

Post-Traumatic Stress Disorder After Natural Disasters: A Review

Doğal Afetler sonrası Travma Sonrası Stres Bozukluğu: Bir Gözden Geçirme

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ABSTRACT

Natural disasters, which are considered as one of the most important problems of recent times, affecting all humanity, have become a public health problem. Disasters have effects on both individuals and society in different dimensions, including health, economic, social, and psychological, and can have serious negative consequences. The number of individuals affected by natural disasters is increasing every year. While it is clear that natural disasters threaten human life and bodily health, little attention has been paid to their effects on mental health. Natural disasters threaten our psychological well-being in many ways, cause both short-term and long-term psychological distress and create a significant psychological burden. Post-traumatic stress disorder (PTSD) is a syndrome that occurs as a result of a serious threat or physical injury, a near-death experience, war-related trauma, sexual assault, interpersonal conflicts, child abuse, or a medical illness. When the literature is examined comprehensively, it has been determined that the incidence of PTSD after natural disasters is quite high. Causes of post-disaster PTSD include the nature of the trauma, its severity, loss of relatives and/or property, poor coping skills, displacement, and direct exposure to disaster. Studies have shown that both non-pharmacological and pharmacological treatments are effective on PTSD.

Keywords: Natural disasters; earthquake; flood; hurricane; post-traumatic stress disorder; treatment.

ÖZ

Son zamanların en önemli sorunları arasında değerlendirilen, tüm insanlığı etkileyen doğal afetler bir halk sağlığı sorunu haline gelmiştir. Afetlerin hem birey hem de toplum üzerinde sağlık, ekonomik, sosyal ve psikolojik olmak üzere farklı boyutlarda etkileri olmaktadır ve ciddi olumsuz sonuçlara ulaşabilmektedir. Her geçen yıl doğal afetlerden etkilenen birey sayısı da artmaktadır. Doğal afetlerin insan yaşamını ve beden sağlığını tehdit ettiği açık olmakla birlikte ruh sağlığı üzerindeki etkilerine çok az dikkat edilmiştir. Doğal afetler birçok yönden psikolojik iyi oluşumuzu tehdit etmekte hem kısa hem de uzun vadeli psikolojik sıkıntılara yol açabilmekte ve önemli bir psikolojik yük oluşturabilmektedir. Travma sonrası stres bozukluğu (TSSB) ciddi bir tehdit veya fiziksel yaralanma, ölüme yakın bir deneyim, savaşla ilgili travma, cinsel saldırı, kişilerarası çatışmalar, çocuk istismarı veya tıbbi bir hastalığın sonucu olarak ortaya çıkan bir sendromdur. Literatür kapsamlı olarak incelendiğinde doğal afetler sonrası TSSB görülme oranının oldukça fazla olduğu saptanmıştır. Doğal afet sonrası TSSB nedenleri arasında travmanın doğası, şiddeti, bireyin yakını ve/veya mülkünü kaybetmesi, zayıf baş etme becerisi, yerinden edilmesi ve doğrudan afete maruz kalması gibi faktörler sayılabilir. Araştırmalar hem farmakolojik olmayan hem de farmakolojik tedavinin TSSB üzerinde etkili olduğunu göstermiştir.

Anahtar kelimeler: Doğal afetler; depresyon; sel; kasırga; travma sonrası stres bozukluğu; tedavi.

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INTRODUCTION

Natural disasters are large-scale adverse events resulting from both geological and meteorological natural processes of the earth. Hurricanes, severe storms, earthquakes, volcanic eruptions, fires, floods, tsunamis, and drought are some examples of natural disasters. Natural disasters are often associated with death, trauma, and loss of housing. According to the International Disaster Database, the number of natural disaster events recorded in the world has increased rapidly after the middle of the 20th century (1). Although traumatic events have different characteristics, the main common feature is the psychological and physical effects on people. The difference between natural disasters and other traumatic events is that they create a mass trauma effect. While natural disasters affect large groups of people, they also negatively affect social services, communication, and social networks. The most important effects are that it causes physical and mental health problems in society (2). In this review, the effects of natural disasters on mental health and their relationship with post-traumatic stress disorder (PTSD) were discussed.

POST-TRAUMATIC STRESS DISORDER (PTSD)

Trauma is generally used for all kinds of events and situations that harm, hurt, and injure the mental and physical state of people in very different degrees. Trauma and trigger factor-related disorders were evaluated in a broad category within mental illnesses (3). According to version 5 of the Diagnostic and Statistical Manual of Mental Disorders (DSM), trauma and stress-related diseases; consists of acute stress disorder, PTSD, reactive attachment disorders, adjustment disorders, unrestricted social participation disorder, other defined trauma and stressor-related disorders, and unspecified stressor-related disorders (4).

History

PTSD is a syndrome that occurs after exposure to a traumatic event and manifests itself with symptoms of re-experiencing, avoidance, blunting, alienation, and hyperarousal. Throughout history, people have faced the risk of being exposed to trauma and traumatic events. The animal attacks that happened to our ancestors and the terrorist attacks that people are frequently exposed to probably produce similar psychological states. Considering all these, it can be said that PTSD has existed throughout human history (5). The first studies on PTSD were made as a result of the wars in the world. Even looking at the works written 2000 years ago, there are articles about war stress. One of the first examples that can be given to these works is the story of Herodotus's Marathon War in the fifth century in Ancient Greece. Ancient stories of war trauma are also found in the poem *De Rerum Natura* by Hippocrates and Lucretius. Later, PTSD flashbacks and nightmares of war experience can be found in the documents of the Hundred Years' War (1337-1453) between France and England (6). The place of trauma in psychology has been with the wars. The psychological problems experienced by the soldiers who were at the front during the war after the end of the war show that wars can affect people psychologically. Especially after the Franco-Prussian war in 1870, the psychological problems seen in soldiers returning from the front attracted the

attention of people who specialize in mental health and made them concentrate on this issue. Delays were observed in the reactions of some of the soldiers returning from the front, they experienced the negative situations experienced at the front again, and they could no longer show interest in the activities they were interested in before the war. As a result of all these symptoms, it was recommended that these people be diagnosed with traumatic neurosis (7). PTSD has not just emerged as a result of wars. Difficult life conditions or other experiences also seem to cause traumatic symptoms. PTSD symptoms have historically been recognized under several different names. For example, in the late 1800s, a term referred to as "railway spine" was used to describe psychological reactions in people who witnessed or were exposed to railroad accidents (8). Bomb shock is a term used by British psychologist Charles Samuel Myers in the First World War to describe the outcome of traumatic experiences many soldiers suffered during the war. Bomb shock; is a notable term because it is a war-related disorder that includes overt and common psychiatric symptoms such as shyness, nightmares, and agitation. Soldiers diagnosed with bomb shock; reported a variety of somatic symptoms similar to combat fatigue, including heart palpitations, chest pain, tremors, fatigue, and even paralysis (9). During the First World War, British troops were subjected to many explosions, especially before the steel helmet was installed at the beginning of 1916. In fact, it is known that 60% of the deaths in the First World War were caused by explosions. Although there were soldiers who lost their lives in the face of the explosions, many soldiers survived. Soldiers who survived the explosions applied to health units for very different reasons. Memory loss, difficulty concentrating, hypersensitivity to noise, and tremor are the most common causes of admission. As the number of cases increased in the face of bomb shock, various explanations were tried to be made. Most of these explanations have been of organic origin. For example, a microscopic cerebral hemorrhage is caused by the jarring or harmful effects of an exploding bomb. On the other hand, Myers found that soldiers who were not very closely exposed to the explosion had similar symptoms (10). This finding proves the knowledge that witnessing the death or serious injury of his friends at the front can cause psychological symptoms (6).

PTSD in DSM Diagnostic Systems

DSM-I includes the diagnosis of "Great Stress Reaction", which requires the individual to be exposed to extreme stress in the face of traumatic events such as war or natural disaster; flood, earthquake, explosion, etc. (11). In one study, war sounds were played to three groups of men. These 3 groups consist of; men who have never been in combat, men who have been in combat but show no signs of psychiatric disorders, and war veterans with symptoms specific to war syndrome. While the sounds were played, physiological response measurements such as EEG, pulse, and respiratory rate were taken. The group, which had no war experience, gave mild, directive responses to the sounds of war. War veterans in good mental health showed mild to pronounced physiological and behavioral responses, while war syndrome veterans showed behavioral disturbances so marked that it was impossible

to record physiological responses. These findings support the diagnosis of Major Stress Reaction (12). In 1968, DSM-II was published by the American Psychiatric Association (APA). For unclear reasons, the diagnosis of Major Stress Reaction was removed from DSMII and no diagnosis was included for pathological reactions after trauma experience (11). The Major Stress Reaction diagnosis was replaced by the Transient Situational Disorders diagnosis category. This disorder encompasses a broader set of stressors and underlines the necessity for the traumatic experience to be extremely unbearable or unusual. Although war-related traumas are grouped under this diagnosis, trauma-related psychiatric disorders are rarely included. In case the post-war symptoms persisted, the soldiers were diagnosed with Anxiety Neurosis, a personality disorder (9). Included in the DSM-III (1980), PTSD was named as Post-Vietnamese Syndrome or Delayed Stress Syndrome, first described in veterans returning to the United States after the Vietnam War. However, its international acceptance is not swift or uncontroversial. Recognition of this disorder has been slower in the United Kingdom, where it was initially thought to be specific to the United States and Vietnam veterans (10). PTSD was first included in the DSM-III under the name Anxiety Disorders. The presence of an obvious event that may cause significant distress to almost everyone is required for a diagnosis of PTSD to be made. While DSM-III reinstated the category for responses to extreme stress, it avoided creating a list of specific types of trauma and instead mandated "the presence of a recognizable stressor that would produce significantly distressing symptoms in almost everyone". The inclusion of PTSD in the DSM-III established a remarkably sustainable and productive period in the scientific study of psychological trauma. PTSD serves as a unifying structure. It has allowed different groups of clinical researchers focusing on seemingly different types of trauma, such as war, sexual assault, and natural disaster, to recognize commonalities in their work on the fundamental and traumatic aspects of psychological trauma (13). The DSM-IV definition of PTSD stressor is quite different from previous versions. The definition is divided into two. The first section shows the frequency of appropriate stressors; the second part stipulates that "the person's response must include intense fear, helplessness, or horror". This two-part definition emphasizes the objective characteristics of trauma and is instead based on the principle that people may perceive and react differently to similar events. The transition from the objective nature of the stressor to the subjective experience of the victim is evident not only in the added subjective component but also in the stressor (14). According to the DSM-IV, to be diagnosed with PTSD, a person must experience, witness, or encounter an event that is significantly life-threatening, involving injury or threats to physical integrity, and the experience must provoke a subjective response of fear, helplessness, and horror (15).

Differences in PTSD Classification in DSM-5

DSM-5 was released in May 2013. The definition of PTSD has undergone significant changes in this version. The most significant of the changes include moving the diagnosis of PTSD from Anxiety Disorders to a separate section for Trauma and Stress-Related Disorders.

Considering the reason for the change, it was evaluated as having common features of trauma-related diseases and increasing the reliability of diagnosis (16). In addition, "Reactive Attachment Disorder of Infancy or Young Childhood" was taken from the "Disorders Usually First Diagnosed in Infancy, Childhood, or Adolescence" and placed in the "Trauma and Trigger-Related Disorders" section of the DSM-5. In addition, "Limitless Social Participation Disorder", which is a determinant in "Reactive Attachment Disorder of Infancy or Young Childhood" in DSM-IV-TR, has been transformed into a separate disorder with the name "Limitless Social Participation Disorder" in DSM-5 (17).

PTSD After Natural Disasters

Since the existence of humanity, disasters are one of the events that affect social life the most. Disasters are natural-origin events that occur unexpectedly, interrupt normal social life, cause negative social and economic effects, cannot be prevented, and cannot be overcome with current opportunities and resources (18). The World Health Organization (WHO) defines a disaster as "an unexpected, sudden ecological phenomenon that exceeds the capabilities and capacity of the institution, disrupts normal functioning, and requires external assistance". The International Federation of Red Crescent and Red Cross (IFRC) defines it as "a situation where an accident, natural event or man-made event that develops as a result of sudden or long processes other than armed conflict poses a significant and major threat to human life, health, property or the environment, and the functioning of society is seriously impaired". Disasters are classified as natural disasters and man-made disasters. Natural disasters are earthquakes, volcanic eruptions, floods, droughts, heavy rains, frost, snow, and storms, and man-made disasters are chemical, biological, radiological, and nuclear accidents, wars, migrations, terrorist incidents, and fires (19). Worldwide, about 400 natural disasters occur annually. In the last two decades, natural disasters have negatively affected approximately 800 million people and caused 3 million deaths (20). Disasters are an important public health problem because they cause heavy loss of life and property, interrupt society and health services, the timing is uncertain, have heavy economic burdens, disrupt psycho-social well-being, and cause serious health problems in the future (21).

Witnessing a natural disaster is an experience that deeply affects people, resulting in anxiety and stress (22). These symptoms, which seem like a normal reaction at first, can become a serious mental health problem when the level of stress and anxiety experienced doesn't decrease over time (23). Although disasters have been around since the existence of humanity, the assessment of their psychiatric effects is relatively new. Because meeting the socio-economic needs such as shelter and nutrition after the disaster has been a priority for both the donors and the victims. Providing post-disaster psychiatric help and drawing attention to this field entered the agenda of the WHO after 1995 (24). Natural disasters not only cause problems such as property loss, infrastructure damage, and resource destruction but also cause secondary psychological disturbances. In post-disaster screening studies, the most common mental illness was found to be PTSD. Major Depressive Disorder takes second place. It

can also be seen in diseases such as alcohol use disorder and Generalized Anxiety Disorder. In addition, psychological effects such as suicidal ideation/attempt, and alcohol and nicotine addiction may occur in people who are exposed to a major disaster (25). Although the order and level of post-disaster mental illnesses change, the relationship between disaster and psychology seems to make its importance felt in every period. After natural disasters, there is an increase in PTSD, major depressive disorder, sleep disorders, generalized anxiety disorder, substance use disorder, suicide, and grief reactions (1). PTSD, on the other hand, is one of the most frequently observed and studied mental health disorders together with natural disasters (26). Although natural disasters affect many people at the same time, according to the World Mental Health Survey, the prevalence of traumatic stress symptoms after a natural disaster is around 3.8% (27). In their study of individuals affected by the Van-Erciş earthquake, they reported the rate of PTSD as 35.5%. In addition, it has been reported that the loss of family members or a relative, housing and health problems after the disaster, unemployment, temporary relocation, financial difficulties, and language problems affect the development of PTSD (28). It has been reported that 90.2% of children who experienced an earthquake in Bingöl are in the risk group for the diagnosis of PTSD (29). Cénat and Derivois (30) reported that 36.7% of those affected by the Haiti earthquake experienced PTSD and 25.9% had depression. In addition, it was stated that being a disaster woman, old age, youth (18-24 years old), low education level and unemployment variables were associated factors for PTSD and depression. In the study conducted by Salloum and Overstreet (31) after Hurricane Katrina, it was reported that 53% of the students were at risk for PTSD and 40% for depression. A study of flood victims in Indonesia showed that 52% of the participants experienced PTSD, and 98.3% re-experienced PTSD symptoms (32). In a study conducted in China, it was reported that the prevalence of PTSD among flood victims was 9.2% (33). In a systematic review and meta-analysis study conducted in 2015, the incidence of PTSD was found to be 15.74% in post-flood disaster victims (34). The results of a meta-analysis study showed that the prevalence of PTSD in children in the first, second, third, and fourth 6 months after an earthquake and a flood was 19.2%, 30%, 24.4%, and 20.4%, respectively (35). The results of another review study showed that the prevalence of PTSD among healthcare workers during coronavirus disease 2019 (COVID-19) was 13.52% (36). Few studies have examined PTSD after natural disasters, especially among first responders, firefighters, and police officers (37). On top of that, researchers have found that the prevalence of PTSD is high in first responders. To give an example from the studies, PTSD was found in 21% of the firefighters who responded to the 1999 Chi-Chi earthquake in Taiwan (38). In 2005, 22% of firefighters who responded to Hurricane Katrina developed PTSD in the subsequent process (39,40).

Risk Factors for the Development of PTSD after Natural Disasters

When the risk factors for the development of PTSD after natural disasters are evaluated, some factors come to the fore. Age, gender, race-ethnicity, economic resources,

education level, employment status, personality traits, level of coping with the problem, emotional regulation, prior exposure to trauma, pre-existing mental illness, biological vulnerability, and social support are the most significant risk factors for the development of PTSD. Young age and female gender are the most prominent risk factors for the development of PTSD (2,41). Gender is another factor that can affect the prevalence of PTSD in victims of floods and other disasters. According to studies, women who survived the earthquake had higher PTSD than men (42). Women are at higher risk of suffering from PTSD after disasters (43-45). It showed that people who lost their property after the flood or were not supported by their families, such as widowed or divorced women, experienced more stress and had higher PTSD scores (46,47). Being an ethnic minority has also been found to predict an increased prevalence of symptoms and risk of disorders after natural disasters (48). In addition, black individuals were found to be more risky in terms of PTSD (41). In the wake of Hurricane Harvey in 2017, a recent study found that black individuals and younger people reported higher levels of post-traumatic stress symptoms (49). Regarding the economic component of resilience, lower socioeconomic status has been reported to be consistently associated with greater post-disaster distress (1,50). The loss of one's own private resources after a natural disaster can affect the individual both materially and spiritually, thus affecting the individual's self-perception and self-confidence (51). It has been determined that many survivors of disasters have adaptation problems in the life process, daily life, and work life of individuals due to the chronic stress they have experienced during the recovery period following the disaster (52). The factors that cause this chronic stress can be attributed to job loss or resource depletion, which leads to socioeconomic distress in the post-disaster period. In a large survey of Hurricane Katrina survivors, an increase in other mental health disorders, especially PTSD, was found in individuals. In addition, the suicide rate doubled from 3-6% (52). In addition, it was determined that 27% of PTSD cases and 47% of suicidal tendencies occur in the future (52). The economic hardship that the disaster survivors will experience arises in the process of individuals being unemployed after the disaster, unable to pay their current debts, and rebuilding the destroyed or damaged property. The prevalence of major depressive disorder in survivors of Hurricane Katrina 2 years later was found to be higher than the data determined in the general population and after other natural disasters, and it was associated with the resulting economic difficulties (53). The educational status of disaster victims is always emphasized as an important factor affecting post-disaster resilience and mental health outcomes (41,54). It has been reported that countries with high income and education level experience fewer losses than countries with low income and low education levels (55). Education can have positive outcomes by influencing perceptions of risk, increasing the knowledge and skills needed to face disasters, and influencing successful access to resources (41). While addressing the increased risk for personality traits, the most common trait associated with post-disaster psychopathology is neuroticism (2,41,56). There is a growing body of literature documenting a close

relationship between neuroticism and PTSD and depressive symptoms (57). In a study conducted on children who survived the Wenchuan earthquake, which killed approximately 90,000 people in China, it was found that older children with neurotic personality traits and a high propensity for the trauma experienced a longer duration of PTSD symptoms (58). Another study of Chinese survivors of the Wenchuan earthquake revealed similar findings in adults. As a result of this study, both neuroticism and psychoticism were found to be positively associated with the morbidity of long-term PTSD (59). Similar results were found in different cultures. A study of firefighters after the devastating and severe fires in Greece in August 2007 found that an increase in neuroticism scores was significantly associated with an increased likelihood of having PTSD after the disaster (60). Inadequacies in coping and problem-solving skills are also risk factors for the development of PTSD (61). One of the negative coping mechanisms after natural disasters is substance use. In New Orleans, the hospitalization rate for substance abuse disorders increased from 7.13 per 1,000 before Hurricane Katrina to 9.65 per 1,000 after Hurricane Katrina. This data shows that substance use disorders may accompany PTSD (62). Individuals who survive multiple traumatic events often experience long-term and short-term problems that affect their lives (63). The level of resilience to trauma is found to be lower in individuals who have been repeatedly exposed to natural disasters and trauma (64). Studies have found that the pre-existing distress increases mental disorders and reduces resilience after natural disasters (41). The literature also suggests that a pre-existing diagnosis of anxiety disorder reduces post-disaster resilience and predisposes participants to other mental health disorders (64,65). Research by Xie et al. (66) shows that the cumulative effect of exposure to two earthquakes on mental health problems is more serious than one earthquake. Disasters often involve communities not directly exposed to trauma, such as those who have lost family members, friends, or colleagues or lost property, were forced to relocate, or were exposed through the media. This raises two critical points about the burden and nature of post-disaster psychopathology. First, the mental health consequences of such events among those indirectly exposed to a disaster may be just as deteriorating as those directly exposed to or close to the disaster epicenter (40). Most of the people interviewed in the post-9/11 national surveys reported that they were indirectly exposed to the attacks, mostly through TV broadcasts (67). Studies have found that religious coping, a secure relationship with God, and belief in the meaning of life are inversely related to PTSD. People with high religious coping have a lower risk of major depressive disorder and a higher quality of life (68). A similar study with Hurricane Katrina survivors found that negative religious coping in the context of perception of punishment was positively associated with acute stress disorder symptoms, while in the context of perception of abandonment, it was associated with higher functional impairment (69). A study of Pakistani earthquake survivors found that negative religious coping in the context of perceiving punishment was associated with higher symptom levels and negative emotions (70). Having a previous mental illness increases the risk of

developing PTSD in the post-disaster period (2,41,54). In a study investigating the psychological responses of firefighters working in disasters after the severe forest fires in Greece, it was found that people with symptoms such as insomnia and depressive symptoms in the pre-event period were associated with the risk of developing PTSD (60). A study of Hurricane Katrina survivors found that those with pre-disaster mental illness were associated with an increased risk of PTSD symptoms (71). A study conducted after a severe earthquake and tsunami in Chile in 2010 found that pre-disaster PTSD was significantly associated with an increase in post-disaster death thoughts and suicide attempts in individuals (72). It has been shown that social support plays an important role in the context of outcomes in the post-disaster period (1). In individuals who experienced the Alberta forest fire, social support from their environment was found to be associated with the post-disaster recovery process (73). It has also been documented that perceived spousal support in postpartum mothers after the Iowa flood, objective stress on depression buffered, and reduced depression levels. This situation also draws attention to the importance of social support in the post-disaster process (41). Another study of Alberta wildfire survivors found that spiritual resources such as positive perspectives, feelings of faith and hope, compassion, and gratitude shared in their spiritual community contributed to increased resilience that helped them support other families and communities in the wake of the disaster (74). Following the collapse of the Buffalo Creek dam in West Virginia, personal trauma was found to be more strongly associated with reductions in perceptions of family support, while the loss in the community was more strongly associated with decreases in perceptions of extra-familial support and social involvement (75). Biological and genetic resilience factors are growing areas of study, demonstrating the potential to find better treatments and identify individuals within the population who may be predisposed to a higher probability of psychopathology (2,41,58). In terms of PTSD in children who survived the Wenchuan earthquake, it has been reported that N-methyl-d-aspartate (NMDA) receptors at the molecular level are an important component of learning and memory. The TrkB (rs920776) gene, which produces the single transmembrane receptor TrkB, modulates NMDA receptor activity through brain-derived neurotrophic factor (BDNF). This ensures that survivors are protected from PTSD. In addition, in the same study, G72 genes (rs3916966, rs3918341) and CNTF genes were also found to be protective factors in PTSD (58). In a study examining the effects of prenatal maternal stress during the Quebec ice storm in 1998, the BDNF (rs6265) and COMT (rs6480) genotypes were found associated with hippocampal volume in their offspring (76). Current findings provide some evidence for gene-environment interactions following a natural disaster.

Clinical Symptoms of PTSD after Natural Disasters

PTSD causes many functional disorders, especially in occupational and social areas. It is characterized by sudden thoughts, nightmares, re-experiencing the traumatic event, avoidance of traumatic events, hypervigilance (sensory sensitivity), and sleep disturbances. Symptoms usually begin within three months of the early traumatic event, sometimes years later, in which case it is referred to as

PTSD with Delayed Onset. Symptoms must last more than a month and be severe enough to suggest PTSD. The clinical features of PTSD are grouped under four main headings: The first group includes findings related to increased arousal. The state of arousal, which is the first response to stress, manifests itself as "increased arousal" in PTSD. They are the most common symptoms of PTSD (77). Continual anxiety, insomnia, and concentration disorder are also included under this heading. Sleep-related disorders are common in PTSD and are associated with an increased risk of suicidal ideation, attempt, and related death (78). It has been shown that adrenergic stimulation is increased in the examinations performed in the state of increased arousal. The tachycardia and increase in tone seen in patients can also be explained by the increase in adrenergic stimulation (79). The second cluster of symptoms is about re-experiencing the traumatic event. These can be in the form of thoughts, perceptions, or dreams. In these cases, the person may re-perceive the sounds or smells associated with the event (80). Sometimes, the person can relive the moment of trauma by experiencing dissociative flashbacks. The incidence of dissociative symptoms in individuals with PTSD is reported to be 8-13%. This can take seconds, sometimes minutes, or even hours. During this period, the person is buried in memories of the moment of trauma, but it is important that the person does not have impaired consciousness and then returns to the present moment (79). The third group is related to avoidance behavior. The person is aware of the difficulty in controlling himself in the face of events in the outer world and withdraws into his inner world. Situations such as avoiding places that remind of the event, avoiding talking about the event or moving away from the spoken environment, and decreasing in activity and interests appear as a result of avoidance behavior (80). The fourth cluster of symptoms is the changes in cognition and mood. Memory impairment can also be seen in these individuals. Dissociative amnesia is more common in various traumatic events such as war genocides and sexual and physical abuse. People experiencing depersonalization say that they watch themselves like a movie. They say that they watch themselves from afar and sometimes they can feel unrealistic. Patients describe the derealization state as "a distant and foggy world" (80).

MASS GRIEF AFTER NATURAL DISASTERS

In addition to all these psychological and physiological reactions, disasters also bring the phenomenon of loss and mourning. In cases where life is in danger, a relative is lost, or financial means are lost, people exhibit certain attitudes and behaviors. All of these emotional, behavioral, and intellectual reactions are mourning reactions (81). Although the concept of mourning is known as the mental state experienced after the loss of a loved one, the loss of anything to which a commitment has been developed is also the cause of the mourning process. The way mourning reactions are expressed is shaped according to the environment and culture. The grieving process is a normal process that occurs after the trauma and it is expected not to exceed six months to two years on average. However, the mourning phenomenon that exceeds this period can be a harbinger of a psychopathological condition. Especially

as a result of major disasters; the advanced process of death and fear of losing loved ones paves the way for the formation of complicated and pathological mourning (81). Providing adequate psychological support, especially to individuals in the grieving process, is very important in the fulfillment of post-traumatic psychological support and grief counseling services. When examining the literature, there is a field of research on the concepts of loss and mourning that goes back to the article "Mourning and Melancholia" published by Freud in 1922. In this work, Freud examined the analysis of grief and the investigation of the phenomenon of mourning in the inner life. Freud mostly showed an evaluation and approach on the individual's inner world and the process of spiritual struggle of the mourning phenomenon. After this work of Freud, many researchers started to work on grief and traumas in his theory. The most well-known theoretical model in the post-disaster traumas and grief process is Kübler-Ros's Five-Stage Theory of Grief (82). According to the perspective of this theory, individuals grieving after a post-disaster loss go through the following process, respectively:

- Denial and isolation.
- Anger process.
- The bargaining process.
- The process of experiencing depression.
- Acceptance process.

The reactions given during this process are:

- Emotional reactions: Depression, hopelessness, anxiety, guilt, anger, loneliness.
- Behavioral responses: crying, withdrawal, and burnout.
- Cognitive reactions: Constantly thinking about the deceased, low self-esteem, thoughts of helplessness, difficulty concentrating, and denial.
- Physiological reactions: Substance use, loss of appetite, fatigue, and somatic complaints.

In the first stage, individuals do not want to accept death and loss and develop different defense mechanisms. This situation leads to the denial of the event and the rejection process by causing inhibition. In the second stage, when it is understood that death cannot be denied, the individual now experiences an anger process. In the next stage, the helpless individual tries to bargain with God in return for whatever he has to give. Failure in this process brings the individual to depression in the next stage, and this experience may be the beginning of the psychopathological process. In the last stage, the acceptance and normalization of life continue and the lost individual will no longer come back. However, individuals who develop obsessions at any stage of this process may experience a transition to psychosomatic and psychopathological diseases. In this context, post-traumatic psychological counseling services and grief counseling by experts constitute an important area of treatment (81,83). In addition to all these, an important problem is that inexperienced individuals who provide post-disaster support also show similar traumatic and mourning reactions as individuals who experienced disasters. After the traumatic events, those who are directly exposed to the event, as well as those who witness the situation, relatives of the victims, and people who take part in the relief efforts may also show signs of traumatic stress.

The reactions of these groups are referred to as secondary traumatic stress or indirect traumatization in the literature. Considering the sources of stress that aid workers face due to their work, it is thought that this group may experience stress reactions similar to those directly exposed to traumatic events. It is important for the healthy functioning of the process that well-equipped mental health workers provide the necessary psychological support in this field (84). The loss of a loved one during a natural disaster is especially traumatic and distressing given that death often happens suddenly and unexpectedly (85). Pathological grief rates, as high as 40-50%, have been reported among those who have experienced traumatic loss after a disaster (86-89). Among the factors affecting the course of traumatic grief are the way the news is covered on TV, social media, the prevalence of trauma, how quickly post-traumatic help arrives, and how the deceased is buried.

TREATMENT APPROACHES

Secondary symptoms such as involuntary symptoms, negative mood, dissociation, avoidance, and arousal, which are frequently observed in the PTSD clinic, affecting important areas of life such as family and work, and psychiatric comorbidity constitute the treatment goals. Treatment options are classified as pharmacotherapy and psychotherapy. The UK-based National Institute for Health and Clinical Practice (NICE) recommends drug therapy as a second-line treatment for PTSD. It is recommended to give priority to psychotherapy in mild cases and to carry out psychotherapy and pharmacotherapy together in moderate and severe cases.

The importance of early interventions and treatment is to ensure the safety and stability of individuals, as well as to prevent distress reactions and risky behaviors and to preserve functionality. This also reduces the severity of PTSD symptoms. The primary goal of early intervention is to reduce the progression of symptoms to a psychiatric disorder. When psychiatric disorders do occur, early diagnosis and treatment are the goals. Goals also include:

- Recognizing the neuropsychiatric symptoms of the related disorder and referring them to relevant medical professionals.
- To treat acute symptoms and restore functionality with treatment including psychotherapy and pharmacotherapy with biopsychosocial strategic planning.
- Distinguish between "normal" and pathological responses in survivors.
- Provide grief and loss treatment.
- Early recognition and treatment of psychiatric disorders.
- Management of relapses of psychiatric disorders in at-risk and socially unsupported groups.
- To provide long-term management of negative psychosocial consequences of natural disasters such as bereavement, financial loss, property loss, and unemployment.

Pharmacotherapy

The first goal of treatment is to prevent the development of PTSD by initiating post-traumatic treatment at an early stage. The general principle is to treat the leading symptom cluster and accompanying conditions, if any. Reduction of avoidance and hyperarousal symptoms, regulation of destructive behaviors, control of uncontrollable impulses,

treatment of accompanying psychotic or dissociative symptoms, and anxiety or depressive symptoms should be considered as general treatment principles. An appropriate intervention immediately after the trauma experience ensures that the traumatic event is processed appropriately in the mind and recorded in the memory without its threatening effect. However, when not intervened, the traumatic experience continues to continue for years in risky individuals. Studies emphasize the importance of intervention time, and this time period is considered as 'golden hours' in some studies. Hypoactivation of the post-traumatic HPA axis is associated with traumatic sensory memory formation. Therefore, HPA hypoactivation is interpreted as a risk factor for PTSD. For this reason, it has been reported that the use of benzodiazepines, especially in the early period, increases the symptoms and this drug group constitutes a risk factor for PTSD. On the other hand, it has been reported in animal experiments that cortisol administration immediately after trauma reduces the risk of PTSD (90). In a study, it was reported that the administration of beta-blockers immediately after trauma has a protective role in the development of PTSD (91). Although the treatment option depends in part on the clinical presentation, antidepressants are the leading treatment option. It includes selective serotonin reuptake inhibitors (SSRIs) as the first choice as a pharmacotherapy approach. Tricyclic antidepressants, mood stabilizers, and atypical antipsychotic, beta blocker drugs are other treatment options. If there is no adequate response from drug therapy, the dose of the drug should be increased at recommended intervals. If there is no response from the treatment, it is recommended to switch to another class of antidepressant or to add an antipsychotic to the treatment. When SSRIs are used, they can cause or exacerbate insomnia and agitation. The duration of maintenance therapy is 6-12 months in acute PTSD patients, and 12-24 months in chronic PTSD patients, with more than 75% improvement in symptoms. In patients with residual symptoms, drug therapy should be at least 24 months (92).

Psychosocial Treatments

Among the psychotherapy approaches, it has been reported that the two most studied approaches in the literature and shown to be more effective than others are cognitive-behavioral therapies and eye movement desensitization and reprocessing EMDR. Behavioral approaches in the treatment of PTSD were generally made by Foa et al. (93). According to this model, both cognitive and emotional processes are important, and the cognitive-affective fear construct is central to PTSD. Even though the fearful life is wanted to be bestowed in the uninvited re-experiencing process, it does not reach the whole process because it is irresistible. For this reason, avoidance behaviors increase, and the interpretation that the person is helpless and always vulnerable appears. In behavioral treatment, it is aimed to experiencing traumatic stimuli and images, activating the fear structure associated with the traumatic experience, and learning that the images are no longer dangerous (93). In line with the theories of Foa et al. (93), they developed Prolonged Exposure Therapy, which predicts a three-stage change consisting of exposure to fear-triggering stimuli, repeated and prolonged exposure, and reduction in anxiety levels (94).

Different researchers have also emphasized the importance of cognitive factors in the pathogen of PTSD. It has been shown that when the person is exposed to a triggering stimulus that is not objectively harmful during therapy, cognitive restructuring, and fear memory are regulated and avoidances are reduced, ultimately reducing anxiety. One therapy method that has been demonstrated in placebo-controlled studies is EMDR therapy. Although the exact mechanism of action is not known, it has been stated that exposure to traumatic moments causes a deterioration by making neural changes, and the balance that is disturbed by two-way eye movements is re-established. In the so-called third-wave therapies, it is planned to observe the symptoms of PTSD rather than focus on them, to accept their existence voluntarily, and to focus on the value areas that the individual attaches importance to (93). Mindfulness is one factor that has also been found to be associated with positive post-disaster psychiatric outcomes (57,94,95). Mindfulness training following a disaster has been shown to provide modest benefits for improving psychological well-being (96).

New Developments

New promising pharmacological agents for PTSD have been clinically experienced. The most recent of new drugs are corticotropin-releasing hormone antagonists and those that affect the endocannabinoid system. CB1 receptor-mediated endocannabinoid agents have proven helpful in forgetting bad memories in animal model studies. Increased levels of anandamide (an endogenous cannabinoid) in the amygdala regulate short-term fear extinction (97-99). High CB1 receptor availability in those with PTSD has been shown to correspond to lower circulating anandamide levels in the blood. These findings support the possibility that cannabinoids such as tetrahydrocannabinol may be an alternative treatment agent in the treatment of PTSD. Another molecule of interest is ketamine. Ketamine is a non-competitive antagonist of the NMDA receptor that affects learning and memory. A rapid reduction in PTSD symptoms has been demonstrated following the intravenous administration of ketamine (100). Drugs that block dopamine reuptake and are associated with NMDA receptor action, such as 3,4-methylenedioxy-methamphetamine (MDMA), have also received attention. Given the potential for abuse of these compounds, it is important to determine whether their use in the treatment of PTSD outweighs the potential risks (101,102). In addition, NPY agonists are an important development for the treatment of PTSD (103). Transcranial magnetic stimulation, deep brain stimulation, and the use of new neurofeedback techniques are other alternative treatment modalities for PTSD (104,105). Another new treatment has been the use of the glycine receptor agonist d-cycloserine in combination with prolonged exposure psychotherapy to accelerate the elimination of fear conditioning (106).

CONCLUSION

The incidence of PTSD after a natural disaster is not to be underestimated. If the traumatic stress symptoms that occur after a traumatic event last longer than a month, this suggests that this situation may become chronic. For this reason, due to the nature of natural disasters, if the destruction and destruction encountered is high, it will take

more than a month to return to daily life after the disaster and to return to the old state of well-being. The potential risk for PTSD also increases when we consider that it takes much longer to recover after the most frightening disasters such as earthquakes, and the time required for debris removal and reconstruction is months or even years. Early detection and intervention programs are necessary for planning PTSD management.

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REFERENCES

1. Saeed SA, Gargano SP. Natural disasters and mental health. *Int Rev Psychiatry*. 2022;34(1):16-25.
2. Goldmann E, Galea S. Mental health consequences of disasters. *Annu Rev Public Health*. 2014;35:169-83.
3. Keane TM, Marshall AD, Taft CT. Posttraumatic stress disorder: etiology, epidemiology, and treatment outcome. *Annu Rev Clin Psychol*. 2006;2:161-97.
4. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 5th ed. Washington, DC: American Psychiatric Association; 2013.
5. Friedman MJ. Finalizing PTSD in DSM-5: Getting here from there and where to go next. *J Trauma Stress*. 2013;26(5):548-56.
6. Crocq MA, Crocq L. From shell shock and war neurosis to posttraumatic stress disorder: a history of psychotraumatology. *Dialogues Clin Neurosci*. 2000;2(1):47-55.
7. Özen Y. Psychological traumen is the old history of mankind. *J Soc Sci*. 2017;1(2):104-17. Turkish.
8. Gasquoine PG. Railway spine: The advent of compensation for concussive symptoms. *J Hist Neurosci*. 2020;29(2):234-45.
9. DiMauro J, Carter S, Folk JB, Kashdan TB. A historical review of trauma-related diagnoses to reconsider the heterogeneity of PTSD. *J Anxiety Disord*. 2014;28(8):774-86.
10. Jones E, Wessely S. A paradigm shift in the conceptualization of psychological trauma in the 20th century. *J Anxiety Disord*. 2007;21(2):164-75.
11. Spitzer RL, First MB, Wakefield JC. Saving PTSD from itself in DSM-V. *J Anxiety Disord*. 2007;21(2):233-41.
12. Archibald HC, Long DM, Miller C, Tuddenham RD. Gross stress reaction in combat--a 15 year follow-up. *Am J Psychiatry*. 1962;119(4):317-22.

13. Bovin MJ, Marx BP, Weathers FW, Gallagher MW, Rodriguez P, Schnurr PP, et al. Psychometric properties of the PTSD checklist for diagnostic and statistical manual of mental disorders-fifth edition (PCL-5) in veterans. *Psychol Assess*. 2016;28(11):1379-91.
14. Breslau N, Kessler RC. The stressor criterion in DSM-IV posttraumatic stress disorder: An empirical investigation. *Biol Psychiatry*. 2001;50(9):699-704.
15. Roemer L, Orsillo SM, Borkovec TD, Litz BT. Emotional response at the time of a potentially traumatizing event and PTSD symptomatology: A preliminary retrospective analysis of the DSM-IV criterion A-2. *J Behav Ther Exp Psychiatry*. 1998;29(2):123-30.
16. Hoge CW, Riviere LA, Wilk JE, Herrell RK, Weathers FW. The prevalence of post-traumatic stress disorder (PTSD) in US combat soldiers: a head-to-head comparison of DSM-5 versus DSM-IV-TR symptom criteria with the PTSD checklist. *Lancet Psychiatry*. 2014;1(4):269-77.
17. Pai A, Suris AM, North CS. Posttraumatic stress disorder in the DSM-5: Controversy, change, and conceptual considerations. *Behav Sci*. 2017;7(1):7.
18. Karaman ZT. Introduction to disaster management and organization in Türkiye. In: Karaman ZT, Altay A, editors. *Integrated Disaster Management*. İzmir, Türkiye: İlkem Matbaacılık; 2017. p.1-36. Turkish.
19. Yeo J, Comfort LK. An expected event, but unprecedented damage: Structure and gaps of large-scale response coordination of the 2011 Thailand floods. *Disaster Prev Manag*. 2017;26(4):458-70.
20. Agyapong B, Shalaby R, Eboeime E, Obuobi-Donkor G, Owusu E, Adu MK, et al. Cumulative trauma from multiple natural disasters increases mental health burden on residents of Fort McMurray. *Eur J Psychotraumatol*. 2022;13(1):2059999.
21. Yorulmaz DS, Karadeniz H. Effects of disasters on mental health. *Doğ Afet Çev Derg*. 2021;7(2):392-8. Turkish.
22. Kar N, Bastia BK. Post-traumatic stress disorder, depression and generalised anxiety disorder in adolescents after a natural disaster: a study of comorbidity. *Clin Pract Epidemiol Ment Health*. 2006;2:17.
23. Sá SD, Werlang BSG, Paranhos ME. Crisis intervention. *Rev Bras Ter Cogn*. 2008;4(1):1-10. Portuguese.
24. Yehuda R, Hoge CW, McFarlane AC, Vermetten E, Lanius RA, Nievergelt CM, et al. Post-traumatic stress disorder. *Nat Rev Dis Primers*. 2015;1:15057.
25. Fergusson DM, Horwood LJ, Boden JM, Mulder RT. Impact of a major disaster on the mental health of a well-studied cohort. *JAMA Psychiatry*. 2014;71(9):1025-31.
26. Cankardaş S, Sofuoğlu Z. Post-traumatic stress disorder symptoms and their predictors in earthquake or fire survivors. *Turk Psikiyatri Derg*. 2019;30(3):151-6. Turkish.
27. Bromet EJ, Atwoli L, Kawakami N, Navarro-Mateu F, Piotrowski P, King AJ, et al. Post-traumatic stress disorder associated with natural and human-made disasters in the World Mental Health Surveys. *Psychol Med*. 2017;47(2):227-41.
28. Boztaş MH, Aker AT, Münir K, Çelik F, Aydın A, Karasu U, et al. Post traumatic stress disorder among adults in the aftermath of 2011 Van-Ercis earth-quake in Turkey. *Turkish J Clinical Psychiatry*. 2019;22(4):380-8.
29. Bulut S. Comparing children posttraumatic stress reactions in terms of age and gender after an earthquake. *Turkish Psychol Couns Guid J*. 2009;4(31):43-51.
30. Cénat JM, Derivois D. Assessment of prevalence and determinants of posttraumatic stress disorder and depression symptoms in adults survivors of earthquake in Haiti after 30 months. *J Affect Disord*. 2014;159:111-7.
31. Salloum A, Overstreet S. Evaluation of individual and group grief and trauma interventions for children post disaster. *J Clin Child Adolesc Psychol*. 2008;37(3):495-507.
32. Nasri RI, Seniwati T, Erfina E. Screening of post-traumatic stress disorder (PTSD) among flood victims in Indonesia. *Enfermería Clínica*. 2020;30(Suppl 2):345-9.
33. Huang P, Tan H, Liu A, Feng S, Chen M. Prediction of posttraumatic stress disorder among adults in flood district. *BMC Public Health*. 2010;10:207.
34. Chen L, Liu A. The incidence of posttraumatic stress disorder after floods: a meta-analysis. *Disaster Med Public Health Prep*. 2015;9(3):329-33.
35. Rezzayat AA, Sahebdel S, Jafari S, Kabirian A, Rahnejat AM, Farahani RH, et al. Evaluating the prevalence of PTSD among children and adolescents after earthquakes and floods: a systematic review and meta-analysis. *Psychiatr Q*. 2020;91(4):1265-90.
36. Sahebi A, Yousefi A, Abdi K, Jamshidbeigi Y, Moayedi S, Torres M, et al. The prevalence of post-traumatic stress disorder among health care workers during the COVID-19 pandemic: an umbrella review and meta-analysis. *Front Psychiatry*. 2021;12:764738.
37. Armagan E, Engindeniz Z, Devay AO, Erdur B, Ozcakir A. Frequency of post-traumatic stress disorder among relief force workers after the tsunami in Asia: do rescuers become victims? *Prehosp Disaster Med*. 2006;21(3):168-72.
38. Chang CM, Connor KM, Lai TJ, Lee LC, Davidson JR. Predictors of posttraumatic outcomes following the 1999 Taiwan earthquake. *J Nerv Ment Dis*. 2005;193(1):40-6.
39. Centers for Disease Control and Prevention. Health hazard evaluation of police officers and firefighters after Hurricane Katrina--New Orleans, Louisiana, October 17-28 and November 30-December 5, 2005. *Morbidity and Mortality Weekly Report*. 2006;55(16):456-8.
40. Neria Y, Nandi A, Galea S. Post-traumatic stress disorder following disasters: a systematic review. *Psychol Med*. 2008;38(4):467-80.
41. Chen S, Bagrodia R, Pfeffer CC, Meli L, Bonanno GA. Anxiety and resilience in the face of natural disasters associated with climate change: A review and methodological critique. *J Anxiety Disord*. 2020;76:102297.
42. Dai W, Chen L, Lai Z, Li Y, Wang J, Liu A. The incidence of post-traumatic stress disorder among survivors after earthquakes: a systematic review and meta-analysis. *BMC Psychiatry*. 2016;16:188.

43. Acierno R, Ruggiero KJ, Galea S, Resnick HS, Koenen K, Roitzsch J, et al. Psychological sequelae resulting from the 2004 Florida hurricanes: implications for postdisaster intervention. *Am J Public Health*. 2007;97(Suppl 1):S103-8.
44. Zhang Z, Wang W, Shi Z, Wang L, Zhang J. Mental health problems among the survivors in the hard-hit areas of the Yushu earthquake. *PLoS One*. 2012;7(10):e46449.
45. Doocy S, Daniels A, Packer C, Dick A, Kirsch TD. The human impact of earthquakes: a historical review of events 1980-2009 and systematic literature review. *PLoS Curr*. 2013;16:5:ecurrents.dis.67bd14fe457f1db0b5433a8ee20fb833.
46. Reacher M, McKenzie K, Lane C, Nichols T, Kedge I, Iversen A, et al. Health impacts of flooding in Lewes: a comparison of reported gastrointestinal and other illness and mental health in flooded and non-flooded households. *Commun Dis Public Health*. 2004;7(1):39-46.
47. Telles S, Singh N, Joshi M. Risk of posttraumatic stress disorder and depression in survivors of the floods in Bihar, India. *Indian J Med Sci*. 2009;63(8):330-4.
48. Norris FH. Disasters in urban context. *J Urban Health*. 2002;79(3):308-14.
49. Fitzpatrick KM. Post-traumatic stress symptomatology and displacement among Hurricane Harvey survivors. *Soc Sci Med*. 2021;270:113634.
50. Luthar SS, Cicchetti D. The construct of resilience: implications for interventions and social policies. *Dev Psychopathol*. 2000;12(4):857-85.
51. Leiva-Bianchi M, Cornejo F, Fresno A, Rojas C, Serrano C. Effectiveness of cognitive-behavioural therapy for post-disaster distress in post-traumatic stress symptoms after Chilean earthquake and tsunami. *Gac Sanit*. 2018;32(3):291-6.
52. Lea CS, Littleton H, Allen AB, Beasley CM. Resilience, self-compassion, and mental health outcomes: Rebuilding eastern North Carolina after natural disasters. *N C Med J*. 2020;81(5):315-9.
53. Nillni YI, Nosen E, Williams PA, Tracy M, Coffey SF, Galea S. Unique and related predictors of major depressive disorder, posttraumatic stress disorder, and their comorbidity following Hurricane Katrina. *J Nerv Ment Dis*. 2013;201(10):841-7.
54. Mandavia AD, Bonanno GA. When natural disaster follows economic downturn: The incremental impact of multiple stressor events on trajectories of depression and posttraumatic stress disorder. *Disaster Med Public Health Prep*. 2019;13(2):173-82.
55. Weems CF. The importance of the post-disaster context in fostering human resilience. *Lancet Planet Health*. 2019;3(2):e53-4.
56. Heir T, Hussain A, Kristensen P, Weisæth L. Delayed post-traumatic stress and memory inflation of life-threatening events following a natural disaster: prospective study. *BJPsych open*. 2021;7(4):e132.
57. An Y, Fu G, Yuan G, Zhang Q, Xu W. Dispositional mindfulness mediates the relations between neuroticism and posttraumatic stress disorder and depression in Chinese adolescents after a tornado. *Clin Child Psychol Psychiatry*. 2019;24(3):482-93.
58. Li Y, Lv Q, Li B, Luo D, Sun X, Xu J. The role of trauma experiences, personality traits, and genotype in maintaining posttraumatic stress disorder symptoms among child survivors of the Wenchuan earthquake. *BMC Psychiatry*. 2020;20(1):439.
59. Yin Q, Wu L, Yu X, Liu W. Neuroticism predicts a long-term PTSD after earthquake trauma: the moderating effects of personality. *Front Psychiatry*. 2019;10:657.
60. Psarros C, Theleritis C, Kokras N, Lyrakos D, Koborozos A, Kakabakou O, et al. Personality characteristics and individual factors associated with PTSD in firefighters one month after extended wildfires. *Nord J Psychiatry*. 2018;72(1):17-23.
61. Birkmann J, Jamshed A, McMillan JM, Feldmeyer D, Totin E, Solecki W, et al. Understanding human vulnerability to climate change: A global perspective on index validation for adaptation planning. *Sci Total Environ*. 2022;803:150065.
62. Moise IK, Ruiz MO. Hospitalizations for substance abuse disorders before and after Hurricane Katrina: spatial clustering and area-level predictors, New Orleans, 2004 and 2008. *Prev Chronic Dis*. 2016;13:E145.
63. Gnass I, Ritschel M, Andrich S, Kuske S, Moschinski K, Herrmann-Frank A, et al. Assessment of patient-reported outcomes after polytrauma: protocol for a systematic review. *BMJ Open*. 2018;8(3):e017571.
64. Mao W, Agyapong VIO. The role of social determinants in mental health and resilience after disasters: Implications for public health policy and practice. *Front Public Health*. 2021;9:658528.
65. Agyapong VIO, Hrabok M, Juhas M, Omeje J, Denga E, Nwaka B, et al. Prevalence rates and predictors of generalized anxiety disorder symptoms in residents of Fort McMurray six months after a wildfire. *Front Psychiatry*. 2018;9:345.
66. Xie Z, Xu J, Wu Z. Mental health problems among survivors in hard-hit areas of the 5.12 Wenchuan and 4.20 Lushan earthquakes. *J Ment Health*. 2017;26(1):43-9.
67. Ahern J, Galea S, Resnick H, Kilpatrick D, Bucuvalas M, Gold J, et al. Television images and psychological symptoms after the September 11 terrorist attacks. *Psychiatry*. 2002;65(4):289-300.
68. Henslee AM, Coffey SF, Schumacher JA, Tracy M, Norris FH, Galea S. Religious coping and psychological and behavioral adjustment after Hurricane Katrina. *J Psychol*. 2015;149(6):630-42.
69. Park CL, Sacco SJ, Mills MA. Do religious habits and coping help in the immediate aftermath of a crisis? Relations with Hurricane Katrina evacuees' acute stress symptoms and functional impairment. *Psychol Trauma*. 2019;11(6):563-70.
70. Feder A, Ahmad S, Lee EJ, Morgan JE, Singh R, Smith BW, et al. Coping and PTSD symptoms in Pakistani earthquake survivors: purpose in life, religious coping and social support. *J Affect Disord*. 2013;147(1-3):156-63.
71. Lowe SR, Raker EJ, Waters MC, Rhodes JE. Predisaster predictors of posttraumatic stress symptom trajectories: An analysis of low-income women in the aftermath of Hurricane Katrina. *PLoS One*. 2020;15(10):e0240038.

72. Brown LA, Fernandez CA, Kohn R, Saldivia S, Vicente B. Pre-disaster PTSD as a moderator of the relationship between natural disaster and suicidal ideation over time. *J Affect Disord.* 2018;230:7-14.
73. McDonald-Harker C, Drolet JL, Sehgal A, Brown MRG, Silverstone PH, Brett-MacLean P, et al. Social-ecological factors associated with higher levels of resilience in children and youth after disaster: the importance of caregiver and peer support. *Front Public Health.* 2021;9:682634.
74. Lalani N, Drolet JL, McDonald-Harker C, Brown MRG, Brett-MacLean P, Agyapong VIO, et al. Nurturing spiritual resilience to promote post-disaster community recovery: the 2016 Alberta wildfire in Canada. *Front Public Health.* 2021;9:682558.
75. Norris FH, Tracy M, Galea S. Looking for resilience: understanding the longitudinal trajectories of responses to stress. *Soc Sci Med.* 2009;68(12):2190-8.
76. Cao-Lei L, Yogendran S, Dufoix R, Elgbeili G, Laplante DP, King S. Prenatal maternal stress from a natural disaster and hippocampal volumes: gene-by-environment interactions in young adolescents from project ice storm. *Front Behav Neurosci.* 2021;15:706660.
77. Rosen V, Ayers G. An update on the complexity and importance of accurately diagnosing post-traumatic stress disorder and comorbid traumatic brain injury. *Neurosci Insights.* 2020;15:2633105520907895.
78. Chen A, Rosenbaum S, Wells R, Gould K, Ward PB, Steel Z. Obesity, physical activity and sleep quality in patients admitted to a posttraumatic stress inpatient ward. *Australas Psychiatry.* 2020;28(3):270-3.
79. Özgen F, Aydın H. Posttraumatic stress disorder. *J Clin Psy.* 1999;2(1):34-41. Turkish.
80. Çırakoğlu OC. Uzun süren bir savaş: travma sonrası stres bozukluğu. *Pivolka.* 2003;2(Savaş Özel Sayısı):20-1. Turkish.
81. Kukuoğlu A. Psychological traumas after natural disasters and a sample psychological support education program. *Afet ve Risk Dergisi.* 2018;1(1):39-52.
82. Kübler-Ross E, Wessler S, Avioli LV. On death and dying. *JAMA.* 1972;221(2):174-9.
83. Aksöz İ. Kayıp ve yas. In: Erdur Baker Ö, Doğan T, editors. *Afetler, krizler, travmalar ve psikolojik yardım.* Ankara: Türk Psikolojik Danışma ve Rehberlik Derneği; 2014. p.43-63. Turkish.
84. Yılmaz B. Traumatic stress in relief workers. *J Clin Psy.* 2007;10(3):137-47. Turkish.
85. Kristensen P, Weisæth L, Heir T. Bereavement and mental health after sudden and violent losses: a review. *Psychiatry.* 2012;75(1):76-97.
86. Johannesson KB, Lundin T, Hultman CM, Lindam A, Dyster-Aas J, Arnberg F, et al. The effect of traumatic bereavement on tsunami-exposed survivors. *J Trauma Stress.* 2009;22(6):497-504.
87. Kristensen P, Weisaeth L, Heir T. Predictors of complicated grief after a natural disaster: a population study two years after the 2004 South-East Asian tsunami. *Death Stud.* 2010;34(2):137-50.
88. Shear KM, Jackson CT, Essock SM, Donahue SA, Felton CJ. Screening for complicated grief among Project Liberty service recipients 18 months after September 11, 2001. *Psychiatr Serv.* 2006;57(9):1291-7.
89. Neria Y, Gross R, Litz B, Maguen S, Insel B, Seirmarco G, et al. Prevalence and psychological correlates of complicated grief among bereaved adults 2.5-3.5 years after September 11th attacks. *J Trauma Stress.* 2007;20(3):251-62.
90. Carmi L, Fostick L, Burshtein S, Cwikel-Hamzany S, Zohar J. PTSD treatment in light of DSM-5 and the "golden hours" concept. *CNS Spectr.* 2016;21(4):279-82.
91. Hoge EA, Worthington JJ, Nagurney JT, Chang Y, Kay EB, Feterowski CM, et al. Effect of acute posttrauma propranolol on PTSD outcome and physiological responses during script-driven imagery. *CNS Neurosci Ther.* 2012;18(1):21-7.
92. Tanir Y, Günay Kılıç B. Pharmacological approach in posttraumatic stress disorder. *Türkiye Klinikleri J Child Psychiatry-Special Topics.* 2016;2(3):59-63. Turkish.
93. Foa EB, Keane TM, Friedman MJ, Cohen JA. *Effective treatments for PTSD: practice guidelines from the International Society for Traumatic Stress Studies.* 2nd ed. New York, NY: Guilford Press; 2010.
94. Foa EB, Kozak MJ. Emotional processing of fear: exposure to corrective information. *Psychol Bull.* 1986;99(1):20-35.
95. Silveira S, Kornbluh M, Withers MC, Grennan G, Ramanathan V, Mishra J. Chronic mental health sequelae of climate change extremes: A case study of the deadliest Californian wildfire. *Int J Environ Res Public Health.* 2021;18(4):1487.
96. Longmuir C, Agyapong VIO. Social and mental health impact of nuclear disaster in survivors: A narrative review. *Behav Sci (Basel).* 2021;11(8):113.
97. Dunlop BW, Rothbaum BO, Binder EB, Duncan E, Harvey PD, Jovanovic T, et al. Evaluation of a corticotropin releasing hormone type 1 receptor antagonist in women with posttraumatic stress disorder: study protocol for a randomized controlled trial. *Trials.* 2014;15:240.
98. Cameron C, Watson D, Robinson J. Use of a synthetic cannabinoid in a correctional population for posttraumatic stress disorder-related insomnia and nightmares, chronic pain, harm reduction, and other indications: a retrospective evaluation. *J Clin Psychopharmacol.* 2014;34(5):559-64.
99. Jetly R, Heber A, Fraser G, Boisvert D. The efficacy of nabilone, a synthetic cannabinoid, in the treatment of PTSD-associated nightmares: a preliminary randomized, double-blind, placebo-controlled cross-over design study. *Psychoneuroendocrinology.* 2015;51:585-8.
100. Feder A, Parides MK, Murrrough JW, Perez AM, Morgan JE, Saxena S, et al. Efficacy of intravenous ketamine for treatment of chronic posttraumatic stress disorder: a randomized clinical trial. *JAMA Psychiatry.* 2014;71(6):681-8.
101. de Kleine RA, Rothbaum BO, Van Minnen A. Pharmacological enhancement of exposure-based treatment in PTSD: a qualitative review. *Eur J Psychotraumatol.* 2013;4(1):21626.
102. Kupferschmidt K. Can ecstasy treat the agony of PTSD? *Science.* 2014;345(6192):22-3.
103. Cohen H, Liu T, Kozlovsky N, Kaplan Z, Zohar J, Mathé AA. The neuropeptide Y (NPY)-ergic system is associated with behavioral resilience to stress exposure in an animal model of post-traumatic stress disorder. *Neuropsychopharmacology.* 2012;37(2):350-63.

104. Novakovic V, Sher L, Lapidus KA, Mindes J, Golier JA, Yehuda R. Brain stimulation in posttraumatic stress disorder. *Eur J Psychotraumatol.* 2011;2(1):5609.
105. Karsen EF, Watts BV, Holtzheimer PE. Review of the effectiveness of transcranial magnetic stimulation for post-traumatic stress disorder. *Brain Stimul.* 2014;7(2):151-7.
106. Rothbaum BO, Price M, Jovanovic T, Norrholm SD, Gerardi M, Dunlop B, et al. A randomized, double-blind evaluation of D-cycloserine or alprazolam combined with virtual reality exposure therapy for posttraumatic stress disorder in Iraq and Afghanistan War veterans. *Am J Psychiatry.* 2014;171(6):640-8.