

Post-traumatic Stress and Growth Among Medical Student Volunteers After the March 2011 Disaster in Fukushima, Japan: Implications for Student Involvement with Future Disasters

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Abstract The March 2011 “triple disaster” (earthquake, tsunami, and nuclear accident) had a profound effect on northern Japan. Many medical students at Fukushima Medical University volunteered in the relief effort. We aimed to investigate the nature of students’ post-disaster involvement and examine the psychological impact of their experiences using a survey containing elements from the Davidson Trauma Scale and Posttraumatic Growth Inventory. We collected 494 surveys (70 % response rate), of which 132 students (26.7 %)

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had volunteered. Volunteers were more likely to be older, have witnessed the disaster in person, had their hometowns affected, and had a family member or close friend injured. In the month after 3/11, volunteers were more likely to want to help, feel capable of helping, and report an increased desire to become a physician. Both in the month after 3/11 and the most recent month before the survey, there were no significant differences in distressing symptoms, such as confusion, anger, or sadness, between volunteers and non-volunteers. Volunteers reported a significantly higher level of posttraumatic growth than non-volunteers. Participating in a greater variety of volunteer activities was associated with a higher level of posttraumatic growth, particularly in the Personal Strength domain. There may be self-selection in some criteria, since students who were likely to be resistant to confusion/anxiety/sadness may have felt more capable of helping and been predisposed to volunteer. However, participation in post-disaster relief efforts did not appear to have a harmful effect on medical students, an important consideration for mobilizing volunteers after future disasters.

Keywords Medical student volunteerism · 3/11 · Posttraumatic growth · Posttraumatic stress response · Disaster mental health · Natural disasters

Introduction

The Great East Japan earthquake on March 11, 2011 and the ensuing tsunami and nuclear accident led to the deaths of almost 16,000 people, caused widespread destruction and property damage, and displaced roughly 470,000 people from their homes (230,000 of whom are still displaced as of January 2015 [1–3]). These devastating events, commonly referred to as “3/11”, had a profound and ongoing impact on the physical and mental wellbeing of local residents [4].

Volunteers played an especially important role in the immediate aftermath of 3/11. Among them were medical students from Fukushima Medical University (FMU), which is located approximately 60 km from the Fukushima Daiichi nuclear power plant and far enough inland to have been unaffected by the tsunami. Students at FMU assisted with clinical and non-clinical duties both at the hospital and in the community, doing tasks such as clearing debris, distributing food, fundraising, and sorting supplies. In addition, upperclassmen who had begun their clinical training organized a team of as many as 60 students per day to help with patient transfer within the hospital [5].

Medical students represent a ready and willing source of volunteers in the wake of a disaster, and can be quickly and efficiently mobilized as part of a large medical center’s emergency response plan. Being involved in the response to a disaster, however, comes with the potential for exposure to traumatic events and experiences and may have long-term consequences for well-intentioned volunteers unprepared for what they witness.

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Although some studies have found that medical students may be more vulnerable to post-disaster stress and symptoms than the rest of the population and encounter barriers to post-disaster mental health services [6–8], others suggest that they are a valuable untapped resource and may not experience lasting psychiatric consequences from volunteering after a disaster [9, 10].

A study looking at volunteering among New York medical students after the 9/11 terrorist attacks, for example, found that there was no relationship between involvement in the relief effort and subsequent wellbeing, though the authors did find that both women and those involved in emotionally stressful activities experienced increased psychiatric symptoms [10]. The authors concluded that involvement in the relief effort might be associated with enhanced professional self-esteem, since those who volunteered were more likely to report an increased desire to become a physician.

Volunteering has other potential benefits for medical students. In addition to reinforcing professional goals, it enables them to build ties with their communities, hone teamwork skills, and experience the satisfaction of playing an active role in the relief effort. This is particularly important for students in their pre-clinical years who may feel unable to contribute due to their lack of clinical expertise; volunteering affords them the chance to do something constructive outside of the classroom, whether clinical or non-clinical, and have the experience of being part of a larger team in a moment of public need.

Fittingly given their chosen profession, a majority of medical students share a desire to help. A study by Kaiser et al. (2009) sheds light on students' willingness to contribute after a disaster: of the 523 students surveyed throughout the US, 96 % said they would respond to a natural disaster, 94 % for pandemic influenza, and 84 % for a radiological event [9]. The authors stress, however, that there is a discrepancy between students' *desire* to respond and their perception of their *ability* to respond, pointing to a need to expand training in disaster medicine.

In this study, we conducted a survey of Fukushima medical students to assess the demographics of those who volunteered after 3/11; their connection to the disaster and how they became involved; and whether their involvement had a significant long-term psychological impact as measured by PTSD symptoms and the experiences of posttraumatic growth (PTG). Our aim was to explore how the act of volunteering after the disaster impacted medical students on a professional and personal level, including their PTG. Although PTG has been studied among physicians [11, 12], little research has been done to examine this phenomenon among medical students. The current study sheds light on the possible utility and safety of including medical students in future disaster relief plans.

Methods

We distributed a paper survey in July 2014 to all medical students at FMU. The surveys were anonymous and were either collected via a drop box in a student lounge or at a collection point outside all-class lectures. The survey contained demographic questions; yes/no questions regarding involvement with the disaster and the volunteer effort; questions about avoidance of certain disaster-related triggers; an adapted version of the Davidson Trauma Scale (DTS) that included questions about professional satisfaction; and the Posttraumatic Growth Inventory (PTGI) [13, 14].

For the DTS, we asked students to rate each of the 15 standard items on a 0–4 scale, where 0 was “not at all” and 4 was “very much”. We asked this separately for the month

after the disaster and the most recent month before the survey. We did not explicitly state that students should restrict their answers to feelings caused by the disaster when responding to the DTS. For the PTGI, we asked students to rate each of the 21 statements based on their 3/11 experiences by using a scale where 0 was “not at all” and 5 was “a very great deal”. The total PTGI score (Cronbach’s $\alpha = 0.94$ for the current sample) and the five subscale scores of Personal Strength ($\alpha = 0.84$), Relating to Others ($\alpha = 0.87$), New Possibilities ($\alpha = 0.83$), Spiritual Change ($\alpha = 0.52$), and Appreciation of Life ($\alpha = 0.72$) were calculated to evaluate the degree of PTG [14].

For the avoidance questions, we asked students to report using the same 0–4 scale whether they had avoided any of the following: sources of radiation such as medical X-rays, visiting locations near Fukushima Daiichi, eating foods grown in Fukushima Prefecture, going outside, or venturing to low-lying (tsunami-prone) locations both in the month after the disaster and the most recent month before the survey. The values from each response were summed to generate an “avoidance score” (Cronbach’s $\alpha = 0.82$ and 0.75 , respectively).

In the disaster involvement section, students who indicated that they volunteered were further asked to specify which type(s) of volunteering work they became involved with by selecting from nine categories: fundraising; clinical work in shelters/hospitals/clinics; non-clinical work in shelters/hospitals/clinics; patient evacuation; cleaning debris in public areas; cleaning debris in private homes; distributing food/necessities; sorting supplies; and door-to-door canvassing. We also recorded how many of the nine types of activities each student was involved into assess the variability of participation in the relief effort.

Statistical analysis was done with SPSS Version 22 (IBM) using t tests, χ^2 tests, one-way ANOVA, two-way factorial ANOVA, and correlations. Variables using an equal interval Likert scale were analyzed using t tests, one-way ANOVA, or factorial ANOVA to compare means; however, some of the variables in the DTS were markedly skewed (skewness greater than 1 or less than -1), so we recoded them into binary variables ($1, 2, 3$ or $4 = 1$ and $0 = 0$) and analyzed using χ^2 tests.

Results

We distributed our survey to all 705 medical students at FMU and collected 494 responses (response rate: 70.0 %). Table 1 shows demographics, disaster involvement, and avoidance scores of our study participants and compares the responses of students who volunteered after 3/11 with those who did not. 401 students (81.2 %) witnessed the disaster in person, and 132 (26.7 %) volunteered in the disaster response. Eleven students (2.2 %) reported still being involved at the time of the survey.

Volunteers were more likely to be older students, have witnessed the disaster in person, had their hometowns affected, and had a family member or close friend injured in the disaster. There was no significant difference in gender distribution between volunteers and non-volunteers (note: 67 % of the FMU student body is male) [15]. There were also no significant differences in avoidance behavior (of the disaster area, local foods, sources of radiation, etc.) between volunteers and non-volunteers either in the month after the disaster or in the most recent month before the survey.

Table 2 shows the DTS scores that were significantly different between volunteers and non-volunteers both immediately after the disaster and in the most recent month before the survey. In the month after the disaster, volunteers were more likely to want to help and to feel capable of helping. They were also more likely to report an increased desire to become

Table 1 Respondent Demographics

	Total	Non-volunteers	volunteers	Test	<i>p</i>
	494	362 (73.3 %)	132 (26.7 %)		
Demographics					
Age ^a	21.3 (2.55)	21.0 (2.41)	21.8 (2.74)	<i>t</i> = 2.91	0.004
Sex					
M	322 (65.2 %)	226 (65.9 %)	83 (62.9 %)	$\chi^2 = 0.49$	0.49
F	169 (34.2 %)	115 (33.5 %)	49 (37.1 %)		
Year in school					
1	99 (20.0 %)	76 (22.2 %)	19 (14.4 %)	$\chi^2 = 22.6$	<0.001
2	123 (24.9 %)	85 (24.8 %)	34 (25.8 %)		
3	91 (18.4 %)	68 (19.8 %)	17 (12.9 %)		
4	75 (15.2 %)	54 (15.7 %)	17 (12.9 %)		
5	66 (13.4 %)	42 (12.2 %)	23 (17.4 %)		
6	40 (8.1 %)	18 (5.2 %)	22 (16.7 %)		
Disaster exposures					
Witnessed 3/11 in person					
Yes	401 (81.2 %)	270 (78.7 %)	118 (89.4 %)	$\chi^2 = 6.34$	0.012
Hometown affected by 3/11					
Yes	340 (68.8 %)	228 (66.5 %)	101 (76.5 %)	$\chi^2 = 4.87$	0.027
Family member or close friend died in 3/11					
Yes	18 (3.6 %)	2 (2.6 %)	7 (5.3 %)	$\chi^2 = 2.15$	0.14
Injured in 3/11					
Yes	7 (1.4 %)	3 (0.9 %)	3 (2.3 %)	$\chi^2 = 1.49$	0.22
Family member or close friend injured in 3/11					
Yes	35 (7.1 %)	18 (5.2 %)	16 (12.1 %)	$\chi^2 = 6.73$	0.009
Victim of previous disaster or trauma					
Yes	9 (1.8 %)	4 (1.2 %)	4 (3.0 %)	$\chi^2 = 1.99$	0.16
Avoidance score (month after 3/11) ^b					
	12.1 (6.45)	12.1 (6.69)	12.3 (5.87)	<i>t</i> = 0.28	0.77
Avoidance score (most recent month) ^b					
	5.91 (4.65)	6.07 (4.81)	5.55 (4.17)	<i>t</i> = 1.10	0.27

^a Age is reported as mean with standard deviation in parentheses

^b Avoidance score is reported as mean with standard deviation in parentheses (score ranges from 0 to 20)

a physician. In the month after the disaster, there were no significant differences in distressing symptoms (confusion, anger, etc.) between volunteers and non-volunteers. In the most recent month before the survey, those who had volunteered still reported higher scores in wanting to help and felt more capable of helping, and also reported a significantly lower score on feeling guilty; there were no significant differences in distressing symptoms.

Table 3 shows the DTS and avoidance scores, reflecting significant gender differences both within the whole student population and among volunteers only. Among all students, women were more likely to feel confused, sad, guilty, and anxious in the month after the

Table 2 Differences in post-trauma symptoms and professional satisfaction between volunteers and non-volunteers

	Non-volunteers	Volunteers	Test	<i>p</i>
Month After 3/11				
Want to help	2.71 (1.03)	3.39 (0.78)	<i>t</i> = 7.74	<0.001
Feel capable of helping	1.30 (0.93)	1.88 (0.96)	<i>t</i> = 5.97	<0.001
Increased desire to be a physician	2.38 (1.18)	2.62 (1.22)	<i>t</i> = 2.01	0.045
Most recent month				
Want to help	2.41 (1.09)	2.67 (0.99)	<i>t</i> = 2.38	0.018
Feel capable of helping	1.65 (1.00)	2.02 (0.93)	<i>t</i> = 3.77	<0.001
Feel guilty	1.15 (1.14)	0.91 (1.03)	<i>t</i> = 2.21	0.028

Scores are reported as means with standard deviation in parentheses (score ranges from 0 to 4). Not shown are non-statistically significant differences at either time point in other Davidson Trauma Scale categories: feel confused, feel angry, feel sad, feel anxious, feel safe at home, feel safe at work, have difficulty sleeping, experience a change in appetite, increase the frequency of alcohol or drug use, have problems concentrating, and have nightmares

Table 3 Gender differences in post-trauma symptoms and avoidance

	Men	Women	Test	<i>p</i>
All respondents				
Month after 3/11				
Feel confused	2.54 (1.15)	2.93 (0.98)	<i>t</i> = 3.96	<0.001
Feel sad	2.68 (1.19)	3.13 (0.97)	<i>t</i> = 4.42	<0.001
Feel guilty	1.51 (1.26)	1.88 (1.26)	<i>t</i> = 3.06	0.002
Feel anxious	2.64 (1.11)	3.13 (0.95)	<i>t</i> = 5.09	<0.001
Avoidance score	11.1 (6.17)	14.1 (6.51)	<i>t</i> = 5.01	<0.001
Most recent month				
Want to help	2.39 (1.07)	2.63 (1.04)	<i>t</i> = 2.39	0.017
Feel guilty	1.00 (1.06)	1.21 (1.16)	<i>t</i> = 2.02	0.044
Feel anxious	1.14 (1.13)	1.41 (1.11)	<i>t</i> = 2.51	0.013
Increased frequency of alcohol or drug use ^a	70 (21.8 %)	19 (11.4 %)	$\chi^2 = 8.01$	0.005
Avoidance score	5.57 (4.43)	6.54 (4.96)	<i>t</i> = 2.21	0.028
Volunteers				
Month after 3/11				
Feel sad	2.81 (1.20)	3.20 (0.91)	<i>t</i> = 2.14	0.035
Feel anxious	2.67 (1.11)	3.17 (0.95)	<i>t</i> = 2.58	0.011
Avoidance score	11.1 (5.81)	14.3 (5.47)	<i>t</i> = 3.10	0.002
Most recent month				
Feel capable of helping	2.19 (0.83)	1.71 (1.00)	<i>t</i> = 2.96	0.004

^a Skewed variable. Data were recoded as binary and analyzed using χ^2 test as described in methods

disaster, as well as show higher avoidance. In the most recent month before the survey, women were still more likely to feel guilty, feel anxious, and show higher avoidance; they were also more likely to want to help. A greater proportion of men reported increasing the frequency of alcohol or drug use in the most recent month before the survey. When looking only among volunteers, women were more likely to feel sad, feel anxious, and show higher

Table 4 Factorial ANOVA of PTGI scores

	Non-volunteers		Volunteers		F value ^a	<i>p</i>
	Men	Women	Men	Women		
Full PTGI	35.64 (20.25)	34.53 (17.98)	44.19 (19.03)	36.38 (18.18)	4.46 6.07 2.51	0.035 0.014 0.114
I: Relating to Others	1.84 (1.14)	1.84 (1.03)	2.19 (1.03)	1.96 (0.96)	1.03 4.00 1.00	0.311 0.046 0.318
II: New Possibilities	1.73 (1.11)	1.64 (1.06)	2.21 (1.05)	1.59 (1.16)	8.98 3.28 4.85	0.003 0.071 0.028
III: Personal Strength	1.38 (1.10)	1.07 (0.97)	1.82 (1.23)	1.37 (1.03)	9.86 9.69 0.35	0.002 0.002 0.553
IV: Spiritual Change	0.78 (0.95)	0.83 (0.97)	1.06 (1.08)	0.67 (0.89)	2.56 0.33 4.41	0.110 0.565 0.036
V: Appreciation of Life	2.34 (1.19)	2.54 (1.08)	2.74 (1.09)	2.63 (1.17)	0.11 3.92 1.47	0.743 0.048 0.226

Scores are reported as means with standard deviation in parentheses. The full PTGI is ranging from 0 to 105. Each of the subscale score is ranging from 0 to 5

^a F value in the upper row indicates the main effect of gender, F value in the middle row indicates the main effect of volunteering, and F value in the lower row indicates the interaction effect

avoidance in the month after the disaster; in the most recent month before the survey, they were less likely to feel capable of helping.

Table 4 shows the results of 2 (gender) × 2 (volunteer/non-volunteer) factorial ANOVA using the total PTGI scores and five subscale scores. For the total PTGI score, volunteers reported higher PTG than non-volunteers, and men reported higher PTG than women. However, the effects varied among the five domains. The main effect of volunteering was observed in the Relating to Others, Personal Strength, and Appreciation of Life domains, indicating that those who engaged in volunteer efforts experienced higher growth in these domains. There were gender differences in the New Possibilities and Personal Strength domains, suggesting that men experienced higher growth in these two domains. In addition, an interaction effect was found in the domains of New Possibilities and Spiritual Change. Volunteers experienced higher PTG in these domains, but this was observed only in men.

PTG showed a positive association with the number of volunteer activities a student was involved in ($r = 0.22$, $p = 0.014$), particularly in the Personal Strength domain ($r = 0.23$, $p = 0.008$). However, being involved in more activities was not significantly associated with post-traumatic symptoms on the modified DTS or avoidance scores.

Discussion

More than 80 % of the FMU student body reported witnessing 3/11 in person, underscoring the extent to which the university community was impacted by the disaster. Although the campus was not affected by the tsunami due to its distance from the coast, everyone in the

area felt the 9.0 magnitude earthquake and its many aftershocks. As a consequence of the quake, FMU experienced a multi-day water and fuel shortage that severely hampered the ability to provide care to patients and forced the only hospital cafeteria to close. A plume of radioactive material traveled in the direction of Fukushima City in the days following the nuclear explosion and caused widespread contamination of the area, as well anxiety and uncertainty among the public about potential threats to health.

There are several possibilities as to why even more students did not report witnessing the disaster. First, since we surveyed students in years 1 through 6, not all students were enrolled at FMU during 3/11 and may have been living in other parts of Japan; if we had limited our study to current 5th- and 6th-year students, the percentage would have likely been greater, which is consistent with the results from χ^2 test we reported above. We chose to include students from all 6 years to test if witnessing the disaster was associated with volunteering, and because FMU is a prefectural college and many students (42 % as of 2014) lived in Fukushima Prefecture before matriculating [15].

More than a quarter of the student body participated in the relief effort, again showing the large impact of the disaster as well as students' desire to become involved. The radioactive contamination may have hindered volunteer involvement, given that certain areas were inaccessible in the aftermath of 3/11 and outdoor activities in contaminated areas were discouraged or forbidden. Shortages of fuel and a suspension of public transportation may also have impacted volunteer turnout; in addition, FMU postponed the start of the new academic year by a month, so many students did not return to Fukushima Prefecture until May 2011 [5]. Had these obstacles not been present, more students may have volunteered.

Not surprisingly, volunteers were more likely to have a personal connection to the disaster: more volunteers had their hometowns affected, knew someone injured in the disaster, and witnessed the event in person. Volunteers were also more likely to be older, perhaps reflecting the fact that upperclassmen were enrolled during the time of the disaster. Notably, there was no statistically significant difference in the gender makeup of those who volunteered versus those who did not volunteer.

Our results suggest that the experience of volunteering fostered personal growth and, more importantly, did not appear to have negative psychological repercussions. In both the month after 3/11 and the month prior to the administration of the survey, volunteers were more likely to want to help and feel capable of helping. In the month prior to the administration of the survey, volunteers were less likely to feel guilty than non-volunteers. These findings underscore that the act of volunteering can have a lasting positive effect, boosting students' confidence levels. Our findings from the PTGI reinforce this: there was a positive correlation between the number of volunteer activities a student was involved in and the likelihood of experiencing growth, particularly in the realm of Personal Strength. Our results are similar to those reported in a recent study of 9/11 volunteers: at the 1-year follow-up, volunteers were more likely to be mentally healthy than non-volunteers, despite their disaster exposure [16]. These findings suggest that volunteering has the potential to be therapeutic, convey a protective benefit, and foster a sense of Personal Strength.

FMU student volunteers reported increased desire to become physicians compared to non-volunteers in the month after the disaster but not in the most recent month before the survey. There are several explanations for this discrepancy. More than 3 years elapsed between 3/11 and the survey, and it is likely that non-volunteers and volunteers alike had other experiences in this period that may have helped solidify their professional goals. If we had surveyed the students at some point sooner than 3 years later, perhaps we would have seen an ongoing significant association between volunteering and desire to become a

physician. Another possibility is that a certain amount of volunteering is necessary to have a long-term effect on career goals and ambitions. Students who put in only several hours of volunteering overall may not have derived a long-term benefit. Examining how much volunteering is sufficient to have a lasting impact is a potential area for future investigation.

Importantly, volunteers were no more likely than non-volunteers to report distressing symptoms in either the month after the disaster or the most recent month before the survey, nor did volunteers have higher avoidance scores at either time period. The fact that volunteers and non-volunteers reported similar behaviors suggests that participation in the relief effort did not cause substantial harm. Our findings are thus similar to those of Katz et al. in their study of New York medical students after 9/11. Both studies have the limitation, however, that baseline levels of stress were not assessed [10].

Our results show several notable differences with respect to gender. In the student body as a whole, women were more likely than men to feel confused, sad, guilty, and anxious in the month following the disaster and also had significantly higher avoidance scores. Many of these differences persisted in the month prior to administration of the survey; however, women were then more likely to want to help, pointing to the complexity of student involvement in disaster relief and underscoring potential differences between genders. The subgroup of volunteers showed several of the same significant differences, but not others. Katz et al. report similar findings from their 9/11 study, observing that female students appear differentially vulnerable to symptoms associated with either major depression or posttraumatic stress disorder. It is also similar to the well-established, if still unexplained, finding that the most common post-traumatic psychiatric diagnosis, PTSD, is more prevalent in women [17]. More research needs to be done to determine the source of this differential vulnerability and what, if anything, could be done to lessen this divide in the event of a future disaster.

There are several limitations to our study. One major caveat is the likelihood of self-selection: those who volunteered may have felt more capable, enthusiastic, and inherently predisposed to help at the time of the disaster. Without pre-3/11 data, we are unable to definitively establish an empowering effect of volunteering. Also, since the data were self-reported, students may not have been entirely truthful in their responses. We might have enhanced the study's validity by not having them complete the survey in class; in this setting, they may have felt pressure from their peers and instructors to complete the survey and to portray Fukushima in a positive light. Finally, the generalizability of our study is limited due to the highly specific nature of the 3/11 disaster and the volunteering constraints imposed by the concern of radioactive contamination.

Our study demonstrates that medical students can be a tremendous resource in the event of a major disaster. The act of volunteering appears to be beneficial for both medical students and the greater community. Medical students who participated perceived a significantly higher level of posttraumatic growth, reported an increased desire to become physicians in the short term, and were no more likely to suffer long-term or short-term psychiatric consequences. These findings have implications for mobilizing volunteers after future disasters and point to the utility and safety of including medical students in the disaster relief team.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Human and Animal Rights and Informed Consent Informed consent was obtained from all individual participants included in the study. This study was granted exemption by the Mount Sinai IRB and approved by the Fukushima Medical University IRB.

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