



# LIVING THE DREAM: PARASOMNIAS

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## Insights

People do bizarre things while asleep, varying from innocent examples such as mumbling to more harmful examples. In 1987, Kenneth Parks, a 23 year old Canadian, drove 14 miles to the home of his in-laws and stabbed his mother-in-law to death. Within an hour after this event he turned himself in. He claimed he did not know what happened and that he woke up with a bloody knife in his hand [1]. In 2008, Brian Thomas, a 59-year-old Welshman, strangled his wife of almost 40 years to death. He called the alarm number and told the operator he dreamed that he was strangling a burglar, but woke up to see that he actually strangled his wife [2]. Both men claimed that they were innocent and said they suffered from so-called parasomnias. Opinions differed on the truth of these statements. In the end, they were both declared innocent [1,2].

## Introduction

With an estimated lifetime prevalence of seven percent, it is likely that you know someone who is or used to be a sleepwalker [3]. Perhaps you have suffered from this condition yourself. The act of sleepwalking often leads to entertaining stories, for example of someone who plunders the entire refrigerator during the night and wakes up with their face covered in chocolate [4]. The situations caused by sleep disorders are not always comical. Sleeping can unfortunately also coexist with violence. In literature, this phenomenon is known as sleep-related violent behaviour. This includes self-inflicted injury and injury to others [5]. Like the murder cases mentioned above, shocking examples of sleep-related violent behaviour draw a lot of media attention. Because of its sensation value, it is also the topic of multiple books and movies, both fiction and nonfiction [6, 7]. Some case reports have also been written about this topic [5]. These cases, however, although sensational, are believed to be extremely rare [5].

Various conditions can cause someone to display behaviour such as walking, eating or acting violent [8]. These include epilepsy and certain psychiatric diseases, such as dementia. Symptoms of these conditions, however, are not exclusively bound to being asleep. The most common cause of sleep-related violence are parasomnias [8]. Parasomnias are undesirable events or experiences that occur during sleep. Over 60% of people have experienced at least one parasomnia at some point in their life [9]. Since parasomnias are not uncommon and are often put in a bad light by the media, it is important that more is known about these sleep-bound diseases. In this article parasomnias are further investigated.

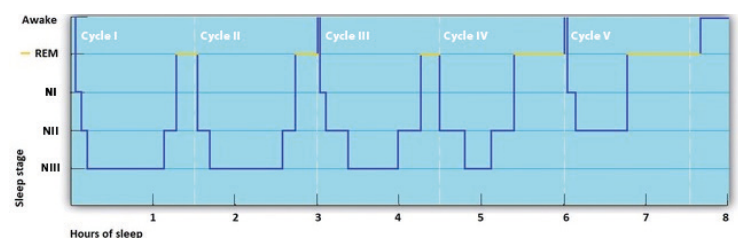
### What is sleep and how does it work?

In order to understand parasomnias it is important that we first learn more about the circumstances in which they occur: while asleep, entry into sleep or during arousals of sleep [11]. Sleep is a naturally recurring state characterised by altered consciousness, reduced interactions with surroundings, automatic eye movements and inhibition of nearly all voluntary muscles [10]. To objectively distinguish sleep from wakefulness, a polysomnography is often performed. This multi-parametric test monitors brain activity, eye movements, muscle activity, heart rhythm and breathing parameters while asleep.

The exact function of sleep is unknown, but it is expected that sleep does not serve solely one physiological role. Sleep seems to be crucial for many vital functions including energy conservation, development, modulation of immune responses, cognition and psychological state.

Sleep plays an important role in memory consolidation [12]. The importance of sleep is apparent from animal studies. In rats for example, chronic sleep deprivation leads to severe consequences even with death as result [13]. But how can just laying down with your eyes closed be that efficient? It turns out that sleeping is not as monotonous as it seems. Human sleep consists of five sleep cycles that take 90 minutes each. During a sleep cycle two different phases occur; non-rapid eye movement (NREM) sleep and rapid eye movement (REM) sleep. An essential difference between these two phases is that during REM sleep, muscle inhibition arises. NREM sleep can be further classified into NREM stage I (light sleep), II (deeper sleep) and III (deep sleep). The ratio in time between NREM and REM varies with each cycle. The duration of NREM sleep gets smaller during each cycle, while those of REM sleep gets longer [14]. The sleep cycle is further illustrated in figure 1.

Since sleep is a complicated process, it is not difficult to imagine it can also go wrong. Roughly 20% of the population suffers from one or more of the 80 sleep disorders described by the International Classification of Sleep Disorders (ICSD-3) [15]. Common examples of these are insomnia, sleep apnea and the aforementioned parasomnias.



**Figure 1: Sleep cycles and its stages.**

In this figure, a hypnogram is displayed which is a graph that represents the stages of sleep as a function of time. A hypnogram is also used in polysomnography to recognise the different phases of sleep: rapid eye movement (REM) sleep and non-rapid eye movement (NREM) sleep. NREM sleep can be further classified into NREM stage I (light sleep), II (deeper sleep) and III (deep sleep). This is indicated in the figure as respectively N1, N2 and N3. In this hypnogram five sleep cycles are displayed, which is the average number of cycles a human experiences during sleep [14, 15]. All sleep cycles start with NREM sleep (the first 60 minutes) and end with REM sleep (the last 30 minutes). The ratio in time between NREM and REM varies with each cycle. The duration of NREM gets shorter as the night progresses, while the duration of REM gets longer.

## Parasomnias

Frenchman Henri Roger was the first to use the term parasomnia in 1932 to describe the odd phenomenon of a boy frequently screaming in his sleep. He derived this term from the words *para* meaning 'beside' in Greek and *somnus* meaning 'sleep' in Latin [16]. Doing the name justice, parasomnias are currently described as a category of sleep disorders defined as undesirable motor, behavioural or sensory experiences that exclusively occur during sleep. Parasomnias occur because of an error in the regulation of sleep, which means that one or more of the aforementioned characteristic symptoms of sleep do not go as planned [16].

As mentioned before, many people have experienced some form of parasomnia at least once in their life. Recurring parasomnias occur most often in pre-adolescent children, with a prevalence of 15%, but can occur at any age. The prevalence amongst adults is estimated to be around four percent [17]. Genetic factors seem to play an important role in the pathophysiology of most parasomnias, as often several family members suffer from it. Parasomnias also occur in close association with other sleep disorders. Furthermore, they are also more common in certain comorbidities, such as Parkinson's disease [17]. The ICSD-3 lists ten core categories of parasomnias, eight of which are described in table 1 and 2 [18]. NREM and REM sleep disorders will be further discussed.

## NREM parasomnias

NREM parasomnias are also known as disorders of arousal, meaning they often result from an incomplete transition out of deep NREM sleep. Since these parasomnias exclusively occur during deep sleep, which is part of NREM sleep, they are more common in children, because their deep sleep cycle lasts longer [17]. NREM parasomnias have certain key characteristics which are described in table 1.

The diagnosis of NREM parasomnias is based on clinical symptoms. Usually no further polysomnography is necessary, because most individuals who suffer from these parasomnias only occasionally show symptoms. One-time polysomnography during a night, therefore, hardly contributes to the diagnosis. A polysomnography can, however, be used to exclude underlying sleep disorders, such as sleep apnea. NREM parasomnias are usually outgrown in early childhood and hardly ever require treatment [19]. If deemed necessary, however, there are some lifestyle and pharmacological treatment options, as described in table 1 [17, 19].

The ICSD-3 distinguishes five NREM parasomnias: disorders of arousal (which is a term for NREM parasomnias not otherwise classified), confusional arousals, sleep terrors, sleep-related eating disorder and sleepwalking [17]. Of these parasomnias, confusional arousals is the most common and least complex type. Confusional arousals are characterised by a short episode in which the individual seems awake, yet absent and oblivious to their surroundings. These events can be accompanied by automatic behaviours, which are mostly purposeless and uncontrolled, such as kicking [17]. Sleep terrors are another common parasomnia in children. Like confusional arousals, the person seems unaware of his or her surroundings, however, instead of coming across as being confused, they seem terrified. Events of sleep terrors are characterised by screaming and by display of autonomic arousal, such as tachycardia and rapid breathing [17]. Both of these parasomnias can evolve into the most complex NREM parasomnia, known as sleepwalking. Sleepwalking, also known as somnambulism, consists of multiple increasingly more complex behaviours that finally result in walking. Events of sleepwalking typically last less than 15 minutes, but there are reports of events that lasted multiple hours. During these sleepwalking events, the individual exhibits decreased awareness and impaired responsiveness to their surroundings. More complex behaviours can be made alongside

walking, such as eating or driving, but in almost all cases individuals do not leave their room [17, 19]. During these actions the sleepwalker appears uncoordinated and prone to self-inflicted injuries. Attempts to wake up a sleepwalker will usually fail [17].

Although extremely rare, some cases of homicidal somnambulism have been reported, including the case of Kenneth Parks who claimed to have killed his mother-in-law in his sleep [1]. His wife and close relatives confirmed he was a known sleepwalker. At the time of his case, polysomnography was a new test and was, therefore, not performed on Parks [21]. Doctors were, however, already convinced of Parks' innocence, because he cut several of his fingers during the murder, injuring tendons and nerves, without noticing. The lack of pain seen during sleepwalking is known as somnambulistic dissociative analgesia [22]. After long deliberation by the jury, Parks was acquitted [1].

**Table 1: NREM Parasomnias.**

*In this table the subtypes, characteristics, provoking factors, diagnosis and treatment options of NREM parasomnias are described. The five subtypes of NREM described in this table are listed in the International Classification of Sleep Disorders (ICSD-3) [19].*

NREM parasomnias				
Subtypes	Characteristics	Provoking factors	Diagnosis	Treatment
(1) Disorders of arousal	More common in young children	Stress Insufficient sleep	Clinical picture (see characteristics)	Create a safe living environment
(2) Confusional arousals	An individual can alternate between subtypes	Medications that deepen sleep and alcohol	Polysomnography	Prevention of stress and sleep deprivation
(3) Sleepwalking	Individuals have their eyes open during an episode	Disorders that result in arousals (including pain and sleep apnea)		Treatment of underlying sleep disorders
(4) Sleep terrors	Individuals cannot be woken up during an episode			Low-dose benzodiazepines or anti-depressants
(5) Sleep-related eating disorder	Individuals have amnesia of the event			

## REM parasomnias

REM parasomnias, which take place during REM sleep, have little in common with each other. In fact, the only thing they have in common is their initiation during REM sleep. This sleep phase is characterised by electroencephalography (EEG) waves similar to those observed during waking. Paradoxically to these EEG waves only the brain appears active during REM sleep. This sleep phase is accompanied by paralysis of nearly all muscles. Only the muscles that allow breathing and control eye movements remain active [17]. Other key characteristics of REM parasomnias are described in table 2. REM parasomnia is a clinical diagnosis almost always supported by video material and polysomnography. There are multiple treatment options for this disorder as described in table 2 [17].

The ICSD-3 distinguishes three REM parasomnias: sleep paralysis, nightmare disorder and REM sleep behaviour disorder (RBD) [19]. Sleep paralysis happens in the sleep-to-wake transition and is thought to be caused by a delay in lifting up of voluntary muscle activity. Although fully conscious, individuals are not able to control the muscles of their body [17]. Nightmare disorder is characterised by frequent nightmares in which the content most frequently involves imminent danger. Nightmares are a normal part of sleep, as 40% of children and 20% of adults experience at least one nightmare per week. It is called a disorder, however, when the nightmares influence the person's daily life, either due to a high frequency of occurrence or because of the content [17].

Although very unpleasant, both aforementioned REM parasomnias cannot lead to violence. This is in contrast to RBD, in which cases of violence are described. This parasomnia occurs due to a faulty mechanism of muscle paralysis. Because there is no paralysis, affected individuals act out their dreams. Typically, patients with RBD have unpleasant, often even frightful dreams in which fighting plays an important role [23]. Studies have shown that induced bilateral brainstem lesions in cats result in RBD-like behaviour, but it is not known if the same applies to humans [17]. This would explain, however, why RBD is far more prevalent in individuals who suffer from synucleinopathies, of which Lewy Bodies and Parkinson's are examples [23]. Synucleinopathies are disorders characterised by accumulation of aggregates of alpha-synuclein protein in the brain. Interestingly, RBD can also proceed these synucleinopathies by many years and will not always lead to these disorders. This indicates that the relationship between RBD and synucleinopathies is not as simple as once believed [23]. Like sleepwalking, RBD hardly ever requires treatment, especially because during episodes of RBD individuals rarely leave their bed. If necessary, it can be treated with clonazepam. This benzodiazepine is effective in reducing both problematic behaviours and threatening dreams. Another treatment option is melatonin, a hormone that affects the sleep-wake cycle [17].

Cases of homicide in RBD are even less common than homicidal somnambulism. The most probable reason for this is that the prevalence of RBD is less than a half percent while the prevalence of somnambulism is seven percent [3, 24]. A few cases of homicide due to RBD, hyped by the media, have been described. Brian Thomas strangled his wife of 40 years while on holiday. He recalled the event as a dream in which he was saving his wife from an intruder [2]. Thomas was not diagnosed with RBD beforehand. However, a few days prior to their holiday he stopped taking his antidepressants [25]. Certain drugs, including antidepressants and hypnotics are known to suppress REMS. Withdrawal from these drugs can, therefore, trigger REM parasomnias [17]. Like Parks, Thomas was also acquitted [2].

**Table 2: REM Parasomnias.**

In this table the subtypes, characteristics, provoking factors, diagnosis and treatment options of REM parasomnias are described. The three subtypes of REM described in this table are listed in the International Classification of Sleep Disorders (ICSD-3) [19].

REM parasomnias				
Subtypes	Characteristics	Provoking factors	Diagnosis	Treatment
(1) REM sleep behaviour disorder (RBD)	More common in adult men (RBD)  An individual cannot alternate between subtypes	Synucleinopathies (such as Parkinson's) (RBD)  REM suppressant drugs (including antidepressants and hypnotics)	Clinical picture (see characteristics)  Polysomnography	Create a safe living environment  Prevention of insufficient sleep (sleep paralysis) and use of REM suppressant drugs
(2) Sleep paralysis	Individuals have their eyes closed during an episode  Individuals can be woken up during an episode	Mental disorders (sleep paralysis and nightmare disorder)	Video material (RBD)	Treatment of underlying disorders
(3) Nightmare disorder	Individuals remember most of the event	Insufficient sleep (sleep paralysis)		Clonazepam (RBD) and cyproheptadine (Nightmare disorder)

Conclusion

Parasomnias are a type of sleep disorder often negatively portrayed in the media, because of the rare association between this disorder and violence. Murder, although extremely rare, especially draws a lot of attention. There are ten core parasomnias, but only two potentially lead to violence, namely somnambulism (a NREM parasomnia) and RBD (a REM parasomnia). Even in these two disorders violent behaviour hardly ever occurs. Diagnosis of these disorders is mostly clinical, because individuals with these disorders only sporadically show symptoms, and a polysomnography is not required. There are multiple treatment options for parasomnias, but these are often unnecessary, because of their harmless character. As can be drawn from the above, parasomnias are not nearly as dangerous as is displayed by the media. So, if you happen to know someone with a parasomnia, or suffer from this disorder yourself, you should not lose sleep over it.

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## EXAM QUESTIONS

As RAMS aims to enlighten both students and professionals, we would like to present you two exam questions. Find out if you can remember what you have learned during your bachelor's!

*We challenge you!*

### Question 1

Different resistance mechanisms exist against antibiotics. What is the most predominant resistance mechanism that bacteria use against tetracyclines?

- A. Efflux
- B. Enzymatic changes
- C. Higher production of target binding sites
- D. Lower membrane permeability

*(Topic from Q4 MGZ Attack and Defence, 2017)*

### Question 2

People without a spleen are more vulnerable to sepsis caused by encapsulated bacteria. This is because the spleen normally ...

- A. Produces complement factors that lead to lysis of the encapsulated bacteria
- B. Filters encapsulated bacteria from the blood circulation
- C. Contains NK-cells that kill encapsulated bacteria

*(Topic from Q4 MGZ Attack and Defence, 2017)*

**The answers to these questions can be found on page 10 in this journal.**