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Obstructive Sleep Apnea? More Like *Des*tructive Sleep Apnea: Examining the Relationship Between OSA and PTSD, and How Treatment Could be Improved

As of today, there is a large number of studies that examine the relationship between posttraumatic stress disorder, also known as PTSD, and sleep. Sleep disturbances such as night terrors and insomnia are a key symptom of PTSD and may have an important role in the maintenance of PTSD. A reason as to why sleep could have an important role in PTSD is because a lack of sleep can lead to lessened cognitive function, allowing for the symptoms of PTSD to worsen over time. As well, memory processing can be affected by frequent sleep disturbances which may make it more difficult to treat PTSD. Insomnia is argued to be a mechanism that is involved in the development and maintenance of PTSD due to its effects on sleep and its high comorbidity rate with PTSD (Lommen et al., 2015). As many as 70-90% of patients with posttraumatic stress disorder report frequent experiences with sleep disturbances (Lancel et al., 2021). This means that there is a high comorbidity rate for sleep disturbances (insomnia and night terrors) and PTSD, as further supported in a 2019 study 81% of PTSD participants experience severe insomnia and 69% experienced nightmare pathology (Boer et al., 2019). This is proven to be true with another sleep disturbance that is associated with PTSD – obstructive sleep apnea (OSA). For specifically veterans, a population largely affected by PTSD, the prevalence rates of OSA range from 40-80% (Barbir et al., 2019). OSA can be defined as repeated episodes of pauses in breathing and shallow breathing while sleeping. This is associated

with sleep fragmentation, meaning that the REM stage of the sleep cycle is broken up as the person goes in and out of it due to oxygen deprivation. This is similar to the effects of night terrors as that causes the person to wake up throughout the night, causing sleep fragmentation. However, while OSA may negatively affect sleep in a similar manner as night terrors and insomnia, both are studied and treated differently. Night terrors and insomnia are often treated with sleep medication and cognitive behavioral therapy (CBT). With OSA, the person affected may have to wear a continuous positive airway pressure (CPAP) machine, a medical device that delivers pressurized air through tubing into a mask worn while the user sleeps. Additionally, the process to get tested for OSA can be tedious and invasive, often requiring the person to stay overnight at a sleep lab. Both treatments heavily vary between their accessibility, the assessment process, and overall treatment cost. This then begs the question, if OSA is affecting sleep in a similar way as insomnia and night terrors, then why is it not studied or treated as commonly in PTSD populations? This paper will aim to examine if implementing OSA treatment into PTSD treatment (if the patient has OSA) can result in a similar outcome as a patient being treated for insomnia and PTSD as well as bring more awareness to obstructive sleep apnea and how it can be destructive if left untreated.

Importance of sleep in relation to PTSD

To better understand why it is important to consider OSA for treatment in regards to PTSD treatment, the relationship between sleep and PTSD management must be examined first. There exists a reciprocal relation between sleep disturbances and PTSD that suggests that sleep can be a causal factor in PTSD symptoms. This is partly based on sleep's role in memory consolidation and emotion regulation (Lancel et al., 2021). Both occur in the REM stage however the ability to process emotional memories primarily within it while memory

consolidation can take place during slow wave sleep. This means that as a result of REM disturbances, there could be a hindrance in extinction memories which are a key part in PTSD treatment. Through extinction learning, the patient can learn that the previously conditioned stimulus no longer represents a threat and therefore can show improvement in the management of PTSD symptoms (Lancel, 2021). Fear extinction does not necessarily mean that the patient is erasing the traumatic association with their memory, but rather there is a formation of a new inhibitory memory that is associated with a certain conditioned response instead of a fearful or avoidant response (Pace-Schott et al., 2022). This process of extinction learning involves conditioning the patient to have a more maintained lowered reactivity to the stimuli associated with their trauma. However, if there is failure in consolidating extinction memories, traumatic memories can still persist and become generalized, leading to the worsening of PTSD symptoms. Additionally, with the decrease of emotional memory processing, there can be a substantial decrease of deep sleep and lower sleep quality (Boer et al., 2014). Furthermore, there have been studies that suggest that lack of sleep can lead to heightened subjective fear ratings and greater psychophysiological responding during fear conditioning (Pace-Schott et al., 2022). This shows that due to the lack of REM sleep specifically, there was a failure to consolidate extinction memories, leading to a heightened emotional response to stimuli associated with the patient's trauma. What this suggests is that the reason why sleep has such an important role in managing and treating PTSD symptoms is due to how sleep disturbances disrupt REM sleep which in turn hinders emotion processing and memory encoding. This makes it more difficult for the patient to consolidate their extinction memories, causing them to continue experiencing emotional and heightened responses to their trauma.

A limitation that both Lancel's and Pace-Schott's papers share is how despite having numerous studies that examine sleep disturbances in relation to PTSD, it can still be difficult to treat both. Within Lancel's article examining a variety of sleep disturbances and synthesizing numerous papers, it is noted that despite the fact that all of the sleep disturbances mentioned are associated with PTSD, there is a lack of a screening instrument that can more effectively and accurately test for all sleep disturbances. As a result, there is no specific guideline for the assessment of sleep disorders in PTSD. Similarly, Pace-Schott mentions that there are many factors that can influence sleep quality and PTSD such as the patient's brain biology, their personality traits, and behavioral effects of psychopathology (e.g. substance use) (Pace-Schott et al., 2022). These are all aspects to consider when trying to treat sleep disturbances and create a guideline for its assessment. Additionally, there is still a clear gap of knowledge of the specific links between sleep and PTSD despite the numerous studies about the relationship between the two. Many of these studies are also limited by the small sample size that they study, reducing their external validity for generalizability.

A factor that can affect sleep quality and is associated with sleep disturbances is rumination, which can be defined as repetitive thoughts about negative feelings and problems. This is associated with worse mental health symptoms and increased emotional distress among veterans (Borders et al., 2015). Borders' study focuses on how sleep problems may mediate associations between rumination and PTSD among OIF/OEF veterans. As rumination is associated with sleep, heightened rumination may worsen the sleep quality which can result in more difficulty with managing PTSD symptoms. This is because the lack of sleep contributes to memories retaining the same magnitude of emotional charge due to the lack of REM sleep the person may receive. While there have been numerous studies in regards to rumination and its

link to poor mental health among nonveterans, the veteran population has yet to be studied as thoroughly. It seems as though including more veteran populations within these PTSD and sleep studies is a novel item and even with that novelty, there are many links between certain sleep disturbances that have yet to be studied entirely. As important as it is to note that the population this study examines is one that needs to be studied more, it focuses on exclusively OIF/OEF veterans which is very limiting as shown by its sample size of 89. This decreases its external validity and generalizability to a larger population due to the sample size and the specificity of this sample. Additionally, this study found that sleep problems may mediate the relationship between rumination and PTSD symptoms but further study is needed in order to gain more clarity on how it is a mediator.

OSA and where it all fits in

Common sleep disturbances that are associated with PTSD include insomnia and night terrors. However, there is another sleep disturbance that is associated with PTSD but specifically in a veteran population and that is obstructive sleep apnea, also known as OSA. In the general population, OSA prevalence was found to range from 9% to 38% however, these rates significantly increase in veteran populations as the rates range between 67% and 83%. This is in regards to the overall veteran population, looking specifically at veterans with PTSD, OSA prevalence was 75.7% (Colvonen et al., 2021). OSA is strongly linked to fragmented sleep similar to both sleep disturbances. Additionally, OSA is linked to lower sleep efficiency which is associated with more frequent and larger mood fluctuations (Colvonen et al., 2021). The relationship between OSA and PTSD can be found in Liempt's study from 2011. The objective of this study was to determine if OSA was associated with more severe PTSD complaints. There were a total of 61 participants; 20 of which were Dutch veterans with PTSD, 24 veterans

without PTSD, and 17 civilians or service members that acted as the healthy control. It was found that there was a relationship between PTSD severity and the AHI. PTSD patients with an AHI greater than 10 exhibited significantly higher CAPS scores compared to PTSD patients without OSA (Liempt et al., 2011). This suggests that the occurrence of OSA can be associated with higher levels of PTSD symptoms. However, one of the main limitations of this study is its small sample size and its lack of representation of the population as it consisted of a homogenous group of middle-aged male veterans. It should also be noted that the observations from this study contrast with previous reports as other studies reported high indices of AHI in 69-91% of PTSD patients while this study reported 10%. This could be due to a difference in the screening instruments used for detecting OSA and how these measures may have varied in sensitivity for diagnosing OSA.

What this means is that effects that the OSA has on sleep are similar to the effects of insomnia and night terrors and that it may have a similar relationship with PTSD. However despite these similarities, there are estimates that 80-90% of veterans with OSA remain undiagnosed (Colvonen et al., 2021). Colvonen's study focuses on how screening and treating OSA could affect residential treatment for PTSD and SUD (substance use disorder). All of the screening and treatment took place on site within the residential unit for the SUD rehabilitation program. Each patient would continue the program for 4-5 weeks and would be screened for OSA. It was found that 53.5% of the 45 veterans participating in the study met criteria for a diagnosis for OSA. This shows how if it was not for the screening process for OSA, half of the veterans in the residential program would have been left untreated and would face the potential detrimental effects as a result. It should be noted that one of the main limitations of this study is the sample, specifically the size and the population that was sampled. This sample was limited

by the location as it took place at the VA Healthcare System in San Diego and accessibility was limited as not all veterans within the system were undergoing the process for the SUD rehabilitation program. As well, since the sample had a very limited scope, there were only 47 participants with 2 participants dropping out resulting in a final total of 45 veterans. This decreases the generalizability of this study however it should be noted that the findings of this study can still open doors for increasing the scope for assessing sleep disorders in those with PTSD and therefore potentially bettering its treatment.

This then begs the question, why is OSA often left untreated in many patients with PTSD? In another study conducted at the VA San Diego Healthcare System, Barbir examines the relationship between subjective and objective data of OSA risk in veterans with PTSD and insomnia. It implements the usage of screening measures like STOP-BANG (snoring, tiredness, observed apnea, high blood pressure, body mass index, age, neck circumference, and male gender) questionnaire. This is an 8-item self-report questionnaire that is used to assess risk for OSA with higher scores indicating a higher risk and lower scores indicating a lower risk (Barbir et al., 2019). Additionally, they used NOX T3 sleep monitors to measure apnea-hypopnea events per hour (AHI) which is a measure that is utilized to diagnose OSA severity. The findings of the study show that there were no significant differences in STOP-BANG scores based on severity of OSA. As well, the STOP-BANG scores did not significantly predict OSA severity. What this means is that this screening measure that has been used to detect risk for OSA lacks specificity and sensitivity suggesting that younger veterans may not be appropriately screened for OSA. As shown by previous studies, untreated OSA can be detrimental to the management of PTSD symptoms and by finding that a screening questionnaire for OSA risk may not be assessing accurately is concerning. STOP-BANG is a well established screening assessment however in

this study, it did not provide support for its use to detect risk for OSA in younger veterans with PTSD and insomnia (Barbir et al., 2019). The screening measures used could have been a limitation of this study as it was only the STOP-BANG and NOX T3 scores that were measured. However, both are used to diagnose OSA risk and severity respectively so it was important for the both of them to be studied and applied to a sample of younger veterans. Similar to previous studies, this one also had a very small sample size as there were only 38 veterans that were screened and examined. That should not deter one from completely throwing away the results of the study as it is important to note that some of the assessment measures for OSA may not be applicable to all veterans and may not be accurately assessing for OSA risk.

Synthesis

After thoroughly reviewing all of the studies mentioned above, it can be concluded that obstructive sleep apnea (OSA) affects posttraumatic stress disorder (PTSD) in a similar fashion as insomnia, and that by implementing better assessment and improving treatment rates for OSA, those who are diagnosed with OSA and PTSD could potentially find improvement in their treatment like their counterparts with insomnia and PTSD. Many of these studies are centered around the relationship of sleep and PTSD in regards to certain sleep disturbances however they vary in their strengths and limitations. One limitation that was often found in these studies is the lack of a large and representative sample. A majority of the studies mentioned had less than 100 participants and were limited by the location of the study, the specific veteran population, and the fact that typically a majority of the veterans were male. They lack external validity as a result because due to having a small sample size, it is difficult to generalize the findings to a wider population. This is something that was interesting because it seems as though these studies are novel despite studying a topic that has a good amount of literature behind it. As well, despite all

of the literature about sleep and PTSD, there exists clear gaps of knowledge about the relationship and how exactly sleep plays a role in PTSD.

Although, even with these gaps of knowledge, it is still possible to see some of the similarities that can be found between REM sleep disturbances like insomnia and OSA. Both have been examined in different ways however due to their mechanisms and how they affect REM sleep specifically, they have a similar effect on PTSD. However, something that differed between the studies was the assessment for sleep disturbances. There are many well established ways to assess insomnia accurately, but when it comes to OSA, there are variations in methods used to assess it and these methods may differ in accuracy and sensitivity in their measures. Even if an assessment method is well established, it is possible that it may not accurately screen for OSA risk for all age ranges which is important as age can be a factor in assessing risk. This was seen in Barbir's study as while STOP-BANG was well established, it lacked support for its accuracy when it was used for younger veteran populations. It shows how while OSA has prevalence rates in veterans with PTSD similar to insomnia prevalence rates in veterans with PTSD, OSA is treated less frequently due to potential failure in accurately screening for OSA as it may not even be considered as a comorbid condition from an initial assessment unlike other sleep disturbances like night terrors or insomnia.

Future directions

It has been established that OSA is prevalent in veterans with PTSD and that if left untreated, it may have detrimental effects on the health of the veteran and make it more difficult to treat and manage their PTSD symptoms. What this entails is that there needs to be a better or more accurate way to screen for OSA risk and diagnosing it in veterans. To start off, it is a given that future studies for sleep and PTSD have to improve their external validity by garnering a

larger and more representative sample size, especially in regards to gender and age. It was shown in Barbir's study that a well-established screening assessment for OSA failed to appropriately detect risk in younger veterans with PTSD and insomnia which did not provide support for its use in a different age range. As well, this questionnaire was a self-report and only had 8-items. For future screenings, there should be an assessment developed to address OSA risk factors in more depth and provide more sensitivity in its measures. This would allow for the detection of OSA to be improved, meaning that more veterans with untreated OSA and PTSD could finally be treated for their OSA which can lead to improvement in their PTSD treatment. Additionally, in regards to gender representation, a majority of the veteran participants in many of the studies were male. There is the possibility that women may experience higher levels of intensity for their nightmares and report higher distress in PTSD symptoms (Sexton et al., 2017). This means that for future research and development of screening measures for sleep disturbances, more women should be included in the samples. If there is a better perspective on gender differences, then this could allow for a broader assessment of PTSD symptoms and allow for improvement in PTSD treatment for everyone, not just middle-aged men.

Another thing that needs to be done next is closing the scientific gap on sleep and its relationship to PTSD. Future studies should include more sleep disturbances than just insomnia and night terrors so that the assessment for sleep disturbances in those with PTSD can cover a wider variety of them, allowing for potential improvement in PTSD treatment. It can be difficult to determine what specific sleep disturbance one may be experiencing as many can share similar symptoms, but by taking the time to accurately assess for it, it can improve the patient's reception to PTSD treatment and their management of PTSD symptoms. In regards to sleep and PTSD in general, future studies should look more into the mechanisms of sleep and how they

compare to the mechanism of PTSD. It is possible that there could be overlap in the mechanisms or that certain mechanisms can interact with each other. In doing so, a better understanding of how sleep plays a key role in PTSD and its symptoms can be further developed. This could also open doors for improvement in sleep treatments as sometimes sleep disturbances like insomnia cannot be fully treated with drugs and CBT.

Lastly, more studies about veterans with PTSD and OSA should be conducted. As well, the importance of early screening and treatment for OSA should be discussed more in publications and research. It was shown that OSA is prevalent in the veteran population and is associated with PTSD however OSA is often left untreated or even unscreened in PTSD treatments. The findings of the studies reviewed in this paper suggest that there needs to be an implementation of better OSA detection and assessment for risk factors in PTSD treatment for veterans. In doing so, the overall health and well-being of the veteran can be improved as they would benefit from OSA treatment to better their sleep quality which in turn can improve their PTSD treatment and symptom management. This leads to the question of, if OSA is treated alongside PTSD, will the veterans' symptoms of PTSD decrease overtime in comparison to those with PTSD and untreated OSA?

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