Review / *Derleme*

DOI: 10.4274/jtsm.galenos.2023.87059

Journal of Turkish Sleep Medicine 2024;11(3):141-146

Earthquake and Sleep Health Effects

Deprem ve Uyku Sağlığı Etkileri

Ege Güleç Balbay, Ali Nihat Annakkaya, Öner Balbay

Düzce University Faculty of Medicine, Department of Chest Disease, Düzce, Turkey

Abstract

Despite receiving little attention in the scientific literature, earthquakes are known to affect sleep patterns indirectly and can contribute to the development or worsening of sleep disorders. Earthquake-caused disruptions, such as structural damage, displacement, and unstable living conditions, create uncomfortable and anxious sleeping environments. Psychological factors such as fear, stress, and anxiety can contribute to sleep disruption. Physical injuries from earthquakes can disrupt sleep due to pain and discomfort. Additionally, infrastructure disruptions such as power outages and utility damage create uncomfortable or unsafe sleeping conditions. This review presents a comprehensive and systematic overview of the relationship between earthquakes and sleep health.

Keywords: Anxiety, earthquake, positive airway pressure (PAP), sleep, stress

Öz

Bilimsel literatürdeki sınırlı ilgiye rağmen, depremlerin uyku düzenini dolaylı olarak etkilediği ve uyku bozukluklarının gelişmesine veya kötüleşmesine katkıda bulunabileceği bilinmektedir. Depremlerin neden olduğu yapısal hasarlar, yer değiştirmeler, dengesiz yaşam koşulları gibi aksamalar rahatsızlık, endişe ve yetersiz uyku ortamları yaratır. Korku, stres ve kaygı gibi psikolojik etkiler uyku bozukluklarına katkıda bulunabilir. Depremlerden kaynaklanan fiziksel yaralanmalar da ağrı ve rahatsızlık nedeniyle uykuyu bozar. Ek olarak, elektrik kesintileri ve kamu hizmetlerinin hasar görmesi gibi altyapı kesintileri, rahatsız edici veya güvensiz uyku koşulları yaratır. Bu derleme, depremler ve uyku sağlığı etkileri arasındaki ilişkiye kapsamlı ve sistematik bir genel bakış sağlamayı amaçlamaktadır.

Anahtar Kelimeler: Kaygı, deprem, pozitif hava yolu basıncı (PAP), uyku, stres

Introduction

Earthquakes are devastating, causing significant loss of life, injuries, displacement, and environmental damage. With over a million earthquakes occurring worldwide each year, the frequency and severity of these events highlight the importance of understanding their effects on human health.[1,2] Earthquakes are natural disasters that can have serious effects on individuals' overall well-being, including their sleep quality.[3] The relationship between earthquakes and sleep disorders has received little attention in scientific literature. However, earthquakes are known to have an indirect impact on sleep patterns, contributing to the development or exacerbation of sleeping disorders in a variety of ways.

Earthquakes can cause structural damage to buildings, displacing people from their homes and creating unstable living conditions. These disruptions can cause discomfort, anxiety, and a lack of conducive sleeping environments, making it difficult for people to sleep or maintain consistent sleep patterns. Following an earthquake, people may be displaced from their homes and forced to live in temporary shelters or evacuation centers. These living conditions may not provide the comfort and privacy required for good sleep. Overcrowding, noise, and unfamiliar surroundings can all cause poor sleep quality.[4,5]

Earthquakes are traumatic events that can have a significant psychological impact on people. Earthquake-related fear, stress, and anxiety can result in various mental health issues, such as post-traumatic stress disorder (PTSD), anxiety disorders, and depression. These psychological conditions can severely disrupt sleep and contribute to the emergence of sleeping disorders.[6,7]

Earthquakes can cause physical injuries, such as fractures or musculoskeletal pain, making it difficult to find a comfortable sleeping position. Pain and discomfort can disrupt sleep, leading to more sleep disturbances.[8,9]

Earthquakes can disrupt infrastructure, resulting in power outages or damage to utilities such as electricity, water, and sewage systems. Environmental changes, such as a lack of lighting, extreme temperatures, or increased noise levels, can make sleeping uncomfortable or unsafe.[10]

In addition, several factors can influence continued positive airway pressure (CPAP) therapy during and after an earthquake. Earthquakes can cause power outages, which can disrupt CPAP therapy. Without electricity, patients may be unable to power their CPAP devices, disrupting their treatment.

Address for Correspondence/Yazışma Adresi: Prof. Dr. Ege Güleç Balbay, Düzce University Faculty of Medicine, Department of Chest Disease, Düzce, Turkey
Phone: +90 533 252 87 94 **E-mail:** egegulecbalbay@gmail.com **ORCID-ID:** orcid.org/0000-0002-1557-7019
Received/Geliş Tarihi: 15.06.2023 **Accepted/Kabul Tarihi:** 23.10.2023

This review aims to provide a comprehensive and systematic overview of the relationship between earthquakes and sleep health impacts (Figure 1). By synthesizing existing research and identifying knowledge gaps, this review aims to shed light on the short- and long-term effects of earthquakes on sleep quality, sleep disorders, and the implications for individuals' overall health and well-being. The findings of this review will help to improve our understanding of earthquakes' multidimensional effects on human health and provide insights into disaster preparedness and post-earthquake recovery strategies.

Disruption of the Sleep Environment

Following an earthquake, people may need to leave their homes and seek temporary shelters in places such as evacuation centers or makeshift shelters. These environments frequently lack the comfort, privacy, and familiarity required surroundings quality sleep. Overcrowding in these facilities can cause noise disturbances, increased discomfort, and a lack of personal space, all of which can disrupt sleep.

Tempesta et al.[11] used the Pittsburgh sleep quality ındex (PSQI) to evaluate sleep quality in 665 earthquake-affected L'Aquila residents. When the results of the study were compared with those before and after the earthquake, they showed a significant decrease in sleep quality. Two years after the earthquake, citizens had the highest PSQI scores (indicating poorer sleep quality) and the highest incidence of disruptive nocturnal behaviors (DNB) compared with those in the surrounding areas. Interestingly, participants living within 70 km of the epicenter had above-threshold PSQI scores, indicating sleep disturbances, whereas trauma-related DNBs were found in people living within a 40-km radius. The findings also suggested a possible mediating effect of depression on PSQI scores, implying that depression may contribute to the observed sleep disturbances. The study found that the psychological effects of an earthquake can extend beyond the immediate building destruction and persist for years, affecting a larger population. The findings revealed a decrease in sleep quality and an increase in DNB 2 years after the earthquake, which may be risk factors for the development of depression and PTSD.[11]

A study in the United States focused on transition-age youth (TAY) aged 18-25 years and aimed to investigate the relationships between sleep disturbances and two factors: sheltered status and perceived safety of the usual sleep environment. The study included 103 participants, 60% of whom reported being sheltered. The results showed that 26% of the participants reported moderate-to-severe sleep disturbances. Data analysis revealed that sleep disturbance was not significantly associated with shelter status. It was, however, positively associated with a sense of being unsafe in one's sleeping environment. This suggests that the perception of safety in the sleep environment is a more significant contributor to sleep disturbances among TAY experiencing homelessness than it is among those who are sheltered. The study also identified other factors associated with sleep disturbances among TAY. These factors included depression symptoms, severe food insecurity, and a younger age. These findings indicate that a variety of factors, including mental health, access to sufficient food, and age, contribute to sleep disturbances in this population. Based on the findings, the study concludes that sleep disturbances are more closely related to how safe people feel in their sleep environment than to their shelter status.[12]

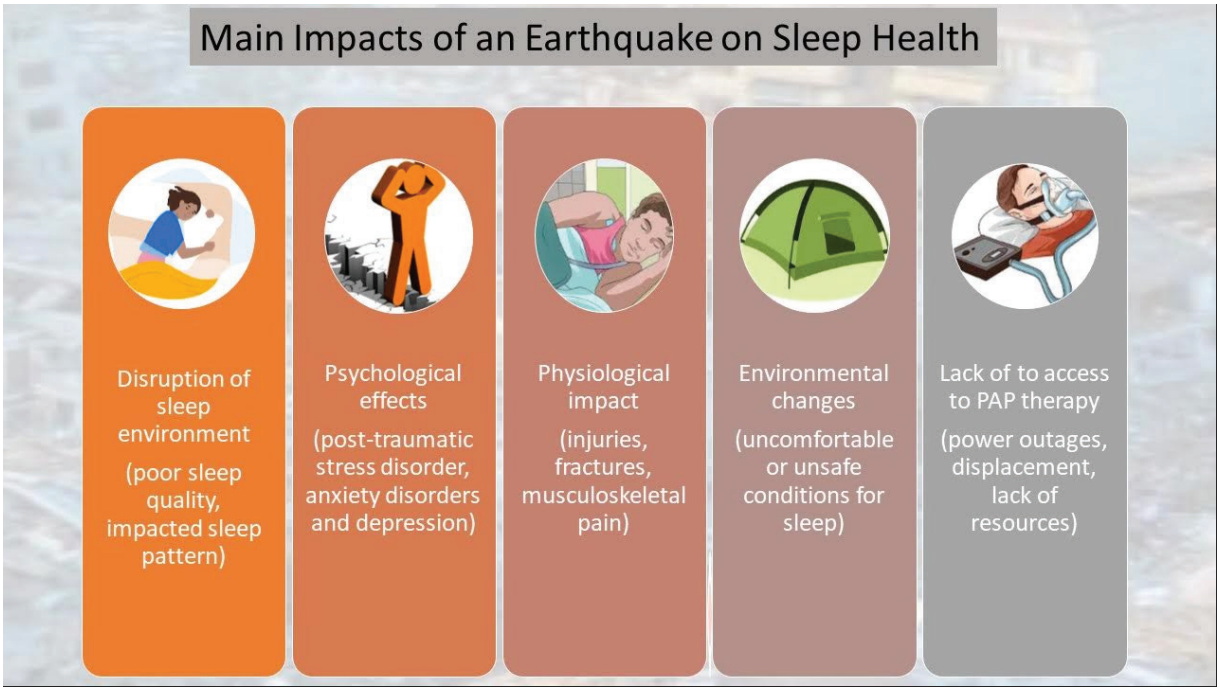

Figure 1. Relationship between earthquakes and sleep health effects
PAP: Positive airway pressure

Addressing these sleep-related issues in the aftermath of an earthquake is critical to the well-being and recovery of those affected. Efforts should be made to provide appropriate and safe temporary housing that prioritizes privacy, comfort, and noise reduction. Psychological support and counseling services should also be made available to help people deal with the emotional aftermath of the earthquake and reduce anxiety and stress, which can improve sleep quality. Furthermore, promoting good sleep hygiene practices and providing access to sleep aids or relaxation techniques can help manage sleep disturbances during this challenging time.

Psychological Impact

Earthquakes can cause severe psychological distress, including PTSD, which can disrupt sleep. Individuals who have been through a traumatic event may experience nightmares, flashbacks, and intrusive thoughts, which can disrupt their sleep and lead to insomnia.[13-15]

Jiang et al.'s[15] study focused on a specific group of earthquake survivors who remained in temporary housing camps for about 2 year following China's Wenchuan earthquake. The researchers aimed to determine the prevalence of sleep disorders, PTSD, depression, and anxiety among these survivors. The study included 387 people who had sleep problems and continued to reside in temporary housing camps 17-27 months after the earthquake. According to the findings, the vast majority of survivors (83.20%) reported having sleep problems. Insomnia was the most common sleep problem (79.33%). Among the participants, 12.14% showed symptoms of PTSD, 36.43% had depression, and 38.24% had anxiety.[15]

The study, conducted in Minamisanriku Town, aimed to determine the prevalence and risk factors for sleep disturbance among people affected by the 2011 Great East Japan Earthquake. The study divided the patients into two groups: those with mental health issues other than sleep disturbance and those with other comorbidities. Of the patients with mental health issues, 60.0% reported sleep disturbance, indicating the need for specific treatments. Among the remaining patients with other comorbidities, 12.1% reported sleep disturbance. It is important to note that sleep disturbance affects both patients with mental health issues and those without. The study used univariate and multivariate analyses on patients with other comorbidities to identify risk factors for sleep disturbance. The findings revealed that females, elderly people over the age of 60 years, and those living in evacuation centers experience more sleep disturbance.[14]

Physiological Effects

The relationship between sleep and pain is bidirectional, which means that sleep deprivation can both cause and result from pain. Several bodily systems have been identified as contributing to the interaction of sleep and pain. These include the opioid, monoaminergic, orexinergic, immune, melatonin, and endocannabinoid systems, as well as the hypothalamus-pituitary-adrenal axis, adenosine, and nitric oxide signaling. These systems interact with one another and with other neural pathways, influencing sleep quality and pain perception. Disruptions in any of these systems caused by sleep deprivation or pain conditions can set off a vicious cycle in which poor sleep leads to increased pain, which then interferes with sleep, exacerbating the problem.[8]

Earthquakes can result in physical injuries like fractures, musculoskeletal pain, and other trauma, making it challenging to find a comfortable sleeping position. Pain and discomfort can disrupt sleep, leading to more sleep disturbances. When people are injured in an earthquake, the resulting pain and discomfort can make it difficult to find a position that relieves or reduces the pain. Lying down or putting weight on the injured areas may aggravate the discomfort, making it challenging to fall asleep and stay asleep all night.[8,9]

Sleep disturbances caused by earthquake injuries can have a variety of consequences. Sleep is essential for the body's healing process, and inadequate sleep can impede recovery from injuries. Furthermore, sleep deprivation can have a negative impact on overall well-being, mood, cognitive function, and immune system function, slowing down the healing process.[16]

Environmental Changes

Natural disasters, such as earthquakes, can cause environmental changes that make sleeping uncomfortable or unsafe. Below are some specific examples:

Lack of lighting: Earthquakes can cause power outages, resulting in a lack of lighting in homes and temporary shelters. This can make it difficult for people to feel safe and comfortable when they try to sleep.[17,18]

Extreme temperatures: After an earthquake, infrastructure disruptions may affect heating and cooling systems. This can produce extreme temperatures, either too hot or too cold, making it challenging to sleep comfortably.[19,20]

Increased noise levels: Earthquakes are frequently accompanied by loud noises, such as shaking, structural collapses, sirens, and emergency response operations. These noises can persist even after the initial event, causing disruptions and making it difficult to fall asleep or sleep uninterruptedly.[21-23]

Unfamiliar sleeping environments: After an earthquake, people may have to sleep in unfamiliar places, such as temporary shelters or crowded evacuation centers. These environments can be noisy, uncomfortable, and lack privacy, reducing sleep quality.[24-27]

Individuals affected by earthquakes may experience sleep disturbances, insomnia, and increased levels of stress and anxiety as a result of these factors.[28-30]

Li et al.'s[31] study aimed to investigate the relationships between disaster experiences, social support, and sleep problems in older adults who experienced the 2011 Great East Japan earthquake and tsunami. A follow-up survey was conducted in 2013, around 2.5 years after the disaster. The findings of the study revealed that financial hardship was significantly associated with an increased risk of several sleep problems. Financial hardship was associated with an increased risk of short sleep duration, sleep insufficiency, poor sleep quality, and insomnia symptoms. Home destruction was found to predict the use of sleep medication, implying that people who had their homes

destroyed were more likely to rely on it. Healthcare disruption was linked to poor sleep quality. Interestingly, the study found that the loss of close relatives or friends did not predict any ongoing sleep problems. This indicates that, despite the emotional impact of losing loved ones, it may not have a direct and long-term impact on sleep in older disaster survivors. The study emphasizes the importance of addressing the specific needs of older survivors, particularly those related to sleep health, as part of targeted recovery efforts to improve overall well-being in this population.[31]

Secondary Effects on Mental Health

In addition to the immediate effects of the earthquake, long-term consequences such as loss of property, displacement, and ongoing stress can have a significant impact on mental health. Depression, anxiety, and other mental health disorders can lead to sleep problems and insomnia.[7]

Eray et al.[32] investigated the long-term effects of relocation and social support on the mental health of adolescents who had survived the Van earthquake. The researchers divided the study group into two groups: adolescents who were relocated following the earthquake and those who remained in their original location. They also included a control group of unaffected adolescents as a comparison. The study found a significant difference in child PTSD scores between the earthquake-affected study groups, with higher scores in the relocated group. This indicates that adolescents' mental health may suffer as a result of their relocation following an earthquake. Furthermore, among earthquake-affected participants, those who had personally witnessed the death or injury of a family member or friend had significantly higher PTSD scores than the others. This finding emphasizes the profound impact of traumatic experiences, particularly those involving the loss or harm of loved ones, on adolescents' mental health. On a positive note, the study emphasized the significance of strong family support in assisting adolescents in dealing with psychological problems. The presence of a supportive family has been shown to play an important role in promoting preventive mental health measures and facilitating psychological recovery in the aftermath of natural disasters such as earthquakes. In conclusion, the study indicates that an earthquake can have a negative impact on adolescents' mental health in the long run. Relocation and exposure to traumatic experiences, such as witnessing a loved one's death or injury, were associated with increased PTSD scores. However, the study emphasizes the importance of social support systems, particularly those within the family, in mitigating the negative impact and assisting adolescents in their psychological recovery after such disasters. Strengthening social support networks, particularly within families, may thus be an important factor in improving the mental health of adolescents affected by natural disasters such as earthquakes.[32]

PAP Therapy

Many factors influence PAP device compliance, including obstructive sleep apnea severity, depression and anxiety levels, mask comfort, lack of side effects, perceived benefits, and therapy satisfaction. Furthermore, several factors can influence CPAP therapy during and after an earthquake. Earthquakes can cause power outages, which can disrupt CPAP therapy. Without electricity, patients may be unable to power their CPAP devices, disrupting their treatment. Earthquakes often cause people to be displaced from their homes or healthcare facilities. This displacement may result in the loss or damage of CPAP equipment, making it difficult for patients to continue their therapy.[33,34]

After an earthquake, medical supplies, such as CPAP masks, hoses, and filters, may become limited or unavailable. This scarcity can make it challenging for patients to obtain the necessary equipment for their CPAP treatment.[35]

Earthquakes can cause emotional distress and anxiety in people, including those with sleep disorders. Anxiety and stress can impair sleep quality and exacerbate sleep-related breathing disorders, potentially worsening the symptoms of patients with CPAP.[36,37]

Mito et al.'s[38] study focused on the impact of the 2011 Great East Japan Earthquake on patients with sleep-disordered breathing (SDB) who use nasal continuous CPAP (nCPAP) devices. The researchers aimed to assess ability of patients with SDB to continue using their nCPAP devices in the aftermath of the earthquake, determine whether the inability to use the device resulted in symptom relapse, and propose measures to reduce disruptions in nCPAP therapy during future disasters. A questionnaire was distributed to 1,047 SDB patients within 14 days of the earthquake. The questionnaire asked about their ability to use their nCPAP devices, the duration of the inability to use the device, the reasons for being unable to use it, the occurrence of symptom relapse during the non-use period, the ability to use the device at evacuation sites, and recommendations for improving the device. The study found that 92.3% of the surveyed patients (966 out of 1,047) were unable to use their nCPAP devices in the immediate aftermath of the earthquake. The primary reason given for being unable to use the device was a power outage, followed by anxiety about sleeping at night due to fear of aftershocks, participation in disaster relief activities, loss of the nasal CPAP device, and fear of being unable to wake up in an emergency. It is critical to develop strategies that ensure the continuation of nCPAP therapy during disasters to provide patients wth SDB with a safe sleeping environment. This study emphasizes the importance of addressing the challenges faced by patients with SDB and implementing measures to prevent disruptions in nCPAP therapy. This allows healthcare providers to better support SDB patients' sleep health and overall well-being during disasters.[38]

Healthcare providers and disaster response teams must be aware of the specific needs of patients receiving CPAP therapy during and after earthquakes. Efforts should be made to ensure the availability of backup power solutions, facilitate the distribution of CPAP equipment and supplies, and provide patients with support and guidance to help them maintain their therapy during such challenging times.

Conclusion

It is critical to address the sleep health effects of earthquakes and provide assistance to those affected by these events. Sleep health is an often overlooked but critical aspect of recovery, as sleep disruptions are common following a traumatic event such as an earthquake. Here are some suggestions about post-earthquake recovery strategies for sleep health:

Establish a safe and stable shelter: Establishing a safe and stable shelter is a top priority in post-earthquake recovery. Adequate shelter can significantly improve sleep quality by protecting from the elements while also reducing stress and anxiety.

Mental health support: Earthquake survivors frequently suffer from PTSD and other mental health issues that interfere with their sleep. Providing mental health services such as counseling and therapy can help to mitigate these effects.

Community-based interventions: Communities can form support groups, workshops, and activities to promote mental health. These interventions promote a sense of belonging and support, reducing feelings of isolation and anxiety that can disrupt sleep.

Natural disaster preparedness education: Teaching communities how to prepare for and respond to earthquakes can help to reduce their psychological impact of them. Knowing what to do during and after an earthquake can reduce fear and stress, which improves sleep.

Physical activity and relaxation techniques: These activities can help reduce stress and improve sleep quality.

Environmental considerations: Darker, quieter environment can aid in sleep.

Healthy nutrition: Promote a balanced and healthy diet, as proper nutrition can affect sleep quality. Avoid excessive caffeine and alcohol consumption, particularly in the evening.[11,39,40]

Future Research

Future research into the sleep health effects of earthquakes would be beneficial in expanding our understanding of the subject. Here are some areas that could be investigated in future research:

Long-term impact: It is critical to investigate earthquakes' long-term effects on sleep health. This includes looking into the persistence of sleep disturbances, changes in sleep patterns over time, and the factors that contribute to prolonged sleep problems after an earthquake.

Vulnerable populations: Exploring the impact of earthquakes on the sleep health of vulnerable populations, such as children, the elderly, people with pre-existing sleep disorders, and those who live in seismically active areas, can yield valuable insights. Understanding their specific challenges and identifying effective interventions can help tailor support for these groups.

Mental health and sleep: Examining the relationship between post-earthquake mental health issues (e.g., PTSD, anxiety, and depression) and sleep disturbances can help us gain a better understanding of how these factors interact. Longitudinal studies can shed light on the bidirectional relationship by investigating how poor sleep causes mental health problems and vice versa.

Sleep interventions: It is critical to evaluate the effectiveness of various interventions aimed at improving sleep health quality following earthquakes. This could include assessing the effectiveness of psychological counseling, sleep hygiene education, access to safe sleeping arrangements, and medical interventions for sleep disorders in earthquake-affected communities.

By focusing on these research areas, we can gain a better understanding of the sleep health effects of earthquakes and develop targeted interventions to help individuals and communities affected by these events.

Ethics

Authorship Contributions

Concept: E.G.B., A.N.A., Ö.B., Design: E.G.B., A.N.A., Ö.B., Data Collection or Processing: E.G.B., A.N.A., Ö.B., Analysis or Interpretation: E.G.B., A.N.A., Ö.B., Literature Search: E.G.B., A.N.A., Ö.B., Writing: E.G.B., A.N.A., Ö.B.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

References

1. Güleç Balbay E. Earthquake and the Lung. Duzce Med J. 2023;25(1):1-5.
2. Bayram H, Rastgeldi Dogan T, Şahin ÜA, Akdis CA. Environmental and health hazards by massive earthquakes. Allergy. 2023;78(8):2081-2084.
3. Kim Y, Lee H. Sleep Problems among Disaster Victims: A Long-Term Survey on the Life Changes of Disaster Victims in Korea. Int J Environ Res Public Health. 2021;18(6):3294.
4. Lazaratou H, Paparrigopoulos T, Anomitri C, Alexandropoulou N, Galanos G, Papageorgiou C. Sleep problems six-months after continuous earthquake activity in a Greek island. Psychiatriki. 2018;29(1):25-33.
5. Halperin D. Environmental noise and sleep disturbances: A threat to health? Sleep Sci. 2014;7(4):209-212.
6. Güler Aksu G, İmrek Y. The Earthquake Disaster in Türkiye: A Review from Child and Adolescent Psychiatry Perspective. Duzce Medical Journal. 2023;25(1):6-14.
7. Makwana N. Disaster and its impact on mental health: A narrative review. J Family Med Prim Care. 2019;8(10):3090-3095.
8. Haack M, Simpson N, Sethna N, Kaur S, Mullington J. Sleep deficiency and chronic pain: potential underlying mechanisms and clinical implications. Neuropsychopharmacology. 2020;45(1):205-216.
9. Yabe Y, Hagiwara Y, Sekiguchi T, et al. Sleep disturbance is associated with neck pain: a 3-year longitudinal study after the Great East Japan Earthquake. BMC Musculoskelet Disord. 2022;23(1):459.
10. Adachi T, Ellingwood BR. Serviceability of earthquake-damaged water systems: Effects of electrical power availability and power backup systems on system vulnerability. Reliab Eng Syst Saf. 2008;93(1):78-88.
11. Tempesta D, Curcio G, De Gennaro L, Ferrara M. Long-term impact of earthquakes on sleep quality. PLoS One. 2013;8(2):e55936.
12. Redline B, Semborski S, Madden DR, Rhoades H, Henwood BF. Examining Sleep Disturbance Among Sheltered and Unsheltered Transition Age Youth Experiencing Homelessness. Med Care. 2021;59(Suppl 2):S182-S186.

13. Güleç Balbay E, Kayalar Ö, Balbay Ö, Dikensoy Ö, Arbak P, Bayram H. Impact of Earthquakes on Lung Health. Thorac Res Pract. 2024 Mar;25(2):89-98.
14. Nakamura Y, Suda T, Murakami A, et al. Sleep Disturbance of Evacuees in Minamisanriku Town after Great East Japan Earthquake: Risk Factors and Treatment. Tohoku J Exp Med. 2020;251(3):207-216.
15. Jiang S, Yan Z, Jing P, Li C, Zheng T, He J. Relationships between Sleep Problems and Psychiatric Comorbidities among China's Wenchuan Earthquake Survivors Remaining in Temporary Housing Camps. Front Psychol. 2016;7:1552.
16. Medic G, Wille M, Hemels ME. Short- and long-term health consequences of sleep disruption. Nat Sci Sleep. 2017;9:151-161.
17. Moreno J, Shaw, D. Community resilience to power outages after disaster: a case study of the 2010 Chile earthquake and tsunami. Int J Disaster Risk Reduct. 2019;34:448-458.
18. Rubin GJ, Rogers MB. Behavioral and psychological responses of the public during a major power outage: A literature review. Int J Disaster Risk Reduct. 2019;38:101226.
19. Gaston SA, Singh R, Jackson CL. The need to study the role of sleep in climate change adaptation, mitigation, and resiliency strategies across the life course. Sleep. 2023;46(7):zsad070.
20. Fukuda K, Shibata Y, Sato H, Okabe S. How the large-scale blackout following the 2018 Hokkaido Eastern Iburi earthquake impacted adolescents' sleep patterns. Sleep and Biological Rhythms. 2020;18:351-354.
21. Khairari, JD, Shabariah R. Factors Affecting Children's Sleep Quality at the Earthquake Refugee Post in Padak Goar Village. In Proceedings of World Conference on Health and Social Science. 2023;1:1-9.
22. Rahill GJ, Joshi M, Blanc J, Littlewood K, Salinas-Miranda A, Rice C. Self-reported sleep disturbance patterns in urban Haitians: A latent class analysis. Int J Ment Health. 2022;53(2):1-28.
23. Zhou X, Zhen R, Wu X. Trajectories of sleep problems among adolescents after the Wenchuan earthquake: the role of posttraumatic stress disorder symptoms. Psychol Health. 2019;34(7):811-827.
24. Budiharjo N, Sismulyanto, Kuswandari H, Nurdiana O, Mursaka, Ulumuddin Y. The Relationship between Environmental Temperature and Sleep Needs of Patients in Emergency Hospitals. Medico-legal Update. 2021;21(3):52-57.
25. Sato K, Sakamoto K, Hashimoto Y, et al. Risk Factors and Prevalence of Deep Vein Thrombosis After the 2016 Kumamoto Earthquakes. Circ J. 2019;83(6):1342-1348.
26. Villasana D. Aftermath of the Türkiye-Syria earthquake. Lancet. 2023;401(10380):894-909.
27. Sideris T. From post-traumatic stress disorder to absolute dependence in an intensive care unit: reflections on a clinical account. Med Humanit. 2019;45(1):37-44.
28. Chen XY, Shi X, Li Y, et al. Psychiatric comorbidity predicts sleep disturbances among adolescent earthquake survivors: a 10-year cohort study. Sleep Med. 2021;78:94-100.
29. Bavafa A, Khazaie H, Khaledi-Paveh B, Rezaie L. The relationship of severity of symptoms of depression, anxiety, and stress with sleep quality in earthquake survivors in Kermanshah. J Inj Violence Res. 2019;11(2):225-232.
30. Khazaie H, Najafi F, Zakiei A, Komasi S. Partitioning the Sleep Quality and Insomnia Severity among Earthquake Victims in the West of Iran: Cluster Prediction Based on Personality and Psychological Factors. J Res Health Sci. 2019;19(4):e00458.
31. Li X, Buxton OM, Hikichi H, et al. Predictors of persistent sleep problems among older disaster survivors: a natural experiment from the 2011 Great East Japan earthquake and tsunami. Sleep. 2018;41(7):zsy084.
32. Eray Ş, Uçar HN, Murat D. The effects of relocation and social support on long-term outcomes of adolescents following a major earthquake: a controlled study from Turkey. Int J Disaster Risk Reduct. 2017;24:46-45.
33. Ercelik M, Balbay EG, Gulhan PY, et al. Factors affecting compliance with positive airway pressure therapy in obstructive sleep apnea. Sleep Breath. 2022;26(2):725-732.
34. Calgaro S, Borellini M, Seni AHA, et al. Neonatal Intensive Care Unit Evacuation and Care During a Natural Disaster: The Experience of Cyclone Idai in Beira, Mozambique. Front Pediatr. 2020;8:584281.
35. Dempsey TM, Lapinsky SC, Melnychuk E, Lapinsky SE, Reed MJ, Niven AS. Special Populations: Disaster Care Considerations in Chronically Ill, Pregnant, and Morbidly Obese Patients. Crit Care Clin. 2019;35(4):677-695.
36. Batool-Anwar S, Omobomi OS, Quan SF. Impact of the novel coronavirus disease on treatment adherence and sleep duration in patients with obstructive sleep apnea treated with positive airway pressure. J Clin Sleep Med. 2020;16(11):1917-1920.
37. Gargano LM, Gershon RR, Ogunyemi A, Dorlette D, Petrsoric LJ, Cone JE. Comorbid posttraumatic stress disorder and lower respiratory symptoms in disaster survivors: Qualitative results of a 17-year follow-up of World Trade Center disaster survivors. Progress in Disaster Science. 2019;4:100050.
38. Mito F, Nishijima T, Sakurai S, et al. Effects of CPAP treatment interruption due to disasters: patients with sleep-disordered breathing in the Great East Japan Earthquake and tsunami area. Prehosp Disaster Med. 2013;28(6):547-555.
39. Weber FC, Wetter TC. The Many Faces of Sleep Disorders in Post-Traumatic Stress Disorder: An Update on Clinical Features and Treatment. Neuropsychobiology. 2022;81(2):85-97.
40. Yildiz Mİ, Başterzi AD, Yildirim EA, et al. Preventive and Therapeutic Mental Health Care after the Earthquake- Expert Opinion from the Psychiatric Association of Turkey. Turk Psikiyatri Derg. 2023;34(1):39-49.