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Post-Traumatic Growth and Resilience Among Medical Students After the March 2011 Disaster in Fukushima, Japan

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Abstract

In March of 2011, an earthquake, tsunami, and nuclear accident struck northern Japan causing profound damage to the surrounding area and lasting effects to all those who lived there. Fukushima Medical University (FMU), the closest hospital that remained open during the disaster, was greatly impacted and its students rallied to help the cause. Many of them were directly affected as their neighborhoods were ruined and family and friends were injured or killed. Our study sought to better understand how this disaster impacted their posttraumatic growth and resilience in the wake of the disaster and today, 8 years later. There were three goals of this study. First, we aimed to replicate previous research that showed positive effects of disaster volunteerism on medical students' posttraumatic growth. Second, we sought to better understand the role of resilience in the wellbeing of these students. Finally, we wanted to explore the advantages to our newly created 10-Factor Resilience Behavioral Scale, which we used alongside the Davidson Trauma Scale (DTS), Posttraumatic Growth Inventory (PTGI-X), and Connor-Davidson Resilience Scale (CD-RISC). Overall, 579 responses were collected (response rate of 71.9%). Volunteers continued to show greater PTG as well as greater overall resilience. Furthermore, there were positive correlations between students' feelings of confusion, anger, sadness, guilt or anxiety and their sense of resilience, both at the time of the disaster and in the most recent month, suggesting that within Japanese culture difficult emotions may promote resilient behaviors and actions.

Keywords 3/11 · Disaster mental health · Posttraumatic growth · Natural disasters · Resilience

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Introduction

The Great East Japan Earthquake and the subsequent tsunami and nuclear accident that followed left a profound mark on Japan's northeastern prefectures. Later termed the 3/11 triple disaster, this event would leave approximately 20,000 people dead, 7,000 people injured, 2,500 people missing, and more than 470,000 people displaced from their hometowns and forced to live in temporary housing units [1, 2]. While eight years have passed since 3/11, the residents of Fukushima are still coping with the social, physical, and mental consequences of the disaster.

In the immediate aftermath of 3/11, those living in the affected areas joined together to volunteer in various ways. Efforts were organized to distribute food and water, maintain temporary shelters, fundraise, clean debris, and provide clinical treatment to those in need. The students of Fukushima Medical University (FMU), the closest hospital that remained open during the 3/11 disaster, rallied together to provide both medical and nonmedical relief efforts.

There is an abundance of literature describing the importance of volunteerism in the wake of a disaster. Specifically, medical students have been shown to represent a capable and mentally prepared group of volunteers who can facilitate disaster management [3]. While there is potential that disaster relief efforts could negatively impact student's wellbeing, many studies have shown that medical students who volunteer in the wake of a disaster have no more distressing symptoms than those who do not [4]. Additionally, in an initial study conducted in Fukushima by Anderson et al. in 2016, disaster volunteerism led individuals to experience greater post-traumatic growth [4]. In this context, post-traumatic growth or PTG refers to positive psychological growth through exposure to trauma and adversity.

Exposure to disasters, both direct and indirect, is often associated with negative mental health consequences. However, a much larger proportion of people continue to function normally or even thrive in the face of adversity [5]. This may be attributable to resilience [6]. Resilience is a quickly emerging area of focus in the field of disaster mental health. Numerous studies have supported the idea that following trauma, resilient people manifest adaptive behavior in the areas of morale, social functioning, and somatic health [7]. Additionally, research suggests that greater resilience can help to alleviate an individual's feelings of helplessness when faced with setback [8]. Relationships between PTG and resilience are equivocal. Although both resilience and PTG have been conceptualized as processes in the wake of adversity, we understand resilience as the process of recovery and potentially experiencing growth, while PTG is the process of struggle along with recognition of positive changes. Most research has thus far focused on cross-sectional studies, but more recently there has been a shift to obtain longitudinal samples to assess post-traumatic experience over time [9]. In one such investigation, Pietzrak et al. worked with survivors of Hurricane Ike in Galveston, Texas [10]. Their results showed that the vast majority of individuals exposed to this natural disaster "bounced back" within 18 months, manifesting resilience rather than long-term mental health consequences. In a second study called the Kauai Longitudinal Study, individuals with perinatal complications were studied for more than 30 years. Resilient individuals were found to be those who were characterized by personal determination, supportive relationships, and reliance on faith [11].

By observing individuals' reactions and feelings following trauma, psychiatrists Dennis Charney and Steven Southwick identified ten specific behaviors among those who adapted most positively and exhibited the greatest resilience [12, 13]. From these ten specific actions, Charney et al. developed a "prescription" for resilience in the wake of adversity. These ten

factors include: optimism, cognitive flexibility, altruism, finding a positive role model, facing fears, developing active coping skills, establishing a social network, attending to physical wellbeing, focusing on how one's mind is working emotionally and intellectually, and fostering strengths.

Resilience is a complex theory that is not easily summarized by any one specific paradigm, but rather draws on numerous dimensions of personality and behavior, social establishments, and coping mechanisms. While many scales exist to assess resilience, the majority focus on providing quantitative measures that determine the strength of resilient personality traits, abilities, and the clinical effects of pharmacologic treatment on resilience. We sought to create a new scale based on Charney's 10-factor prescription that could shift the focus from resilient traits or abilities to resilient-enhancing behaviors. By doing so, we hoped to identify certain actions and outlooks that could encourage resilience and PTG in future disasters.

This study aims to investigate how students at FMU perceive PTG and exhibit 10 resilient factors as a consequence of 3/11, and how they are associated with their post-3/11 volunteer efforts, desire to help other people, and post-traumatic emotions at the time of the disaster. Medical students, both current and future, also represent a unique population, as they have chosen to enter a profession where tragedy and death is the norm. Our investigation sought to better understand if first-hand experience of a disaster like 3/11 might have reinforced their desire to become a physician, and whether they represent an exceptionally resilient population.

In this study, we conducted a survey of Fukushima medical students to assess the demographics of those who desired to help and volunteered in the wake of the 3/11 disaster. Since the disaster was six years ago, the oldest students at FMU were in their first year at the time of the disaster. Many of the students in the other classes were originally from Fukushima prefecture and deliberately chose to attend school at FMU despite its distraught past. We sought to better understand how these student's involvement impacted their PTG and resilience. This current study sheds light on the effects of helping and negative emotions after a disaster and the sorts of resilient-enhancing behaviors and outlooks that ought to be encouraged to increase overall wellbeing.

Methods

A paper survey was distributed in July 2017 to all medical students during their course lectures at FMU. The surveys were anonymous and were either collected via a drop box in the administrative office or at a collection point close to the exit of all-class lectures. The survey contained demographic questions; yes/no questions regarding involvement with the disaster and their volunteer effort; questions about avoidance of certain disaster-related triggers; an adapted version of the Davidson Trauma Scale (DTS) [14] that included questions about professional satisfaction; the recently developed and expanded version of the Posttraumatic Growth Inventory (PTGI-X) [15]; the Connor-Davidson Resilience Scale (CD-RISC) [16]; our newly created 10 Factor Resilience Behavioral Scale (10FRBS) based on ten specific resilient behaviors identified by Charney and Southwick. The items of 10FRBS were developed by a group of researchers and psychiatrists, translated into the Japanese language, then back-translated into English and confirmed with linguistic equivalence.

In the first section of the survey that focused on disaster involvement, students who indicated that they had volunteered were further instructed to specify which type(s) of

volunteerism they engaged in by selecting from nine categories: fundraising; clinical work in shelters/hospitals/clinics; nonclinical 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 engaged in to assess the variability of participation in the relief effort.

For the DTS, students were asked to rate each of the 17 questions on a 0–4 scale where 0 represented "not at all" and 4 represented "very much." These questions were asked with respect to the month following the disaster and the most recent month. Students were not told to restrict their answers to feelings caused only by the 3/11 disaster. We slightly modified this scale by adding an additional question that asked about professional satisfaction and desire. Taken together, the questions in DTS can be grouped into three broad areas: contribution, professional satisfaction, and post-traumatic symptoms (PTSS). Cronbach's alpha coefficients for the PTSS for the month following the disaster and the most recent month were .71 and .87, respectively. Alpha was not calculated for contribution because it included two items and for professional satisfaction because it was measured by one item.

For the PTGI-X, students were asked to rate each of the 25 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 internal consistency for the total 25 items was .956. The PTGI-X consists of five sub-scales, Personal Strength, New Possibilities, Relating to Others, Spiritual and Existential Change, and Appreciation of Life. Cronbach's alpha for these five sub-scales ranged from .75 (Appreciation of Life) to .90 (Relating to Others).

For the CD-RISC, each item was rated using a 5-point scale in which 0 represented "not true at all" and 4 was "true nearly all the time." The internal consistency for the 25 items in the current sample was .94. Cronbach's alpha for the five sub-scales of CD-RISC ranged from .43 (F5: Spiritual influences) to .89 (F1: Personal competence, high standards, and tenacity).

For the 10FRBS (available upon request), students were asked to rate each of the 10 behaviors on a scale from 0 which represented "not at all" to 4 which represented "very much." These questions were asked both for the month following the disaster and the most recent month. We also asked about students' level of interest in learning more about these resilience factors. Students who answered 0 or 4 were given space to elaborate on the sorts of behaviors and actions they performed. There was a final question at the end of the survey that asked how much the 3/11 disaster shaped their decision to attend medical school on the same 0 to 4 scale. The 10FRBS items were totaled up into a composite 10FRBS resilience score. Cronbach's alpha coefficients for the month following the disaster and the most recent month were .91 and .95, respectively.

We also conducted optional in-person interviews to better understand how our population of students understood the concepts of resilience. We asked open-ended questions to hear more about their stories during the days and months following 3/11 and the ways in which the exhibited resilience.

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 805 students at FMU and collected 579 responses (response rate: 71.9%). Table 1 shows demographics and compares the responses of students who volunteered after 3/11 with those who did not with respect to their PTG and overall resilience. The overall resilience scores were determined by both the CD-RISC and 10FRBS scales. 332 students volunteered while 243 did not. Volunteers showed greater overall PTG ($p < .001$) as well as higher scores in PTG F1 (relating to others), F2 (new possibilities), F3 (appreciation of life), and F5 (spiritual and existential change). Volunteers also exhibited greater resilience as assessed by 10FRBS in the immediate month following 3/11 ($p < .001$) and trended towards greater resilience in the most recent month leading up to the survey distribution ($p = .055$). However, there was no significant difference in resilience scores between those who volunteered and those who did not as assessed by CD-RISC. In addition, resilience in the most recent month assessed by 10FRBS (Mean = 2.21, SD = .89) was not different from resilience in the immediate month following 3/11 (Mean = 2.12, SD = .75) for those who volunteered, $t(140) = -1.28$, n.s., since both were relatively high. However, it was significantly increased for those who did not volunteer (Mean = 2.01, SD = .98 in the most recent month; Mean = 1.77, SD = .87 in the immediate month following 3/11), $t(181) = -3.55$, $p < .001$, suggesting that medical students who did not volunteer showed increased motivation toward resiliency at the survey point.

PTG was positively correlated with the desire to engage in volunteer work in the future, both 1 month after 3/11 ($r = .286$, $p < .001$) and at the time of the survey ($r = .328$, p < .001). Resilience, as assessed by CD-RISC was also correlated with the desire to continue volunteer work in the future, both 1 month after 3/11 ($r = .253$, $p < .001$) and at the time of the survey ($r = .193$, $p < .001$). In addition, the students' perceived impact of their 3/11 experiences on their decisions to pursue a career in medicine, led by their direct exposure to 3/11, was associated with both PTG ($r = .454$, $p < .001$) and resilience assessed by CD-RISC ($r = .207$,

Table 1 Respondent demographics

		Volunteers	Non-volunteers	test	p value
Age		M = 21.89 (SD = 2.84)	M = 21.61 (SD = 2.14)	$t = 1.26$	.206
Sex	M	155	230	$\chi^2 = 1.912$	.167
	F	88	102		
PTGI total		M = 54.12 (24.94)	M = 46.11 (24.60)	$t = 3.66$	<.001
PTGI-F1: Relating to Others		M = 16.21 (8.02)	M = 14.03 (8.09)	$t = 3.09$	.002
PTGI-F2: New Possibilities		M = 11.39 (5.99)	M = 9.18 (5.61)	$t = 4.36$	<.001
PTGI-F3: Appreciation of Life		M = 8.31 (3.59)	M = 7.49 (3.57)	$t = 2.65$	.008
PTGI-F4: Personal Strength		M = 6.86 (4.64)	M = 6.17 (4.42)	$t = 1.76$	.079
PTGI-F5: Spiritual Change		M = 11.40 (6.40)	M = 9.31 (6.18)	$t = 3.79$	<.001
CD-RISC total		M = 55.16 (15.82)	M = 53.61 (16.83)	$t = 1.03$	.300
CD-RISC-F1		M = 18.87 (6.45)	M = 18.50 (6.67)	$t = 6.32$	.528
CD-RISC-F2		M = 15.24 (4.85)	M = 14.83 (5.20)	$t = .905$	.366
CD-RISC-F3		M = 12.00 (3.43)	M = 11.79 (3.71)	$t = .665$	.507
CD-RISC-F4		M = 6.60 (2.56)	M = 6.27 (2.66)	$t = 1.41$	.158
CD-RISC-F5		M = 4.16 (1.88)	M = 3.73 (1.93)	$t = 2.49$	.013
10FRBS month post 3/11		M = 1.97 (.78)	M = 1.73 (.82)	$t = 3.53$	<.001
10FRBS most recent month		M = 2.21 (.89)	M = 2.01 (.98)	$t = 1.92$	.055

$p < .001$). Resilience, as assessed by CD-RISC and PTG were also positively correlated with each other ($r = .526$, $p < .001$), suggesting that individuals who are more resilient also exhibit increased PTG or those who experienced PTG as a result of 3/11 are more likely to be resilient at the survey point.

Table 2 shows DTS scores that were positively and significantly correlated to overall resilience as assessed by 10FRBS both immediately after the disaster and in the most recent month before the survey. Our adapted version of DTS includes questions that ask about contribution (want to help, feel capable of helping), professional satisfaction (increased desire to be a physician), and post-traumatic symptoms (feeling confused, angry, sad, guilty and anxious). All factors were positively correlated, but questions that asked about contribution showed stronger Pearson correlations, with all values above .300 for the month following the disaster and ranging from .133 to .376 for the most recent month. Professional satisfaction was also strongly correlated to resilience for both time frames with correlations consistently above .300.

Post-traumatic symptoms on the DTS also showed positive correlations to overall resilience in both the immediate month and most recent month. These correlations were weaker than those that assessed contribution and professional satisfaction, but nevertheless they were consistently positive and significant.

Table 3 shows the correlations between the two scales of resilience that we utilized, CD-RISC and 10FRBS. As the table indicates, there were positive correlations between the total CD-RISC score and the total 10FRBS scores both in the month after 3/11(.337) and in the most recent month (.437). These represent only moderate correlations, suggesting that these two scales might assess different, although partially overlapping constructs within resilience with CD-RISC emphasizing resilient traits or personalities while 10FRBS focuses on developing resilient behaviors or outlooks (Table 4).

Table 2 Correlations between post-traumatic symptoms and professional satisfaction with factors of resilience as assessed by 10FRBS

	10FRBS month after 3/11		10FRBS recent month	
	Pearson correlation	Significance (p)	Pearson correlation	Significance (p)
Month after 3/11				
Want to help	.406	<.001	.278	<.001
Feel capable of helping	.410	<.001	.133	<.001
Increased desire to be a physician	.396	<.001	.324	<.001
Feel confused	.238	<.001	.371	<.001
Feel angry	.275	<.001	.254	<.001
Feel sad	.148	<.001	.301	<.001
Feel guilty	.232	<.001	.244	<.001
Feel anxious	.164	<.001	.279	<.001
Most recent month				
Want to help	.323	<.001	.376	<.001
Feel capable of helping	.307	0.002	.270	<.001
Increased desire to be a physician	.361	<.001	.387	<.001
Feel confused	.262	<.001	.212	<.001
Feel angry	.239	<.001	.162	<.001
Feel sad	.210	<.001	.241	<.001
Feel guilty	.201	<.001	.190	<.001
Feel anxious	.206	<.001	.152	<.001

Table 3 Correlations between post-traumatic symptoms and professional satisfaction with factors of resilience as assessed by CD-RISC

	CD-RISC	
	Pearson correlation	Significance (p)
Month after 3/11		
Want to help	.253	<.001
Feel capable of helping	.234	<.001
Increased desire to be a physician	.218	<.001
Feel confused	.175	<.001
Feel angry	.188	<.001
Feel sad	.166	<.001
Feel guilty	.101	0.025
Feel anxious	.207	<.001
Most recent month		
Want to help	.193	<.001
Feel capable of helping	.265	<.001
Increased desire to be a physician	.257	<.001
Feel confused	.048	0.292
Feel angry	.093	0.038
Feel sad	.101	0.026
Feel guilty	.060	0.185
Feel anxious	.063	.161

Discussion

The 3/11 triple disaster had devastating consequences for the people of northern Japan. This tragedy not only affected those in the surrounding area, but also left an unimaginable mark on Japanese society as a whole. 76% of students at FMU at the time of our survey reported experiencing direct exposure to 3/11, emphasizing the large-scale impact such a disaster had on this selected community. Even today, over 8 years later, the residents of Fukushima are still recovering from the immediate stresses that threatened their psychological wellbeing and physical health. The purpose of this study was threefold: to confirm the positive effects of volunteerism on PTG, to better understand the role of resilience in the wellbeing of these students, and to explore the use and potential advantages of our newly created resilience scale.

The first goal of this study was to follow-up on the findings of Anderson et al., regarding the PTG experiences in students at FMU who were directly exposed to the 3/11 disaster and who chose to volunteer. Our population of students was significantly younger (ages 12–20) at the time of 3/11 than those in their study, suggesting that adolescents too are in a psychologically healthy position to help and that volunteering can further foster personal growth.

Table 4 Correlations between CD-RISC and 10FRBS

	CD-RSIC	
	Pearson correlation	Significance
10FRBS month after 3/11	.337	<.001
10FRBS recent month	.437	<.001

Furthermore, of all the dimensions of PTG, volunteers showed the greatest increase in the second factor: New Possibilities ($p < .001$). When comparing our overall PTG scores to the PTG reported in Anderson et al.' paper, our female volunteers scored 54.86 and male volunteers scored 53.53, while their female volunteers scored 34.53 and their male volunteers scored 35.64. It is possible that younger adolescents are better able to reinterpret the disaster positively to open new doors or possibilities as they represent a more malleable population with developing personalities and identities.

There are few studies that examine PTG among non-adults. Children have not yet developed full cognitive maturity and their ability to appraise trauma, cope appropriately, use resources effectively, and understand their internal mental states undoubtedly influences their PTG. In one study, Cryder et al. found that children in the aftermath of Hurricane Floyd reported PTG largely based on their ability to ruminate often [17]. This finding is consistent with our data and suggests that adolescents can undergo PTG and perhaps should be encouraged to help in the wake of a disaster. However, our population of future physicians may represent an especially courageous and willing group and more studies ought to be done to investigate if adolescents pursing other professions exhibit the same personal strength from volunteering.

Some studies have posited that there is a difference between adolescents' ability to show PTG and resilience, becasue resilience refers to a dynamic developmental process reflecting positive adaptation in the face of adversity, while PTG refers to a growth process that transforms or changes survivors [17]. The second goal of this study was to further investigate the role of resilience in the wellbeing and recovery of these students. There is a rapidly growing body of research understanding resilience as a multi-dimensional concept that differs among people and cultural backgrounds. While researchers previously described resilience as a characteristic trait or ability to bounce back, it is now more commonly understood as a dynamic process that can be acquired at any point throughout a lifespan (state) [18]. Our results showed strong correlations between desires to help and overall resilience, suggesting a shared belief that helping was necessary. This is in line with accepted views of resilience that highlight the importance of having meaning and purpose with pro-social motivations.

Our results also showed a positive correlation between reported feelings of confusion, anger, sadness, guilt and anxiety and overall resilience as assessed by both 10FRBS and CD-RISC, indicating that negative feelings in the aftermath of 3/11 and present day might have served as a catalyst to undertake more adaptive and resilient pursuits. This stands in contrast to prevailing views in the United States that positive emotions or expectations and appraisals of challenge are crucial in the development of resilience [19]. If this were to be the case, we would have expected to see negative correlations between these post-traumatic symptoms and overall resilience. Whether these findings suggest a cultural difference in appraisals and reactions or merely different understandings of resilience is unclear. Further research is needed to assess how positive and negative emotions differentially lead to resilience among different cultural groups. But our research shows preliminary evidence that negative emotions can drive individuals to become more resilient, or at least not deter them from doing so, and that there is an important role for negative emotions within our psyche for the development of resilience. Future programs designed to build resilience and promote PTG need to recognize the spectrum of emotions as our findings raise questions about the nature of resilience and the discrepancies that might exist across cultures.

In a series of interviews, we attempted to better understand how resilience is defined among these students in Fukushima, and whether it is inherently different from the American definition. While we are not focusing on the qualitative data in this paper, there are some

findings that are consistent with the quantitative data and should be shared in order to further support our findings. When asked about resilience, a 20-year old female from Kanagawa Prefecture said, "every time I get depressed or feel in vain, I try to analyze the situation. And try to think about the main reasons for those bad feelings. Then, I try to restore the situation." Another student from Iwaki city believed "there are two groups within my friends. One group who tries to keep the memory of 3/11. And the other group, who tries to forget everything. I am in the group to face the disaster and try to remember about it." Another student tried to explain that while not common, "positive thinking is very good for Japanese people. Doing or using positive thinking means that we need to get rid of negative thinking; we need to push it aside so we can focus on what's important." When explaining the differences between Americans and Japanese people, a 21-year-old male from Tochigi Prefecture said, "a few weeks ago, we attended a cultural exchange with people from New York and I found that they talk a lot about what happened on 9/11 and this gives them resilience. This is a big difference. [Here], people tend to say things indirectly or say nothing at all. This is Japanese character. Of course not everyone, but it makes such resilience difficult."

These interviews begin to shed light on a form of resilience that is perhaps more action-oriented and less vocal or internal. This sort of resilience might be motivated more by suppression of memory and promotion of action rather than exploration of emotions. It is also possible that in a culture that stresses the collective good over individual pursuits, emotions are less important than behaviors. In one study, Ugner et al. found that key factors underlying resilience were universally accepted across many countries, but that they were perceived differently by the adolescents completing the surveys [20]. More research should be aimed at understanding a way to systematically understand how models of resilience vary across cultures.

The final goal of our study was to test a new scale of resilience, our 10Factor-Reslience Behavioral Scale, and compare its purpose and findings to the highly-validated CD-RISC. The relatively low correlations between the two scales seems to suggest that they are assessing different aspects of resiliency. In an original paper explaining the use of CD-RISC, the authors claim that resilience is a personal quality that reflects the ability to cope with stress [21]. This argues that resilience is an inherent characteristic of an individual and perhaps less amenable to change given life's events. Because of this, CD-RISC might not properly acknowledge resilience as culturally and contextually dependent and therefore subject to change. Our scale stresses the importance of resilience as a process that acknowledges the interactions between an individual, their surrounding environment, and the broader community. It is a scale that focusses more on behaviors that are influenced and encouraged based on internal and external factors. Rather than asking about subjective traits, we focus on recent behaviors to understand whether an individual has objectively acted in a resilient manner. This might explain why volunteering was associated with significantly increased resilience as assessed by 10FRBS, but not by CD-RISC. Thinking that an individual either is or is not resilient leaves little room for improvement in comparison to a resilience that can be developed, grown and even taught by acting with modifiable resilient behaviors. Further research is warranted to see how resilience can be fostered within various populations, including medical students.

Several limitations exist in our study. The setting in which a questionnaire is administered plays an important role as situational effects alter how an individual completes a survey. We administered our surveys during lectures in the University, which might have influenced the way students responded as they are accustomed to act more professionally in this setting and perhaps showed less vulnerability and openness with their responses. Since the 3/11 disaster was over 6 years ago at the time the survey was distributed, our participants were subject to

recall-bias. Self-selection also plays a role in our research, as students who volunteered were likely more predisposed to help and could inherently be more resilient individuals. Future studies are required to assess whether their volunteerism can promote PTG and resilient behaviors or whether volunteering is a reflection of these dimensions.

Our study demonstrates that adolescents and future medical students can be trusted and encouraged to volunteer during times of disaster. Furthermore, it emphasizes the role of resilience in responding to tragedy. We have also sought to introduce a new way to assess resilience through our 10FRBS and hope that its use can be more widely analyzed in future studies to show that resilience is a behavioral process rather than a fixed trait. Our findings have implications for how we can encourage PTG and resilient behavior in populations that experience trauma and the ways in which we can reliably measure their improvements.

Compliance with Ethical Standards

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

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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