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## Case report

## PTSD and bipolar II disorder in Fukushima disaster relief workers after the 2011 nuclear accident

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**SUMMARY**

The global threat posed by the COVID-19 pandemic has highlighted the need to accurately identify the immediate and long-term postdisaster impacts on disaster-relief workers. We examined the case of a local government employee suffering from post-traumatic stress disorder (PTSD) and bipolar II disorder following the Great East Japan Earthquake. The complex and harsh experience provoked a hypomanic response such as elated feelings with increased energy, decreased need for sleep and an increase in goal-directed activity, which allowed him to continue working, even though he was adversely affected by the disaster. However, 3.5 years later, when he suffered further psychological damage, his PTSD symptoms became evident. In addition to treating mood disorders, trauma-focused psychotherapy was required for his recovery. Thereafter, we considered the characteristics of mental health problems that emerge in disaster-relief workers, a long time after the disaster, and the conditions and treatments necessary for recovery.

**BACKGROUND**

Disasters continue to affect people not only in the moment of a disaster but also throughout the long-term recovery process. Post-traumatic stress disorder (PTSD) and depression significantly impair the social functioning of those affected and are often recognised as the most visible mental health effects on survivors, as was the case with the Great East Japan Earthquake (GEJE) of 2011.<sup>1-4</sup> In the present study, however, we would like to focus on manic and hypomanic episodes that occurred in the victims of the GEJE.<sup>5,6</sup> While bipolar disorder requires medical treatment, social functioning of the patient tends to be maintained during the hypomanic episode. Hypomanic patients show symptoms such as elated feelings with increased energy, decreased need for sleep and an increase in goal-directed activity. They could continue to contribute to the community as disaster-relief workers in the disaster-recovery process, which delays the recognition of their treatment needs by healthcare providers. The GEJE, which was followed by the nuclear accidents, left the affected areas severely damaged and required the victims to contribute as disaster-relief workers for a long period.<sup>7</sup> Therefore, after the GEJE, not a few of the people involved may have continued to work as disaster-relief workers while exhibiting hypomania.

In the general postdisaster context, relief workers are considered to be a group vulnerable to mental

health problems<sup>8</sup> and have a higher incidence of late-onset PTSD.<sup>9</sup> This may be partly due to the fact that there are many opportunities for relief workers to come into contact with the misery of victims of disasters or adverse situations. In the case of the Chernobyl disaster, the long-term effects on the mental health of the population who lived through the events are known.<sup>10,11</sup> The risk of mental disorder was particularly high among the workers involved in the clean-up efforts after the disaster because they were in constant fear of being exposed to radiation.<sup>10-12</sup> From this, one can infer the magnitude of the burdens borne by those engaged in the work of providing support to a community during any disaster. In the GEJE, the risk of mental disorder was also shown to be higher among disaster-relief workers, such as local government employees and Tokyo Electric Power Company officials.<sup>13-15</sup> In this case, being the target of blame and attacks from victims was a major factor contributing to increased risks.<sup>14,15</sup>

In this study, we observed the emergence of bipolar II disorder and symptoms of PTSD in a local government employee who experienced almost all the events of the GEJE disaster. Even after the acute phase of the disaster, he continued to work diligently as a local government employee for more than 3 years. While he was forced to deal with social conflict caused by aspects of his job, he came across reports of floods in other parts of Japan. Consequently, he began experiencing symptoms of PTSD and major depressive episodes.

The COVID-19 pandemic is, at the time of writing, wreaking havoc around the globe in what is a major health disaster. During the pandemic, many people, including healthcare workers, are expected to work in appalling conditions for extended periods. Therefore, understanding how the experience of a long-term, complex and severe disaster affects the mental health of essential responders (who are engaged in essential services) is important in guiding future policies and practices.

**CASE PRESENTATION**

The patient was a male in his 40s when he first visited our clinic. He was born and grew up in a town in Fukushima Prefecture (within 20 km of the nuclear power plant). After he graduated from a college in another city, he returned to his hometown and started working in a town office. He has no medical history of note. After the accident at the nuclear power plant in 2011, an evacuation



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order covering his hometown was issued. The order was lifted in July 2017.

### Summary of the patient's traumatic experience

He was working at the town office at the time of the earthquake. Later, while conducting a tour of the coastal area to check for earthquake damage and to ensure that people had evacuated, he experienced the tsunami near his childhood home. He and his colleague evacuated the lower floor of the house, moved upstairs with his family and watched as the surrounding houses were swept away, fearing that, along with his family and his colleague, he would also be swept away at any moment. Eventually, the water receded, but the area around the house was flooded, preventing any movement. Mobile phone services collapsed. In the evening, he carried his grandmother on his back and waded through the waters to take refuge on a nearby hill, where about 40 people had gathered. He barely slept during the night. At daylight the next day, he was rescued—along with the other people who were with him—by a Self-Defence Forces helicopter.

On the afternoon of the second day, he began engaging in relief work throughout the area. Among the tasks and efforts he undertook was aiding the local fire brigade and he was involved in housing the corpse of a man whom he had known since childhood. He would go on to help recover six or seven bodies in half a day. With nowhere to go, he slept that night wrapped in a blanket by his desk in his office. He heard a rumour of a nuclear power plant being in danger and fell asleep in a daze.

By the morning of the third day, it was clear that the nuclear power plant was in danger. Evacuation orders for everyone within a 5 km radius, followed by a 10 km radius, from the nuclear power plant, were conveyed. On the night of the fourth day, the town office was closed. On the morning of the fifth day, he told his family to flee, although he decided to stay and aid in the relief work being carried out. On the morning of the seventh day, 200–300 people—taking refuge at a junior high school—were transported to another prefecture aboard seven or eight buses. There were only three staff members remaining, including himself. Initially, he felt a strong sense of urgency and was in high spirits. He carried on working for 3 months with the local authorities, which included visiting evacuees. One of the evacuees once made him kneel for 2 hours, scolding him and saying, 'You're here too late'. Even after he returned to his hometown, he continued to work as a local government employee. He was involved in a lot of heartbreaking work—such as catching and slaughtering the growing number of untended or escaped cattle and pigs within the evacuation area.

### Medical history

In August 2014, after watching the news of the flood damage in another area of Japan, he experienced flashbacks of scenes from the tsunami during the GEJE; these flashbacks made him anxious and made sleeping difficult. This affected his work severely. At that time, he was working in a department of the town and frequently attended briefings in his hometown. He notes that there was a lot of shouting at these briefings. In the same month, he visited a clinic in the city and was diagnosed with PTSD and depression. He was given leave from the time of his initial visit for a duration of about 8 months. His symptoms subsequently improved, and he decided to discontinue treatment. During this time, while taking antidepressant medication, he experienced an uptick in his mood and spent a lot of money on mail order goods besides elated feelings with increased energy, decreased need for sleep and an increase in goal-directed activity.

Two-and-a-half years later, he became depressed again and visited another psychiatric hospital in the city. This visit began a second leave of absence from his work; he returned to work after 4 months. Three months later, he took a third leave of absence after suffering a worsening of his anxiety and depression. His physician, at the time, determined that he needed specialised treatment for PTSD and referred him to our clinic for the purpose of implementing trauma-focused psychotherapy.

### Treatment history

His first visit to our clinic was 7 years and 7 months after the GEJE. Although outwardly he appeared well groomed, his speech was sluggish. His alcohol consumption increased after the disaster, but he had been abstaining from alcohol for a month and a half before his visit, so we told him to continue. The previous doctor's prescriptions were escitalopram (20 mg), mirtazapine (30 mg), ethyl loflazepate (4 mg) and diazepam (10 mg). Although we considered this prescription inappropriate for a bipolar patient, we continued this treatment first then started to taper it down. After two general outpatient meetings, a total of 10 sessions of trauma-focused psychotherapy were conducted twice a week.

Weekly outpatient visits continued for a month. Whenever he heard news about an earthquake on the TV, he became anxious; however, he had learnt to respond by practising breathing techniques. The psychotropic drugs were gradually reduced.

He returned to work the next month, on a half-day basis, and began working full time after 3 weeks. At that time, he was still taking escitalopram (10 mg) and ethyl loflazepate (1 mg).

### Trauma-focused psychotherapy

We conducted prolonged exposure therapy.<sup>16 17</sup>

In the first session, we listened in detail to comprehend all aspects of his trauma. Because he had experienced multiple traumatic events, we asked him to evaluate the degree of subjective distress he felt about the different events. He expressed the following: (1) on the tsunami: 'I feel like blaming nature, wondering why this once-in-a-thousand-year event happened at this time'; (2) in reference to the harsh complaints emanating from residents after the disaster: 'It's not just my fault' and 'There's only so much I can do'; and (3) concerning the scene where corpses were taken: 'Why did it have to be this way?'

In the second session, he expressed survivors' guilt: 'There was some fear in the trauma part, but I wondered if the loss of an acquaintance was greater. The village where I was born and raised was gone. The person I told immediately after the earthquake to "get out of here fast" also died. I am wondering why I didn't tell them more forcefully. Images of the disaster and [the sound of] sirens on fire trucks and ambulances trigger my anxiety. There were other times when we were all talking about the disaster and everyone was normal, and I was the only one who froze'.

In the third session, he recalled that he was near his childhood home soon after the earthquake when the tsunami hit and how he had escaped by taking shelter on the second floor. He further recalled that he was left with others on high ground until the following day.

In the fourth session, he described the first few days in detail. The moment the tsunami came, he was told: 'There's a tsunami coming, run away quickly'. He recalled that 'The waves were really black, and [that] the water was extremely powerful', and that he 'was rescued by a helicopter with [his] colleagues and [that he] went back to the town office crying'. In addition, on

the afternoon of the 12<sup>th</sup>, he was tasked with helping recover the deceased; the first person he found and carried was a fire brigade worker who he knew.

In the fifth session, he remembered that, after recovering bodies on the afternoon of the 12<sup>th</sup>, he received the news that the nuclear power plant was in danger. In addition, after the evacuation order was issued, he had to help evacuate local residents while his family was evacuated to another area. There were times when he was subjected to abuse. He stated that: 'There's so much going on, so much work, it makes me just laugh'.

In the sixth session, he was asked to explain, in detail, the scenes when the lifeless body of someone he knew was recovered. He had received a call from the fire brigade, telling him that a body had been found; subsequently, he was sent to pick it up. On recognising the corpse as someone he knew, he thought, 'I could have been dead, that could well have been me rather than him'.

In the seventh session, he could recall and express his memories more easily than previously. He said, 'It's over, but why did it take so long?'

In the eighth session, we dealt with the tsunami scene again and he recalled the episodes in greater detail.

In the ninth session, he was asked to speak about his recollections of the first 3 months after the earthquake and how he lost 15 kg of weight during that period, resulting in a colleague telling him that he looked completely different.

In the tenth session, he was asked to repeat his recollections of those first 3 months. He responded by saying that 'it's great that I've been able to organize the memories in my head. Before, they were all jumbled up. I have been able to cut out some of the worst traumatic experiences, organize others, and accept the result. So, I've come to understand that it's all in the past'.

The patient continued his visits to the outpatient clinic as well as his medication—mainly the mood stabiliser lamotrigine (25 mg; in Japan, the dosage of each psychotropic drug is usually set lower than in Western countries) used for the treatment of bipolar disorder. He voluntarily practised coping techniques, such as breathing exercises, in situations where he felt stressed. Every year, emotional instability emerged around 11 March, the day the earthquake struck. In October 2019, the area where the disaster occurred suffered from flooding and water damage due to a major typhoon. He was involved in the management and operation of the evacuation centre that was set up at that time, but later became unwell and needed to take a leave of absence for about a month. Trauma-focused psychological interview sessions were conducted following this event, and two traumatic memories were treated, which were left unaddressed in the prolonged exposure method interviews conducted. One recollection concerned the times when he was angrily abused by some evacuees during the period after the GEJE. The second was about the scene when he was verbally abused at his job. After the two sessions, he recovered and has returned to work and continues to be well.

The COVID-19 outbreak, which began in January, has caused intense and extensive fear and anxiety. The patient has reported that the outbreak has brought back memories of the GEJE, as well as that of the atmosphere of the people at the time, causing him to experience some heightened emotions of fear. He has also realised, however, that for a long time he was too absorbed in and preoccupied by his GEJE experiences; because of this awareness and acceptance, he was mindful not to be like that this time round.

## GLOBAL HEALTH PROBLEM LIST

How do the complex and harsh experiences of the GEJE disaster and its aftermath affect disaster-relief workers?

The GEJE was a complex disaster that involved an earthquake, tsunami and nuclear power plant accident, followed by a series of compulsory evacuations.

What are the crucial aspects of the trauma caused by complex disasters?

What kind of response does such trauma provoke in the short term and what are the long-term consequences?

What kind of measures should be taken to deal with mental health problems caused by complex disasters, including nuclear disasters?

## GLOBAL HEALTH PROBLEM ANALYSIS

Important characteristics of the traumatic events experienced by disaster-relief workers in complex disasters, including nuclear accidents, and as demonstrated throughout this case, are as follows:

1. They intermittently experience multiple traumatic events over an extended period.
2. The impact of being caught up in social conflicts over nuclear power and radiation exposure is significant, as is receiving strong condemnation and attacks from residents.<sup>14 15</sup> Considering these two points, two further observations can be made:
3. In addition to the magnitude of the trauma or loss experienced, there may be a mildly manic reaction to dealing with persistent crisis situations in the community at large. In this psychological defence reaction, there is a risk that mental health problems, such as depression and PTSD, would appear or develop a few years after the disaster.
4. Anxiety concerning the health effects of radiation exposure, which is generally considered to be a problem following nuclear disasters,<sup>8 10 18 19</sup> might be neglected.

This patient experienced the GEJE as a local government employee and had an extremely harsh and traumatic time in the months following the disaster. These included the recovery operations, a fear of exposure to radiation, harsh living conditions following the evacuation, separation from his family, and strong condemnation and reprimands as a result of postdisaster social strife and conflicts.

Despite this strong psychological burden, this individual continued to work diligently for the recovery and reconstruction of the community, which illustrated the strength of his resilience. It is believed that participation in the altruistic activity of contributing to the recovery of the community boosted that resilience.<sup>20</sup> At the same time, it is worth noting that in the present case, the patient demonstrated a hypomanic state. The hypomanic state is pathological, as it involves the avoidance of realistic anxiety.<sup>21</sup> Denial of self-damage or fatigue can make self-care more difficult to implement. However, in the short term, it produces desirable effects by maintaining social activity, which can protect people from being overwhelmed by practical challenges in a disaster situation. This may be an adaptive response which enhances resilience.

We would like to draw attention to the fact that the patient did not complain of anxiety concerning the adverse health effects of radiation exposure, which is generally expected in mental health problems associated with nuclear disasters.<sup>8 10 18 19</sup> As in the present case, this may be due to the fact that residents who choose to live in relatively close proximity to the accident site can be seen as a biased group that does not take the possible

damage of radiation exposure seriously. It is also possible to think that a manic avoidance of anxiety<sup>21</sup> may be at work here. Alternatively, it could be an outcome of the risk communication<sup>22</sup> that took place after the disaster. People living in the area had learnt that the levels of radiation that they were exposed to while living in close proximity to the plant were not the kind that would actually have serious consequences.

Three years and 5 months after the disaster, the PTSD symptoms—including flashbacks—suddenly flared up after the patient was exposed to news of another disaster in Japan. In addition, during this period, the patient endured a situation in which he was required to negotiate, as a representative of the local government (being an employee himself), with residents who were affected by the nuclear accident. However, communication and negotiations did not go well, resulting in strong admonishment. In the case of an elderly woman with symptoms of PTSD caused by the tsunami, as reported by Hori *et al*, the recurrence was also caused by being involuntarily blamed for being involved in a severe conflict among residents in the communal dwelling where she was living.<sup>23</sup>

Although our patient recovered from his mood disorder by using medication, he had two repeated flare-ups which led to the implementation of prolonged exposure therapy<sup>16 17</sup>—a psychotherapy focused on PTSD. North and Pfefferbaum have argued that less invasive treatments should be prioritised in the immediate aftermath of a disaster as an intervention for post-disaster PTSD, and specialised trauma-focused treatments should be provided only when depression and PTSD symptoms persist.<sup>24</sup> Our treatment is consistent with this argument. The actual psychotherapy process involved sorting out a situation in which multiple traumatic events were intricately intertwined, in addition to habituation through the recall of traumatic memories. We also discussed the destruction of his hometown and the loss of his relatives and acquaintances.<sup>16</sup>

Although improvement was observed following the treatment described previously, emotional instability was sometimes caused by increased stress in daily life; as such, it was necessary to continue the outpatient treatment, including the prescription of lamotrigine (25 mg). We also provided psychological education about stress coping. Although trauma reactions and feelings of depression may intensify on the anniversary of the GEJE, he gradually became able to care for himself. In addition, we discussed his tendency to be manically uplifted in crisis situations and overly immersed in his community contributions. However, the traumatic experience of receiving strong condemnation from residents<sup>14 15</sup>—that could not be addressed in the initial PTSD treatment—necessitated additional psychotherapeutic interviews later on. On the other hand, we should not rely solely on improving the coping skills of patients. Because experiencing multiple disasters would increase the suicide rate,<sup>25</sup> the same person should not be repeatedly burdened as a relief worker.

The following lessons can be drawn from this case:

1. The recovery and reconstruction of the community, including a medical system that allows general psychiatric treatment, such as treatment for mood disorders, should be ensured as quickly as possible after a disaster.
2. It is not easy for those who have an important role in the affected community to reduce their responsibilities in the community during the postdisaster phase. There is also a prejudice against psychiatric issues. Awareness-raising activities related to mental health, including psychoeducation about symptoms of mood disorders and PTSD, should be carried out widely in the community, even though this could be difficult after the disaster. The medical facilities where the cur-

rent treatment was provided also existed in the areas affected by the disaster.<sup>26 27</sup>

3. A system that allows access to specialised treatment focused on PTSD should be developed<sup>16 17 23</sup> when necessary.
4. The public should be made aware that they should refrain from unwarranted severe criticism of local government officials in the wake of a disaster,<sup>14 15</sup> as it would increase the risk of mental health problems for those who are criticised.

### Learning points

- ▶ For the victims of the Great East Japan Earthquake who experienced the earthquake, tsunami, nuclear accident and subsequent evacuation, there are two highly significant points: (1) the persistence of the crisis situation over a long period (weeks, months or even years) and (2) the emergence of social conflicts over radiation exposure from an early stage.
- ▶ In particular, disaster-relief workers are at a high risk of mental health problems because they are repeatedly exposed to other victims' tragic situations and are prone to be strongly criticised or attacked, even though they themselves are victims of the disaster.
- ▶ With respect to postdisaster mental health, both depression and hypomania may emerge. Since hypomania is a partial disavowal of difficult realities, decrease in anxiety and increasing physical activity can represent an adaptive response to difficult situations arising after a complex disaster, including a nuclear disaster where the threat is invisible.
- ▶ Exposure to radiation after a nuclear accident can damage mental as well as physical health, both or either of which may not manifest for some considerable time after the initial disaster, or which may appear following various trigger events.
- ▶ In postdisaster patients, mood disorders that are combined with post-traumatic stress disorder (PTSD) may not be controlled without PTSD-focused treatment.

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### REFERENCES

- 1 Yabe H, Suzuki Y, Mashiko H, *et al*. Psychological distress after the great East Japan earthquake and Fukushima Daiichi nuclear power plant accident: results of a mental health and lifestyle survey through the Fukushima health management survey in FY2011 and FY2012. *Fukushima J Med Sci* 2014;60:57–67.
- 2 Kunii Y, Suzuki Y, Shiga T, *et al*. Severe psychological distress of Evacuees in evacuation zone caused by the Fukushima Daiichi nuclear power plant accident: the Fukushima health management survey. *PLoS One* 2016;11:e0158821.

- 3 Harada N, Shigemura J, Tanichi M, *et al*. Mental health and psychological impacts from the 2011 great East Japan earthquake disaster: a systematic literature review. *Disaster Mil Med* 2015;1:17.
- 4 Hori A, Hoshino H, Miura I, *et al*. Psychiatric outpatients after the 3.11 complex disaster in Fukushima, Japan. *Ann Glob Health* 2016;82:798–805.
- 5 Matsumoto J, Kunii Y, Wada A, *et al*. Mental disorders that exacerbated due to the Fukushima disaster, a complex radioactive contamination disaster. *Psychiatry Clin Neurosci* 2014;68:182–7.
- 6 Hisamura M, Hori A, Wada A, *et al*. Newly admitted psychiatric inpatients after the 3.11 disaster in Fukushima, Japan. *Open J Psychiatr* 2017;7:131–46.
- 7 Hori A, Tsumuraya K, Kanamori R, *et al*. [Report from Minamisoma City: diversity and complexity of psychological distress in local residents after a nuclear power plant accident]. *Seishin Shinkeigaku Zasshi* 2014;116:212–8.
- 8 Garbern SC, Ebbeling LG, Bartels SA. A systematic review of health outcomes among disaster and humanitarian responders. *Prehosp Disaster Med* 2016;31:635–42.
- 9 Utzon-Frank N, Breinegaard N, Bertelsen M, *et al*. Occurrence of delayed-onset post-traumatic stress disorder: a systematic review and meta-analysis of prospective studies. *Scand J Work Environ Health* 2014;40:215–29.
- 10 Bromet EJ. Mental health consequences of the Chernobyl disaster. *J Radiat Prot* 2012;32:N71–5.
- 11 Bromet EJ, Havenaar JM, Guey LT. A 25 year retrospective review of the psychological consequences of the Chernobyl accident. *Clin Oncol* 2011;23:297–305.
- 12 Laidra K, Rahu K, Tekkel M, *et al*. Mental health and alcohol problems among Estonian cleanup workers 24 years after the Chernobyl accident. *Soc Psychiatr Psychiatr Epidemiol* 2015;50:1753–60.
- 13 Setou N, Fukumori T, Nakao K, *et al*. Factors related to the fatigue of relief workers in areas affected by the Great East Japan Earthquake: survey results 2.5 years after the disaster. *Biopsychosoc Med* 2018;12:14.
- 14 Ikeda A, Tanigawa T, Charvat H, *et al*. Longitudinal effects of disaster-related experiences on mental health among Fukushima nuclear plant workers: the Fukushima news project study. *Psychol Med* 2017;47:1936–46.
- 15 Tanisho Y, Shigemura J, Kubota K, *et al*. The longitudinal mental health impact of Fukushima nuclear disaster exposures and public criticism among power plant workers: the Fukushima news project study. *Psychol Med* 2016;46:3117–25.
- 16 Foa EB, Kozak MJ. Emotional processing of fear: exposure to corrective information. *Psychol Bull* 1986;99:20–35.
- 17 Hori A, Takebayashi Y, Tsubokura M, *et al*. Efficacy of prolonged exposure therapy for a patient with late-onset PTSD affected by evacuation due to the Fukushima nuclear power plant accident. *BMJ Case Rep* 2019;12:e231960.
- 18 Fukasawa M, Kawakami N, Umeda M, *et al*. Longitudinal associations of radiation risk perceptions and mental health among non-evacuee residents of Fukushima Prefecture seven years after the nuclear power plant disaster. *SSM Popul Health* 2020;10:100523.
- 19 Suzuki Y, Takebayashi Y, Yasumura S, *et al*. Changes in risk perception of the health effects of radiation and mental health status: the Fukushima health management survey. *Int J Environ Res Public Health* 2018;15:1219.
- 20 Haglund M, Cooper N, Southwick S, *et al*. 6 keys to resilience for PTSD and everyday stress. *Curr Psychiatry* 2007;6:23–30.
- 21 Goossens PJJ, Knoppert-van der Klein EAM, van Achterberg T. Coping styles of outpatients with a bipolar disorder. *Arch Psychiatr Nurs* 2008;22:245–53.
- 22 Murakami M, Kumagai A, Ohtsuru A. Building risk communication capabilities among professionals: seven essential characteristics of risk communication. *Radiat Prot Dosimetry* 2018;182:120–7.
- 23 Hori A, Morita T, Yoshida I, *et al*. Enhancement of PTSD treatment through social support in Iodobata-Nagaya community housing after Fukushima's triple disaster. *BMJ Case Rep* 2018;2018. doi:10.1136/bcr-2018-224935. [Epub ahead of print: 19 Jun 2018].
- 24 North CS, Pfefferbaum B. Mental health response to community disasters: a systematic review. *JAMA* 2013;310:507–18.
- 25 Reifels L, Spittal MJ, Dückers MLA, *et al*. Suicidality risk and (repeat) disaster exposure: findings from a nationally representative population survey. *Psychiatry* 2018;81:158–72.
- 26 Ochi S, Tsubokura M, Kato S, *et al*. Hospital staff shortage after the 2011 triple disaster in Fukushima, Japan—An earthquake, Tsunamis, and nuclear power plant accident: a case of the Soso district. *PLoS One* 2016;11:e0164952.
- 27 Fukunaga H, Kumakawa H. Mental health crisis in northeast Fukushima after the 2011 earthquake, tsunami and nuclear disaster. *Tohoku J Exp Med* 2015;237:41–3.

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