared to controls. In fact, 62% of
patients met the criteria of either a diagnosis of dissociative amnesia (8%) or a dissociative disorder not otherwise specified (NOS) (53%).

Significantly more women met the criteria for a dissociative disorder (25 female versus 12 male, \( p = .008 \)). All patients fulfilling the criteria of dissociative amnesia (n = 5) were female. Subjectively insufficient thinking and loss of concentration were not significantly associated with a dissociative disorder (respectively 19/25 patients, \( p = .053 \) and 32/48 patients \( p = .014 \)). No significant associations were found between dissociative disorders and the presence of disturbing dreams/nightmares, sleep terrors or hypnagogic hallucinations. The use of narcolepsy medication, in general, was not associated with a dissociative disorder neither were the specific use of stimulants, antidepressants, sodium oxybate or antipsychotics. On a symptom level, only dissociative fugue was significantly associated with the use of antidepressants (thirteen patients without antidepressants experienced dissociative fugue, in contrast to only one patient who was using antidepressants \( p = .02 \)).

### Discussion

We performed a case-control study using semi-structured formal psychiatric interviews and show for the first time that the majority of patients with narcolepsy type 1 display symptoms of dissociation. More than 60% of patients fulfilled the DSM-IV-TR criteria for a dissociative disorder versus only 1% of matched population controls. More than half of the patients met the criteria for “dissociative disorder NOS”, and almost 10% the criteria for “dissociative amnesia”. As mentioned before, a formal diagnosis of dissociation should not be made if symptoms can be the result of an underlying neurologic or somatic disease. However, these findings do illustrate the significant extent and severity of dissociative symptoms in narcolepsy. On the symptom level, dissociative amnesia, dissociative disorder of voluntary movement, dissociative fugue, changed perception of time, trance experience and amnesia centered around recent stress were most frequently reported. The abundant presence and wide range of dissociative symptoms is remarkable. Perhaps the most striking example of a dissociative symptom is that 10% of the patients reported the experience of harboring two or more discrete personalities, compared to none of the control subjects.

Epidemiological studies in the general population find a prevalence of dissociative disorder with rates in the order of 1–3% (Rauschenberger & Lynn, 1995; Sandberg & Lynn, 1992), in agreement with our control group. Studies regarding gender differences in dissociation were not conclusive (Spitzer et al., 2003; Vanderlinden et al., 1993). In our study, we found no gender differences on a symptom level. However, females did meet the criteria for dissociative disorders more often.

The 'formal' diagnosis based on the SCAN 2.1 interview is mainly indicating the significant presence of dissociative symptoms, but obviously, caution should be exercised regarding the underlying cause. Symptoms due to a periodic lowering of consciousness with an organic cause, as in narcolepsy, and symptoms due to a presumed functional cause of changed consciousness, as in dissociation disorder, could very well be similar. Symptoms such as dissociative amnesia and trance experience could be caused by the excessive daytime sleepiness, characteristic for narcolepsy. Moreover, automatic behavior as a result of hypersonomolence is often reported in narcolepsy, involving sometimes bizarre behavior accompanied by amnesia (Sturzenegger & Bassetti, 2004). This could very well match the description of a “dissociative fugue” according to the DSM-IV-TR or a “sleep-related dissociative disorder” according to the ICD-10.

### Table 4. Number of subjects fulfilling DSM-IV-TR criteria of dissociative disorders.

<table>
<thead>
<tr>
<th></th>
<th>Narcolepsy</th>
<th>Controls</th>
<th>P-value (Fisher Exact)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>60</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>Dissociative disorders</td>
<td>37 (62%)</td>
<td>1 (1%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Dissociative amnesia</td>
<td>5 (8%)</td>
<td>0 (0%)</td>
<td>0.004</td>
</tr>
<tr>
<td>Dissociative identity disorder</td>
<td>0 (0%)</td>
<td>1 (1%)</td>
<td>1.000</td>
</tr>
<tr>
<td>Dissociative disorder not otherwise specified</td>
<td>32 (53%)</td>
<td>0 (0%)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
In the past two decades, several studies highlight the importance of unusual sleep experiences in the development of dissociative symptoms (Koffel & Watson, 2009; Lynn et al., 2019); (Selvi et al., 2015; Van Heugten-van Der Kloet, Cosgrave et al., 2015; Van Heugten-van Der Kloet, Giesbrecht et al., 2015). Unusual sleep experiences in these studies were defined as nightmares, vivid dreaming, “narcolepsy symptoms” and complex nighttime behavior. Van der Kloet et al. reviewed 23 clinical and non-clinical studies, showing a correlation between unusual sleep experiences and dissociative symptoms (Van Der Kloet, Merckelbach et al., 2012). Several studies demonstrate an increase in dissociative symptoms triggered by sleep deprivation (Giesbrecht et al., 2007; Selvi et al., 2015; Van Heugten-van Der Kloet, Giesbrecht et al., 2015) whereas sleep normalization was accompanied by a reduction of dissociative symptoms (Van Heugten-van Der Kloet, Giesbrecht et al., 2015). In addition, longer REM sleep periods during the night were predictive of dissociation (Van Heugten-van Der Kloet et al., 2013). In this study, no significant associations were found between dissociative disorders and the presence of disturbing dreams or nightmares, sleep terrors or hypnagogic hallucinations, however this could be due to the fact that the prevalence of all these symptoms are very high in narcolepsy in general (Kornum et al., 2017; Pisko et al., 2014). It is evident that people with narcolepsy suffer from disordered sleep, and moreover, the mentioned “unusual sleep experiences” are part of the core symptoms of narcolepsy. In this sense, our findings strengthen the presumed link between disordered sleep, unusual sleep experiences and dissociation. Lynn et al. argue that sleep disturbances and unusual sleep experiences can persist to an attenuated degree in everyday life, and push waking consciousness more toward the dreaming end of the sleep-wake continuum (Lynn et al., 2019; Van Heugten-van Der Kloet et al., 2013).

Narcolepsy is caused by a deficiency in hypothalamic hypocretin signaling (Peyron et al., 2000; Thannickal et al., 2000). The hypocretin neurons are presumed to stabilize transitions between wake and sleep by stimulating wakefulness and preventing uncontrolled transitions between sleep states (Saper et al., 2005). Saper described two master-switches in the brainstem, controlling the sleep-wake cycle. The hypocretin deficiency causing type 1 narcolepsy results in faster and more unstable transitions between and within different sleep states, dreaming, and wakefulness (Schoch et al., 2017). Since hampered (meta)consciousness is a key element in the understanding of dissociation (American Psychiatric Association, 2000; Lynn et al., 2019), it does not seem unreasonable to suggest that a flawed regulation of consciousness ultimately results in dissociation. So, the neural circuit that is responsible for consciousness, could be responsible for the expression of dissociative symptoms as well. This would locate the source of dissociation in this brainstem circuit. So far other circuits, in the limbic system and (pre)frontal cortex have been found to be functional in producing dissociation (Brand et al., 2012; Krause-Utz et al., 2017). These circuits do not by themselves have a function in regulating consciousness but do undergo secondary changes in activity during the phases of wake, REM- and non-REM- sleep. Hypothetically, instability of the sleep-wake cycle in narcolepsy could be part of the explanation of the dissociative symptoms. Because of the breakdown of the usually strictly orchestrated sleep states, components of REM sleep express themselves independently resulting in cataplexy, sleep paralysis, hypnagogic hallucinations and automatisms. During REM sleep, the prefrontal areas of the brain are in a state of deactivation resulting in more fluid “reasoning” (Llewellyn, 2013). Excessive REM sleep pressure and the occurrence of (micro)sleep episodes during the day, could lead to more fluid and flexible reasoning, which is related to the occurrence of dissociative symptoms (Van Heugten-van Der Kloet et al., 2013). However, it should be mentioned that especially in the case of dissociative symptoms, the precise mechanisms in relation to (REM) sleep remain speculative.

Dissociative symptoms are not limited to dissociative disorders, but can occur in a variety of mental health problems such as post-traumatic stress disorder (PTSD) and schizophrenia. Often, dissociation in these other conditions has been found to be related to traumatic experiences. Because of the presence of hypnagogic hallucinations, narcolepsy patients have been misdiagnosed with schizophrenia or other psychotic disorders (Plazzi et al., 2015). However, a role for trauma in the emergence of dissociation in narcolepsy patients has not been established, nor have there been reports of an
overrepresentation of PTSD in narcolepsy patients. So, although there seems to be some overlap in symptoms between schizophrenia and narcolepsy, phenotypically the hypnagogic hallucinations in narcolepsy have been shown to be different from hallucinations of schizophrenic patients. Moreover, delusions are exceptional in narcolepsy patients, but hallmarks in schizophrenic patients (Fortuyn et al., 2009).

The results of the present study show that patients with narcolepsy type 1 are more prone to develop dissociative symptoms. Whatever the underlying cause, the high prevalence of dissociative symptoms implicates that patients and their close family members should be educated about the possible occurrence and should be given the opportunity to discuss these symptoms with their treating health professionals. Not only can the presence of dissociative symptoms in narcolepsy patients aggravate the burden that narcolepsy patients experience, it can also lead to significant functional impairment at school, work or in social interaction. In our study, narcolepsy medication in terms of stimulants, antidepressants, antipsychotics or sodium oxybate did not affect the occurrence of dissociative symptoms, nor dissociative disorders. Therefore, adjusting narcolepsy medication is not likely to have a direct effect. Psychological treatment recommendations for dissociative symptoms or disorders are often based on the assumption of an underlying trauma causing the symptoms (International Society for the Study of Trauma and Dissociation, 2011). As there is no evidence in the literature that narcolepsy patients are more traumatized compared to the general population, treatment focusing on an underlying trauma is probably not beneficial. Nevertheless, it is recommended to explore the possibility of trauma during the diagnostic process. Treatment of dissociative symptoms or disorders in patients with narcolepsy which are not related to trauma, could be part of a cognitive behavioral therapy, focusing on optimizing sleep and lifestyle, psycho-education, and enhancing coping skills. Since narcolepsy is usually treated in a multidisciplinary way, a psychologist should be involved in the care of these patients, with specific expertise in narcolepsy. It should be noted that, effects of these interventions in narcolepsy patients are hypothetical and lack scientific evidence at this time.

More and more it is becoming clear that the spectrum of narcolepsy is much broader than the “narcoleptic pentad” (Canellas et al., 2014; Droogleever Fortuyn et al., 2012; Fortuyn et al., 2010; Zhang et al., 2018). From a clinical point of view, this might lead to difficulties not to miss symptoms, or having “blind spots”. From a research perspective, it also raises the question if these, perhaps less obvious, symptoms have interdependencies and could possibly be clustered. Longitudinal monitoring of the broad spectrum of narcolepsy symptoms may be useful to discover such relations and to increase our understanding of the course of symptoms. Modern tools may help in such studies, for example, with the Narcolepsy Monitor, a recently developed mobile app enabling long-term monitoring of the subjective severity of a wide range of narcolepsy symptoms (Quaedackers et al., 2020).

In this study we used the DSM-IV-TR criteria to assess the presence of dissociative disorders. The DSM-IV-TR was replaced by the DSM-5 in 2013, so the new system was not yet available during data collection. However, since the purpose of this study is to emphasize the presence of dissociative symptoms rather than diagnosis, in patients with narcolepsy, the precise diagnostic classification system is less relevant. Also, given the adult age of the narcolepsy patients included in this study, we have no information about the prevalence of dissociative symptoms in children or adolescents with narcolepsy. Another issue which could be addressed in future prospective studies is the lack of polysomnographic data and detailed information about the dose and timing of medication. While some studies have suggested an association between sleep deprivation or sleep fragmentation and the occurrence of dissociative symptoms, our data did not suffice to either confirm or refute this hypothesis. Future research could employ a prospective design with detailed registration of medication use and new technologies to monitor sleep architecture over longer time periods and correlate this to the presence of dissociative symptoms. Future studies could also consider contrasting narcolepsy type 1 versus type 2 with respect to the presence of dissociative symptoms, to gain more insight in the specific role of hypocretin deficiency. Assessing relation with the severity or frequency of cataplexy would need a longitudinal follow up design which would not be easy, but very interesting.
In summary, the results of this study show a high prevalence of dissociative symptoms in patients with narcolepsy type 1. Although there might be an overlap between symptoms of dissociation and symptoms of narcolepsy, the proportion of narcolepsy patients suffering from dissociative symptoms is strikingly high and may impact a broader sense of wellbeing and quality of life. Dissociation in narcolepsy type 1 could be a more serious and more frequent symptom than is currently assumed. Caregivers should actively inquire not only after the classical symptoms of narcolepsy, but also after the presence of less obvious symptoms, such as dissociation.

**Acknowledgments**

LQ, MvG and SO are supported in the IMPULS framework of the Eindhoven MedTech Innovation Center (e/MTIC, a collaboration between Sleep Medicine Center Kempenhaeghe, Eindhoven University of Technology and Philips Research). The framework was co-funded with a PPS-supplement for research and innovation from the Dutch Ministry of Economic Affairs and Climate.

The resources for collecting the Nijmegen Health Area 2 Study data were provided by the Dutch Prevention Foundation (Grant No. 28-816-2) and the Ministry of Health, Welfare and Sport (Grant No. VWS- 64-4528-54272-299857-98). We wish to thank all of the patients and control subjects who volunteered for this research.

**Disclosure statement**

S.O. has received research support by UCB Pharma and consulted for UCB Pharma, Jazz Pharmaceuticals and Bioproject, all paid to the institution, and all unrelated to the present work.

**References**


Llewellyn, S. (2013). Such stuff as dreams are made on? Elaborative encoding, the ancient art of memory, and the hippocampus. *Behavioral and Brain Sciences, 36*(6), 589–607. https://doi.org/10.1017/S0140525X12003135


