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Nightmares in Traumatized Children: Does Emotion Dysregulation Play a Mediating Role?

Literature Review

This review paper discusses to what extent emotion dysregulation acts as a mediator in the relationship between trauma in children and the experience of nightmares. There is evidence for an association between trauma and the experience of nightmares. The role of emotion dysregulation is discussed both from a neurological and from a psychosocial perspective. The neurological perspective concerns the key role played by the amygdala, which is hyperactive during nightmares and chronically hyperactive after trauma. The psychosocial perspective concerns the role of attachment style for the development of emotion regulation and presents theories of dream function in order to portray the role of an emotion dysregulation for post-traumatic nightmares in children. A critical review of the literature suggests that - from both the neurological and the psychosocial perspective - emotion dysregulation plays the role of a mediator between child trauma and nightmares. A model showing this interplay is hypothesized and explained. Empirical

research is needed to validate the hypothesized model and to further examine emotion regulation therapy as part of the treatment for child trauma patients who frequently experiencing post-traumatic nightmares.

Keywords: nightmares, childhood trauma, emotion dysregulation, triangular model

INTRODUCTION

Feelings of being chased, falling, being paralyzed and the death of a loved one are some of the most common contents of nightmares in humans (Schredl, 2010). It can be assumed that nearly everyone can remember at least one nightmare in their life that contained one of these situations. But what if one nightmare – which may always be the same horror scenario – disrupts one's sleep one night after another? This describes the burden frequently faced by many traumatised children (Secrist, Dalenberg & Gevirtz, 2019). This review paper hypothesizes a model for the relationship between child trauma, which might lead to the experience of nightmares, and emotion dysregulation as a mediator in this relationship.

Nightmares are frightening dreams that include terrifying, vivid phases and often lead to the awakening of people (Tanskanen, Tuomilehto, Viinamäki, Vartiainen, Lehtonen, Puska, 2001; Zadra, Pilon & Donderi, 2006). The awakening mostly happens during rapid eye movement (REM) sleep and people can clearly recall the content of the nightmare. This content mainly involves a high load of emotions of fear, but disgust and anger as well (Nielsen & Levin, 2007). Nightmares are the most prevalent form of sleep disturbances (Zadra, Pilon & Donderi, 2006). Often, nightmares and bad dreams are differentiated by the awakening criterion. Nightmares cause an awakening of the sleeper due to very frightening dreams, whereas bad dreams describe frightening dreams as well, but these do not cause awakening of the sleeper (Zadra & Donderi, 2000).

Experiencing nightmares significantly disturbs one's sleep quality (Zadra, Pilon & Donderi, 2006). The huge impact of the negative

consequences of having a disturbed sleep quality can be estimated when considering the evidence that was found for sleep quality as a major determinant of human health (Mander, Winer, Jagust & Walker, 2016). Sleep disturbances may have consequences including physical ones such as an increasing risk of developing Alzheimer's disease or cardiovascular diseases (Mander, Winer, Jagust & Walker, 2016). Furthermore, sleep disturbances heighten the likelihood of developing depression, anxiety or other psychiatric pathologies. Sleep accounts for one third of life, therefore the consequences of sleep disturbances are dramatic (Wong et al., 2013).

Most people experience bad dreams from time to time, but nightmares occur more rarely. In a sample of 10-year-old children, 3,5% stated that they experienced nightmares 'often' (Schredl, Fricke-Oerkermann, Mitschke, Wiater & Lehmkuhl, 2009). A distinction is made between idiopathic nightmares and post-traumatic nightmares. Idiopathic nightmares describe nightmares without a specific cause, whereas post-traumatic nightmares are a symptom of people suffering from post-traumatic stress disorder (PTSD) (Langston, Davis & Swopes, 2010) following a traumatic event, which is the type of nightmare focused on in this review.

The regular experience of nightmares is a symptom found especially in the population of individuals with a traumatic history (Secrist, Dalenberg & Gevirtz, 2019). A trauma arises after the exposure to a traumatic event that has a huge emotional impact and that has such power that the person is unable to handle it (Copping, Warling, Benner & Woodside, 2001). Traumatic events leading to chronic trauma with persisting symptoms may include abuse - either physical or sexual -

(domestic) violence, death of a loved one, threats of suicide, neglect or other traumatic events (Copping, Warling, Benner & Woodside, 2001). Someone who has suffered a traumatic event may develop a PTSD, which is a pathology listed in the DSM-5 (PTSD; DSM V, American Psychiatric Association, 2013).

Trauma is especially drastic and triggers massive, possibly lifelong consequences when it happens during childhood, since the central nervous system, especially the brain, has not completed maturation yet (Copping et. al, 2001). The trauma may have adverse effects on cognition and attention as well as on impulse control and self-esteem, particularly because these functions are still in development in the early years of life (Pfefferbaum, 1997). Moreover, childhood trauma is known to cause anxieties and sleep disturbances, such as nightmares (Winje & Ulvik, 1998).

Experiencing a traumatic event overwhelmingly triggers negative emotions in the child. This consequently may disturb the children's emotion regulation. Emotion regulation describes the ability to identify all kinds of emotions and understand them, accept emotions, control one's own emotions and show appropriate emotions in all kinds of situations (Weinberg & Klonsky, 2009). An emotion dysregulation, on the other hand, describes a person's disability in these regards. It is defined as a poor understanding of emotions as well as having difficulties regulating negative emotions (McLaughlin, Hatzenbuehler, Mennin & Nolen-Hoeksema, 2011). Research found out that emotions play a major role in the experience of nightmares, since the 'dreamer' experiences a high load of negative emotions, which they are temporarily unable to downregulate (Nielsen & Lara-Carrasco, 2007).

This review paper takes the previously described three components into account and arranges them in an explanatory model: Childhood trauma, experience of nightmares and emotion dysregulation. An association between child trauma and the experience of nightmares has been found. Since research suggests that the key cause for nightmares is a failure of processing emotions (Levin & Nielsen, 2009; Schredl et al., 2008; Van der Helm et al., 2011), and since it has been established that especially children with trauma may develop emotion dysregulation (Aideuis, 2007), this review paper discusses to what extent emotion dysregulation plays a mediating role in the association between child trauma and the experience of nightmares. It is hypothesized that an emotion dysregulation is a mediating dysfunction and trigger for the symptom of nightmares, which lower the life quality of child trauma patients due to the described major impact of sleep on health. The question whether emotion dysregulation acts as a mediator in the relationship between children with trauma and the experience of nightmares, is answered from two perspectives: firstly, from the viewpoint of neurology and secondly, from the viewpoint of psychosocial mechanisms. Both the neurological and the psychosocial perspective are related to the experience of nightmares, the presence of child trauma and how emotion dysregulation factors in.

Neurological perspective on nightmares, childhood trauma and emotion dysregulation

Nightmares explained neurologically

When an individual experiences nightmares, a unique interplay between different brain areas creates a specific condition. Brain regions involved in nightmares are the medial prefrontal cortex (mPFC), the hippocampus, the

amygdala and the anterior cingulate cortex (ACC) (Nielsen & Lara-Carrasco, 2007). The amygdala responds to fear-related memory elements in the dream in an exaggerated, hyperactive manner. MPFC, hippocampal complex and ACC are substrates that have the function of reacting to the activity of the amygdala by downregulating it, but these mechanisms are disrupted during the experience of nightmares (Nielsen & Lara-Carrasco, 2007).

Levin and Nielsen (2009) assume a multilevel model for the function of dreams and the production of nightmares. It includes both neural processes and cognitive processes that take place during sleep and waking phases. These two branches – neural and cognitive – are represented as two networks: the AMPHAC for the neurophysiological processes and the AND for cognitive processes. The AMPHAC network includes the amygdala (A), the medial prefrontal cortex (MP), the hippocampus (H), and the anterior cingulate cortex (AC) and it illustrates the interconnected network of forebrain and limbic structures included in the expression and representation of emotions. The affective network dysfunction (AND) describes the system of dream-production that converts memories of fears into dream or nightmare fantasy and imagery, as for example the replaying of traumatic memories (Levin & Nielsen, 2009). Levin and Nielsen (2009) suggest that the intentional function of dreaming is the extinction of fear. In the networks mentioned above, emotions are reduced by re-processing memories. This function is exactly what is disrupted during nightmares: the intention of decreasing fear is failing which is suggested to be due to a failure of emotion regulation (Levin & Nielsen, 2009).

On the neurotransmitter level, an equivalent theory is proposed. Van der Helm, Yao, Dutt, Rao, Saletin and Walker (2011) conducted research in the depotentiation of emotional experiences during REM sleep. Dreams mainly occur during REM sleep, where a suppression of central adrenergic neurotransmitters takes place. These adrenergic neurotransmitters are incorporated in stress and arousal. In addition to that, amygdala-hippocampal networks are activated during REM sleep in order to encode salient events, and to depotentiate these. This means that previously affective events or memories are decreased in their intensity of emotional load. The adrenal neurotransmitter suppression and the amygdala-activity for depotentiation are two processes during REM sleep that have the intention to decrease the emotional load of events; therefore, if these processes do not work and if an individual experiences high next-day emotional load from dreaming (persisting feelings caused by the dream content), this may be due to an exaggerated amygdala reactivity (Van der Helm et al., 2011).

Discussing the neurophysiology of nightmares, one element seems to play a major role: the inclusion of emotions, especially via the emotion substrate amygdala. It is suggested that dreaming is a process including high emotions, often coming from emotional memories, salient events or extreme feelings. The amygdala is supposed to over-react during nightmares (Nielsen & Lara-Carrasco, 2007). Levin and Nielsen (2009) suggest the multilevel model of dreams and nightmares that includes the amygdala - which represents emotions during sleep - and discuss how the affective network dysfunction converts fears into nightmare imagery. Van der Helm et al. (2011) claim that the mechanisms normally taking place

during REM sleep involve a special role of the amygdala: to reduce the emotional load of salient events in order to reduce the emotional intensity of previously affective events (that may cause nightmares). The amygdala and the emotional load and regulation seem to play a major role in the production and experience of nightmares, supporting the hypothesis emotion dysregulation may be an indirect cause of the nightmare experience in traumatized children.

Childhood trauma explained neurologically

A trauma may cause huge consequences on and for the brain. Evidence was found that individuals suffering from PTSD have an increased amygdala responsivity during the recall of traumatic states, but during the processing of affective information and events that are unrelated to the trauma content, as well (Shin, Rauch & Pitman, 2006). In addition to the amygdala over-reacting in this way, the mPFC, which is supposed to downregulate affective arousal of the amygdala via critical thinking, has a smaller volume in PTSD patients. This leads to a hypo-responsivity of the mPFC during emotional cognitive events and tasks (Shin, Rauch & Pitman, 2006).

The amygdala is a mediator of the acquisition and expression of fear conditioning and it further increases the emotional memory (Koenigs & Grafman, 2009). The ventromedial prefrontal cortex (vmPFC), on the other hand, is intended to extinct this conditioned fear. This task of the vmPFC – to decrease emotional memory by inhibiting the amygdala– is the stage of defect in people suffering from symptoms related to trauma, which often includes nightmares (Koenigs & Grafman, 2009). Functional imaging studies found decreased activity of the mPFC and an increased and

exaggerated activity of the amygdala in patients with PTSD (Shin et al., 2004).

The neural disruptions occurring in people suffering from the post-traumatic symptom of nightmares include emotion dysregulation of negative events, as well. The vmPFC and the amygdala play a major role in this negative emotion regulation: the vmPFC is intended to suppress negative emotions triggered by the amygdala. This process is an inverse relationship: during events that trigger negative emotions, the vmPFC increases its activity, which is coupled with a decrease in the amygdala's activity (Koenigs & Grafman, 2009). This inverse relationship is comparable and somehow the same in the mechanisms of emotion regulation, as well as in the extinction of fear (lowering the extremity of emotional load) (Delgado, Nearing, Ledoux & Phelps, 2008). And this inverse relationship between vmPFC and amygdala seems to be disrupted in pathologies characterized by an increased level of negative affect, including PTSD and trauma patients in general (Koenigs & Grafman, 2009).

All in all, neural consequences of trauma mostly refer to disruptions of emotional substrates combined with disruptions of evaluative substrates (Milad, Rauch, Pitman & Quirk, 2006). On a more detailed level, researchers claim that the pathogenesis of PTSD is based on two main disruptions including the hyperactivity of the amygdala that causes high emotional distress on the one hand, and a disinhibition of the vmPFC, which should normally act in an inhibitory fashion on the amygdala (Milad, Rauch, Pitman & Quirk, 2006). This leads to the assumption that since PTSD patients intensively suffer from traumatic nightmares, the imbalance between the activity of the amygdala as the emotion regulation substrate

and the prefrontal cortex as the critical thinking substrate may as well play a major role in the general population with trauma history suffering from nightmares.

A lesion study, conducted by Koenigs and others (2008), further confirms the hypothesis that a hyperactivity of the amygdala is the major neural mechanism characteristic for symptoms of post-trauma patients. The so-called Vietnam Head Injury Study found out that Vietnam veterans that suffer from a lesion in their amygdala have a lower-than-normal likelihood of the development of PTSD. In fact, the prevalence of developing PTSD among the control conditions – consisting of a group of veterans with no brain lesion and a group of veterans with a non-amygdala lesion – was the same prevalence as found among all Vietnam veterans. But the prevalence found in this VHIS study for amygdala-lesioned veterans was zero percent. This study therefore supports the amygdala-hyperactivity hypothesis regarding the genesis of nightmares and the other PTSD symptomatologies of people who experienced major trauma (Koenigs et al., 2008).

Experiencing a traumatic event during childhood may be an amplifying factor in the extremity of consequences on the psyche and on the brain (Perry, Pollard, Baker & Vigilante, 1995). Traumatic experiences or salient events happening during the maturation of the brain determine the organization and functional status of the fully matured brain. Consequently, the unmaturing brain may incorporate extreme emotional affect in its normal reactions towards stimuli, which quickly becomes pathological (Perry, Pollard, Baker & Vigilante, 1995).

The findings give rise to the assumption that trauma significantly leads to an imbalance between emotion regulatory mechanisms, which again seems to be the cause of the experience of nightmares (Milad, Rauch, Pitman & Quirk, 2006). The role of the prefrontal cortex - to downregulate emotional affection, which is happening in traumatized patients when re-living memories - is disrupted, which leads to frequent nightmare imagery. This disrupted mechanism is found to be especially present in children who have less prefrontal cortex ability to downregulate amygdala activity, due to the incomplete maturation (Perry, Pollard, Baker & Vigilante, 1995).

Emotion dysregulation explained neurologically

The amygdala is the core substrate responsible for generating negative emotional stimuli, and therefore abnormalities in the amygdala are taken as the cause for an emotional dysregulation (Donegan, et al., 2003). The hypothesis raised by the present research question, i.e., whether emotion dysregulation may play a mediating role in the relationship between child trauma and nightmares, may be confirmed based on the neuronal phenomena of nightmares, trauma and emotion dysregulation. Traumatized individuals often suffer from a decreased volume of the mPFC and experience hypersensitivity and hyperactivity of the amygdala (Shin, Rauch & Pitman, 2006). Most healthy people occasionally experience nightmares, and in these cases, the mPFC is not downregulating the emotional load of the dream content as usual. In people who experienced trauma, and especially dramatic in children who experienced trauma, this hypoactivity of the mPFC and the hyperactivity of the amygdala become chronic (Koenigs & Grafman, 2009). This is due to an overload of negative

affect stemming from the traumatic event that leads to an emotional lability and to an emotion dysregulation (Milad, Rauch, Pitman & Quirk, 2006). A child's amygdala, which is still in maturation, suffers even more from the trauma since the prefrontal cortex has not matured to a sufficient degree to downregulate emotional stimuli (Hartley & Lee, 2014). A traumatic event is such an invasive experience that it causes unhealthy reactions in the neurophysiology of the patient. It may be concluded that many children who experienced trauma suffer from an increased frequency of nightmares due to a neurologically caused emotion dysregulation occasioned by a hyperactivity of the amygdala and a hypoactivity of the mPFC.

Psychosocial perspective on nightmares, childhood trauma and emotion dysregulation

Nightmares explained psychosocially

Nightmares are most common at the age between five and ten and children in that age group experience nightmares more often than parents assume, which was found out by comparing children's and parents' questionnaires (Schredl, Fricke-Oerkermann, Mitschke, Wiater & Lehmkuhl, 2008). The production of nightmares seems to be associated with a personality that is characterized by great reactive emotional distress (Levin & Nielsen, 2009).

Factors influencing the frequency of nightmares have been found to be the experience of stressors, such as problems at school, parental divorce or traumatic events that may be sexual abuse or even the experience of wars (Schredl et al., 2008). Furthermore, children frequently

watching violent TV shows are found to experience negatively toned dreams more often (Viemeröe & Paajanen, 1992). For a child, the procedure of going to sleep already involves several stressors, including the end of social contact and darkness (Schredl, Blomeyer & Görlinger, 2000). In addition to the process of falling asleep, the awakening after sleep – in case of having experienced a nightmare – causes stress again, which further increases the frequency of nightmares, like a vicious cycle (Schredl, Blomeyer & Görlinger, 2000). The association found by Schredl et al. (2008) is in line with the other influencing factors for nightmares that have been discussed so far: the highest correlation of nightmares was found with emotional symptoms and problems which include worrying, experiencing anxieties and being nervous. Partly due to the fact that girls have higher values of trait anxiety and emotionality, it was found that girls experience nightmares more often than boys (Schredl et al., 2008). It can be concluded that events with a high emotional load lead to an increased probability of experiencing nightmares (Schredl et al., 2008).

A theory developed by Revonsuo (2000) further shows the incorporation of emotions in nightmares via describing the function of dreaming: to simulate threatening events. This Threat Simulation Theory (TST) of dreaming was inspired by the evolutionary theory: it is suggested that the original function of dreaming was an adaptive solution in order to survive life threats. Repeatedly facing these life-threatening situations via dreams may provide protection in the long run by practising and enhancing threat perception and threat avoidance (Revonsuo, 2000; Valli et al., 2006).

Theories about the function of dreams suggest that dreaming plays a facilitating role in the process and regulation of emotional distress,

triggered by emotional events in daily life (Vandekerckhove & Cluydts, 2010). A restful sleep provides the ability for an individual to cope with emotionally triggering events during the day, therefore sleep has a de-arousing and restorative function. If sleep is disturbed by an over-interpretation and over-imagery of emotional stimuli leading to nightmares, this restorative role gets lost, leading to even more distress. Sleep deprivation causes an even higher sensitivity to stressful and emotional events during the day, which again may lead to nightmares which triggers the downward spiral of sleep disturbances (Vandekerckhove & Cluydts, 2010).

Additionally, sleep disturbances in children and youth, leading to a low sleep quality, have been found to impair the development of cognitive and physical functions (Fernandez et al., 2013). This causes problems at school, a disturbed affect regulation and frustration processing and this again causes huge distress for the child. Consequently, a vicious cycle has been started including poor sleep quality, distress in the child, stress that affects the family and performance, leading to poor sleep again (Fernandez et al., 2013). This emergence of a vicious cycle again shows the major influence of emotions on sleep and dream content and underlines why children are especially prone to experience nightmares after highly emotional-enhancing events such as a traumatic event.

Childhood trauma explained psychosocially

Evidence was found that stimuli which are emotionally arousing are better remembered by individuals than stimuli that are emotionally neutral (Koenigs & Grafman, 2009). This enhancement of the emotional memory

is carried out by the hippocampus-amygdala interaction, where the amygdala's hyperactivity - due to the high emotional load - leads to an enhanced memory of the event in the hippocampus. Individuals suffering from the disorder PTSD have an extreme emotional memory enhancement and their memory of the traumatic event becomes consolidated in an excessive manner (Koenigs & Grafman, 2009). This emotional memory is easily transferred into nightmare imagery (Brewin, 2001). People suffering from trauma-related nightmares often experience a 're-living' of the traumatic event, also known as flashbacks (Brewin, 2001). The traumatic event is not only remembered as one memory as usual, but the content of the situation is accompanied by high sensory details including sounds, vivid visual imagery, smells and other sensory perceptions. The traumatic memory is emotionally charged and thus gets triggered involuntarily very easily via external or internal stimuli, which leads to flashbacks (Brewin, 2001). Valli et al. (2006) found out, that children reported a higher number of dreams containing threatening events and a higher number of threats per dream compared to non-traumatized children. These children activate the threat-simulation response and dream about the traumatic event frequently and intensively, other than children who did not experience real-live threat.

Furthermore, the extent to which a child can cope with high emotions and emotional events is assumed to be influenced by the attachment the child experiences in the setting it is brought up in (Aideuis, 2007) and evidence was found that the type of attachment determines the extremity of symptomatology following a trauma (Waldinger, Schulz, Barsky & Ahern, 2006). This finding further supports the assumption

regarding the influence of emotions on symptoms following trauma. The psychologist Bowlby hypothesized an ethological theory of attachment: He assumes that attachment derives from a biological preparation of parents for the child's future and relates to the extent to which the parents provide the child with care and protection (Leman & Bremner, 2012). The development of attachment is closely connected to and highly responsible for the emotional development of the infant (Leman & Bremner, 2012). A secure attachment – characterized by interaction, security and proximity by the parents – is responsible for the development of a healthy emotion regulation (Aideuis, 2007). This self-regulation of the child develops as a result of parents or caregivers providing a secure environment. This encourages a feeling of safety and receiving help, i.e. in situations where the child is overwhelmed by its feelings, the parent or caregiver provides assistance in coping with the situation. This provides the child with the ability to regulate affects and emotional events on its own (Aideuis, 2007). If this safe environment and secure attachment style is not given, the child's development may go in the exact opposite direction. Neglect and disinterest of the parents lead to the development of a fearful and insecure attachment of the child (Leman & Bremner, 2012). Waldinger, Schulz, Barsky and Ahern (2006) found out that the attachment style the child is surrounded with, has adapted to and develops later, has a significant impact on the somatization and the extremity of symptoms in adulthood. Since the attachment style of the parents determines the emotion regulation of the child, this result further supports the hypothesis that emotion dysregulation is responsible for the high frequency of symptoms including nightmares in children after a trauma.

Emotion dysregulation explained psychosocially

Several psychosocial phenomena give rise to the assumption that emotions play a mediating role in the experience of nightmares in traumatized children. First, nightmares are in general more prevalent in children than in adults and especially emotional symptoms, such as anxiety, are significant predictors of a higher number of nightmares (Schredl et al., 2008). This higher number of nightmares in children can be attributed to the unfinished brain maturation leading to high emotional sensitivity (Perry, Pollard, Baker & Vigilante, 1995). Second, the Threat Simulation Theory of dreaming by Revonsuo (2000) suggests that dreams are a re-experience of life-threatening situations in order to heighten the perception of threats and to self-regulate the exposure to threat. Consequently, since traumatized children are exposed to real-life traumatic events, these children activate the threat-simulation response – dreaming of the event to acquire a better regulation of emotion and perception – more frequently. Others, including Vandekerckhove and Cluydts (2010) assume that dreams play the role of emotion regulators that fails during nightmares. This happens even more extremely in children suffering from PTSD, since they store their traumatic memory in an excessive manner (Koenigs & Grafman, 2009). This extreme memory is not only an exact imagery of the event, but also of other sensory perceptions which in turn increases its emotional load (Brewin, 2001). The emotional load thus plays a determining role in the frequency of nightmares in traumatized children.

The role of emotions becomes even more significant in case of a traumatic event happening in the family environment. A healthy emotion regulation develops via a secure and enhancing environment, leading to a

secure attachment of the child (Aideuis, 2007). If this is not given, but instead neglect, abuse or traumatic events take place emotion dysregulation is the consequence, leading to the experience of nightmares in order to try to decrease the emotional load (Cook et al., 2005; Revonsuo, 2000). Furthermore, if the traumatized child grows up with an insecure attachment style, the child cannot build a healthy emotion regulation, which may be the mediating reason why children with an insecure attachment style at home experience more frequent and extreme PTSD symptoms in adulthood (Waldinger, Schulz, Barsky & Ahern, 2006).

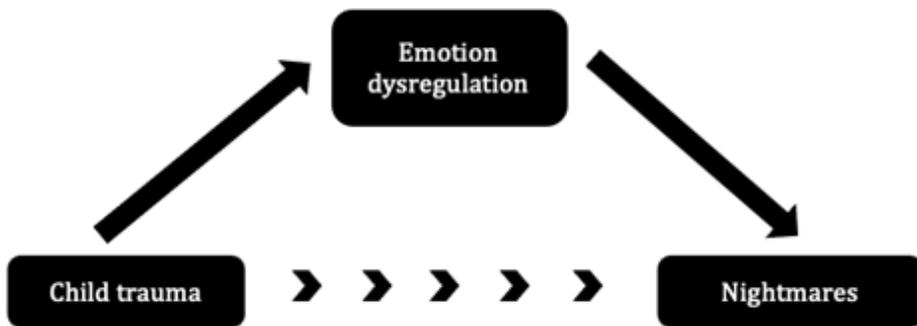


Figure 1. Hypothesized model for the causative pathway of nightmares in children with trauma history.

Modelling the relationship between nightmares, childhood trauma and emotion dysregulation

Based on the discussion about the occurrence, the mechanisms and the circumstances in which children with trauma experience nightmares, a model for the construct and origin of nightmare experience is hypothesized. Both from a neurological perspective, as well as from a

psychosocial perspective, emotion dysregulation seems to play the role of a mediator for the experience of nightmares in children with a trauma history.

The relation between childhood trauma and nightmares

Evidence was found that nightmares occur more often in children who experienced a trauma (Secrist, Dalenberg & Gevirtz, 2019). The experience of post-traumatic nightmares is currently even seen as the 'hallmark' of PTSD (Langston, 2007). From another perspective, Agargun et al. (2003) found out via interviews with undergraduates at a university that the rate of experienced childhood trauma was larger in people who suffered from nightmares.

For many children, nightmares are one of the most prominent symptoms after the experience of a traumatic event (Fernandez, DeMarni Cromer, Borntrager, Swopes, Hanson & Davis, 2013). Traumatic events cause short-term consequences, but nightmares are a symptom that has long-term and severe effects. As children who experience trauma and suffer from PTSD often have nightmares, a search for a specific term was conducted, which shows the high prevalence and common occurrence of nightmares in traumatized children (Fernandez et al., 2013). Often, they are referred to as trauma nightmares, trauma-related dreams or post-traumatic nightmares, but no agreement has been reached in this regard. The occurrence of nightmares in traumatized children is presented with a dotted arrow in Figure 1. It is to be assumed that there is some kind of link since evidence was found that nightmares are frequently occurring in children with trauma. This research paper, however, hypothesizes that this

connection might often be an indirect one (Fig. 1, dotted line), since emotion dysregulation seems to play a mediating role and act as an indirect cause for the nightmare experience.

The relation between childhood trauma and emotion dysregulation

An emotion dysregulation describes a loss of control of emotions, extremely high emotional reactions and extremely rapid changes in emotions (Bradley, DeFife, Guarnaccia, Phifer, Fani, Ressler & Westen, 2011) and emotion dysregulation is suggested to have different possible causative factors. Biological factors as well as temperamental factors, that are intrinsic, may be the reason for emotion dysregulation, but exposure to stressful or chaotic situations in early life – extrinsic factors – as well (Bradley et al., 2011). These may include childhood abuse or the failure of an appropriate attachment of parents or caregivers to the child. An association was found between negative childhood experiences and adult mental health problems including depression and substance abuse. And this association is suggested to originate from the child's vulnerability to emotion regulation because of the exposure to adverse and traumatic events in their childhood (Bradley et al., 2011). Dvir et al. (2014) found an association between affect/emotion dysregulation and PTSD, where an affect dysregulation is defined as the disturbed ability to regulate negative emotional states (Dvir et al., 2014). Furthermore, children that were exposed to traumatic events have a high chance of developing developmental, psychosocial and medical impairments in the long run, and an emotion dysregulation is the core trigger that heightens the risk of

developing pathologies (Dvir et al., 2014). Due to this associations, there is a direct link between child trauma and emotion dysregulation (Figure 1).

The relation between nightmares and emotion dysregulation

Secrist, Dalenberg and Gevirtz (2019) conducted research with the aim to find factors influencing the frequency of nightmares. One of the predicting factors was a low level of emotion regulation. Emotion regulation can be measured on the basis of the individuals' heart rate variability (HRV). HRV is a psychosomatic measurement which determines how capable the individual is of rapidly adjusting to internal and external circumstances such as physiological arousal. HRV reflects oscillation amplitudes. A high complexity and a high variability determine a healthy adjustment to stressors. A low variability, on the other hand, is characteristic for lower levels of recovery of the body and psyche after the exposure to stressors. Thus, HRV is an important measure of emotion regulation capacity (Secrist, Dalenberg & Gevirtz, 2019). With the help of HRV as a measure for emotion regulation, Secrist, Dalenberg and Gevirtz found an association between low HRV, meaning low emotion regulation, and low quality of sleep in children. Furthermore, HRV was even directly associated with the experience of nightmares (in a small sample). Due to significant research that has established the connection of emotion dysregulation and experiencing nightmares, Figure 1 shows a direct arrow between the two factors.

The triangular model

An association was found for the experience of nightmares in children with a trauma history. When investigating this association more closely, emotion dysregulation seems to play the role of a mediator between these two factors, since separate connections were found between child trauma and emotion dysregulation, as well as between child trauma and emotion dysregulation. Thus, emotion dysregulation seems to be explanatory for the experience of nightmares. This assumption was supported by the neurological and psychosocial underpinnings of nightmares, trauma in children and emotion regulation – in each case both individually and in their interplay, as discussed above. Emotion dysregulation seems to play the role of a mediator since nightmares trigger huge hyperactive waves of emotions that neurologically are unable to get downregulated by prefrontal substrates and that psychosocially are unable to be coped with due to learned emotional distress since the traumatic event has happened to an unmatured brain of a child. Consequently, emotion dysregulation can be suggested to constitute a step in between the two factors of child trauma and nightmares (Figure 1).

DISCUSSION

This review discusses whether emotion dysregulation might play the role of a mediator in the relationship between child trauma and nightmares. Based both on the neurological background of nightmares and trauma and on proven psychosocial mechanisms, it may be concluded that emotion dysregulation indeed acts as a mediator. In neurological terms, the

amygdala's activation seems to represent the connecting component between trauma consequences and nightmare aetiology. This substrate for emotion processing acts as an arousal and emotional centre, which exaggerates its activity during nightmares. The emotions of fear or anxiety are represented in an excessive manner leading to a hyperarousal of the amygdala. During this process, the prefrontal cortex should normally downregulate the amygdala's activity, but this is failing during nightmares and a hypoactivity is the result. Indeed, a smaller prefrontal cortex volume was found in children with PTSD (Schredl et al., 2008). In children experiencing trauma, this amygdala hyperactivity and mPFC hypoactivity becomes chronic due to the excessively intrusive event that conditioned the activity of the substrates mentioned above and the unmatured brain which already has an imbalance between amygdala and prefrontal cortex (Nielsen & Lara-Carrasco, 2007; Levin & Nielsen, 2009; Van der Helm et al., 2011; Shin, Rauch & Pitman, 2006; Perry, Pollard, Baker & Vigilante, 1995).

In psychosocial terms, emotion regulation is learned via a secure attachment style from the parents. If this is not given, for example due to neglect or disinterest, the child cannot develop a secure emotion regulation leading to huge emotion processing problems at night. Children growing up with an insecure attachment style from the parents experience a higher somatization of the PTSD symptoms in adulthood. This includes the frequent experience of nightmares, where the brain does not process the emotionality of the dream content correctly but in an excessive fashion. Furthermore, nightmares are associated with emotional symptoms in children, and a theory hypothesizes that nightmares simulate threat perception that took place during the day, which is happening in children

exposed to trauma. Emotion regulation seems to play a major role in the aetiology of traumatized people who experience nightmares, and this major role is even more important in children experiencing trauma. When a child experiences a trauma, it is still in the development of emotion regulation and cognitive functions such as critical thinking, which further means that an extreme emotional event may disrupt the healthy development of the prefrontal cortex and amygdala. (Schredl et al., 2008; Revonsuo, 2000; Leman & Bremner, 2012; Aideuis, 2007).

On both the neurological and the psychosocial level, emotions and emotion dysregulation seem to act as a mediator in the relationship between trauma in children and their frequent experience of nightmares. Consequently, therapies for children with nightmares due to a trauma experience may be enhanced via focusing on the improvement and acquisition of a healthy emotion regulation. If a traumatized child learns how to cope with waves of different extremities of emotions, how to process emotions and how to reflect emotions, the frequency of nightmares may decrease.

Limitations and Implications

The theoretical framework and model approached in this review paper is hypothetical and hypothesized via discussing current literature. All conclusions and findings should be tested scientifically via empirical research. Empirical research is needed to test whether an emotion regulation therapy can significantly decrease the frequency and intensity of nightmares in child trauma patients. In case of a significant decrease of nightmare frequency and intensity, clinics with a population of trauma

patients may include an emotion regulation therapy, such as mindfulness-based therapy, in the treatment plan of traumatized children suffering from nightmares.

In terms of research, the hypothesized model might be strengthened via further empirical research, in order to obtain a more reliable arrow construction. In this review, there is a dotted line between child trauma and nightmares, which implies the need for further evidence as regards the possible direct connection between the two factors of child trauma and nightmares, since the literature review cannot explain the whole interplay, or confirm that emotion dysregulation is the mediator in every case, for every patient. In addition, the connection of emotion dysregulation leading to nightmares needs more empirical evidence as well, since the HRV approach has been criticised. HRV alone may not be enough to explain the occurrence of emotional distress, which emphasized the need for more evidence for this connection.

Furthermore, especially in the section about the neurological perspective, a significant part of literature was taken from adult population. The adult population studies were used for the explanation of the three components of nightmares, trauma and emotion dysregulation. In addition, literature based on studies carried out in children was used for explaining the age factor as an amplifying factor for mechanisms occurring in adulthood. Due to the focus on child population in this review, reliability for the neurological underpinnings in children may be enhanced. More research is needed regarding the neurological underpinnings of nightmares in a child population to get more reliable and direct results. In the future, functional imaging methods may be used to study amygdala and prefrontal

cortex activity in children and adolescents, maybe even in comparison to adults, to verify and further support the hypothesis of childhood as an especially susceptible age to nightmare imagery after a traumatic event due to emotion regulatory disturbances.

Additionally, literature used for this review regarding the explanation and symptoms of traumatized patients was a mixture of studies conducted in people diagnosed with PTSD and patients suffering from post-traumatic nightmares, but it is not clearly stated that they are diagnosed with PTSD. Since research in nightmares, and especially its neurological underpinnings is only a relatively new field of research, this review could not focus on only one of the two populations, but future studies may separate the two groups and may even find interesting results when comparing the two.

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