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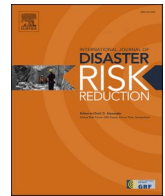
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Quality of life and subjective social status after five years of Mount Sinabung eruptions: Disaster management and current sources of inequality in displaced, remaining and relocated communities

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1. Introduction

The impact of volcanic activity on the physical and psychological health of people directly affected by eruptions, such as by exposure to ash and gasses or problems caused by accumulating ash deposits, has been widely investigated [1–4]. Comparative studies have examined health differences resulting from eruptions that are acute or chronic and low or high-impact [5,6], while research on the secondary effects of eruptions has focused on diseases (e.g., in evacuation camps [3]), mental health problems, and distress caused by loss of assets and livelihoods [3–5].

When social and environmental dimensions of well-being or quality of life are part of a broad conception of public health, differences between groups can result from inequal and potentially unjust distribution and concentration of resources at personal, household, community and regional levels. Inequalities can also arise due to the disaster management approaches adopted towards groups (e.g., resettlement of a village) based on factors such as their vulnerability and location [6]. Thus while the physical health and psychological effects of eruptions can be explored in terms of variables such as risk perceptions, willingness to prepare, and mental health problems [7], it is important to explore whether differences in social psychological and environmental forms of quality of life occur in groups of people who, for example, have either been evacuated and then returned to their homes, displaced for an extended period, or relocated [6].

In policy terms, this is an important empirical test of a recommendation for the next global disaster risk reduction framework to address people's health and well-being by including "immediate and long-term indicators of injuries, disease, disability, and quality of life" as well as "long-term indicators of health and social outcomes" (p. 4 [8]). Our research focus on multidimensional quality of life in an Indonesian sample also fits with a major international United Nations policy

initiative to integrate sustainable development goals (e.g., SDG 3 health and wellbeing) with disaster risk reduction practices in order to develop equitable resilience in developing or low-income nations [9–11].

Accordingly, our aim was to determine whether variations in the disaster experiences and management of groups (e.g., through temporary and ongoing displacement or relocation) were connected with newly identified quality of life differences. In this study, we used a multidimensional quality of life framework and measure for the following reasons: 1) the WHOQoL-BREF measure [12] has been used with disasters such as wildfires [13], floods [14] and earthquakes [15] but to our knowledge no study has been conducted with groups in a chronic eruption situation; 2) a study exploring differences between people in three groups according to initial location and subsequent disaster management would indicate whether a multidimensional measure is sufficiently sensitive and potentially useful in monitoring the effects of disaster management long-term [16]; and 3) there are potentially rich connections with social concepts including themes of "relations with the community" and "social status and connections" [17] that might extend current earthquake-relevant theoretical models of disaster impact (to be outlined below).

In this last vein, we included a measure of subjective social status [18] as a further potentially sensitive aggregative indicator of group differences, possibly due to the way individuals and their communities have been managed as well as their current circumstances. Social status is a useful addition to disaster research because while lower measured levels have been linked to compromised health status and QoL associated with particular health conditions (e.g., chronic pain [16])—mostly in communities not affected by disasters [19]—poorer health and pre-existing poverty are likely to be exacerbated in communities affected by disasters. In other words, lower social status scores may indicate levels of deprivation relative to other people in one's nation [20]. Identifying differences in aggregative levels of social status by

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disaster management group category might therefore not only indicate areas for potential QoL-focused intervention (i.e., beyond psychosocial support), but also show how addressing environmental QoL factors can help to develop new theoretical models of disaster impact, resilience and recovery [21].

In the sections below, we provide a focused overview of the literature specific to the health and wellbeing impact of volcanic eruptions. First, we outline the findings of research on the health and psychosocial effects of volcanic eruptions of particular relevance to communities in the low-income nation of Indonesia. Second, we summarize research on the impact of eruptions on the quality of life of affected individuals and communities along with evidence of secondary stressors and factors that mitigate social and community effects of volcanic hazards. In the third section, relevant disaster research findings and respective theoretical frameworks are presented to make explicit the rationale for exploring multidimensional QoL and subjective social status in disaster contexts. A fourth section presents the current study and outlines the hypotheses to be examined.

1.1. Health, psychosocial impact and QoL effects of volcanic eruptions

Research on the impact of eruptions has focused on the physical consequences and mental health or psychological quality of life sequelae [2]. For example, longitudinal research by Carlsen et al. [4,22] and Hlodversottir et al. [23] examined the impact of volcanic ash and associated acid rain with measures of physical symptoms, psychological distress, perceived stress and post-traumatic stress disorder (PTSD). However, the findings suggested that few individuals are likely, compared to controls, to develop new serious health problems as a result of exposure to volcanic ash and gasses. Moreover, while Carlsen et al. acknowledged that extended and repeated volcanic eruptions can be stressful and lead to increases in respiratory and cardiovascular symptoms, they found no abnormal physical and mental health symptoms when comparing eruption affected communities with an appropriate reference group. Instead, their research suggests that people with pre-existing physical and health conditions are more prone to developing further and similar symptoms. Following up on an earlier study [2], Hlodversottir et al. [23] also found no statistically significant difference in reported PTSD symptoms in residents who were highly exposed to the Eyjafjallajökull volcanic eruption than those in medium, low and no-exposure regions three years after the eruption.

In contrast, other researchers have found that psychological symptoms and psychiatric morbidity in populations who have been exposed to volcanic eruptions (in contrast to controls) depend on the level [24] and length of exposure. Gissurardóttir et al.'s research [25] shows that participants who had direct experience of the event by living in areas highly exposed to the 2010 eruption of the Eyjafjallajökull volcano were more likely than less exposed individuals to suffer from perceived stress, mental distress and PTSD. Research has also highlighted the adverse effects of stressors involving family networks and what have been described as non-immediate, secondary stressors; that is, features of the disaster situation that are additional to potentially traumatic exposure to the initial or ongoing natural hazard [26]. Countering an individualistic view of trauma and suggesting the importance of examining psychosocial distress, Carlsen et al. found higher PTSD symptoms were associated with people who experienced feeling helpless and fearing for their own safety but also evident in those who feared "for the lives of others... during the eruption period" [4] (p. 6).

In similar research from Indonesia conducted two years post-disaster, Warsini et al. [28] examined the effects of the 2010 volcanic eruption of Mount Merapi on members of two villages living on its slopes. They found that women, people who had family members living with them, and home owners were most likely, of all eruption survivors, to develop PTSD or rather, due to limitations of the measure they used, psychosocial distress. In a further indication that particular forms of psychological impact involve individual, household or family and

community or group factors, Ohta et al.'s [27] study of the impact of eruptions of Mount Unzen in Japan (which was active from 1992 to 1996), found that depression only began to improve among evacuees 44 months after the initial displacement. Thus the way that people are managed after a disaster often contributes to the challenges that individuals and communities face.

1.2. Secondary stressors and social mitigators of volcanic eruptions

In their study of the sudden onset volcanic eruption on Miyake Island in 2000, Goto et al. [29] found that as well as experiencing primary stressors associated with the eruption in the 5 years before residents were allowed to return, residents were exposed to a wider range of secondary stressors than those highlighted by Carlsen et al. and Warsini et al. [4,28]: these included "economic loss, occupational and job uncertainty; family and education disruption; future concerns, and loss of community organisations, neighbourhood, and activities" (p. 2004). Research focusing on post-traumatic growth suggests that this can be found in communities with more exposure to eruptions [31], thereby indicating individual well-being and psychological resilience [29]. However, for members of communities who experience what Tobin et al. [30] term chronic rather than an acute hazardous environments, it seems that long-term exposure may "produce a subset of people who are more concerned about the hazard than are fellow villagers and this may be either cause or consequence of mental health status" (p. 709). Although the focus in our study is not on the connections between individual well-being and risk perception, it is important to examine whether the impact of displacement for an extended period or permanent resettlement potentially has a worse impact on communities than remaining close to a volcano that exhibits ongoing rather than periodic or rare acute activity.

Subandi et al.'s [31] study of a different group of villagers affected by the same eruption investigated by Warsini et al. focused on individuals who had been displaced for 8 months by the acute volcanic eruption that killed 277 people. While people's spirituality predicted levels of post-traumatic growth (PTG) experienced by the survivors, qualitative interviews suggested that people who reported PTG experienced increased religiosity (i.e., including more participation in communal prayer), had become aware of new opportunities (e.g., to improve existing skills) and were grateful for their survival despite some losing family members, houses and land. Although the authors emphasized cultural traditions of acceptance, patience and surrender that are central to Javanese culture, they acknowledged that social support and other factors such as feeling more harmonious as a community due to living closer together in temporary housing had strengthened and improved previous relationships. While this could indicate community resilience, as Tobin and Whiteford [32] note there is likely to be considerable variation in how individuals, families and communities are able to recover after a disaster: "Those with personal resources or strong kin support networks can move away from dependence on assistance programmes and re-establish themselves using these other resources. Others cannot." (p. 29).

The situation with regard to relocated people would appear to be clearer than ongoing displacement: that is, less exposure to a natural hazard should reduce feelings of distress but new challenges have been found to emerge as people struggle to create a new home. However, it is not clear whether reduced exposure to volcanic activity and hopefully improved economic circumstances will have compensated for any "loss of communality" through destruction of physical structures and disruption of social capital (e.g., access to health services, opportunities for leisure, availability of information needed to live in daily life which enable stable and meaningful patterns of social life) or been addressed systematically in the new location by authorities and non-governmental organisations. Moreover, research [32] suggests that attachment to place is a significant factor in resisting relocation; here we construe attachment to place broadly to include satisfaction with conditions in

one's living place which might outweigh risks from specific natural hazards (e.g., eruptions, lahars) and include a sense of status or even collective pride resulting from living in a special location (which might also be understood as Topophilia [33]). In the following section, we explicitly examine the contribution of studies that draw upon social capital or social identity theories and their role in "understanding the breadth of QoL impacts from adverse conditions (eg, earthquakes) and afterwards" (p. 4) [8] before presenting the current study hypotheses.

1.3. Relations between post-disaster social capital or social identity, multidimensional QoL and subjective social status

While research on the health and well-being effects of natural hazards within the framework of a multidimensional quality of life is not yet common [13–15], when conducted narrower concerns of subjective well-being (SWB [16]) or psychosocial impact can be supplemented by examining social and environmental quality of life features of the disaster and post-disaster context. For example, in their study of impoverished Indonesian community members living on the banks of a polluted river and affected annually by floods, Purba et al. [13] found significantly lower scores on the physical, social and environmental QoL domains compared to controls; but this community somewhat paradoxically scored higher than a population control group on life satisfaction, perceived life situation and financial condition (despite objectively lower levels of monthly income). The findings point to important similarities with research examining communities affected by chronic natural hazards and help to explain group differences that emerge on the basis of what has been examined in the disaster literature in terms of bonding, bridging and linking social capital [34]. For instance, giving social support is important for communal coping with natural hazards (including adjusting to extended displacement or relocation [6,30–32]) and such bonded, cohesive communities can demonstrate quicker post-disaster recovery and resist relocation efforts by authorities [30,34].

However, recent research suggests that the social capital focus on preexisting networks of trust, sense of belonging to communities and reciprocal relations fails to address new groups that emerge (or old ones that decline) during and after a disaster. The finding that home ownership can be stressful for people living on the slopes of Mount Merapi, for example, is understandable when we consider that eruption survivors "may feel they lose a part of their identity when they lose their home" (p. 6 [28]). Extending these ideas to communities, social identity theorists [35–37] have argued that a sense of "we-ness" or an emergent shared social identity and a sense of common fate play an important role in subsequently expecting or offering emotional social support to others in communities affected by disasters. In contrast, however, there are some indications that an emergent shared social identity might not emerge in post-eruption rural communities in Indonesia because community-level considerations already play a prominent role in rural communal resilience and the collectivist culture of many villages [38, 39]. Moreover, conflicts can emerge among people displaced to temporary shelters [30,32], in relocated groups "dissatisfaction with the new community can exacerbate a feeling of loss of well-being and nostalgia for the old location" (p. 31 [32]), and conflict over the allocation of resources after resettlement might undermine both previous harmonious in-group (i.e., previous village) and current outgroup relations (e.g., with other villages relocated to a new setting).

We contend therefore that a focus on multidimensional quality of life, and environmental quality of life specifically, might address limitations of both social capital and social identity (or "social cure" [37, 40]) approaches to disaster response and recovery; that is, some findings indicate that environmental QoL factors [12] contribute to individual and communal coping and resilience [21] which include features such as access to health services, the healthiness of the physical environment, feeling safe in everyday life, access to important information for daily life, satisfaction with conditions in your living place, and opportunities

for leisure and earning enough money to meet your needs. For example, in a post-wildfire context [13], lower environmental QoL was the only significant dimension to differ between people exposed to wildfires and controls 3 years after the disaster. Similarly, Ceyhan and Ceyhan's [41] study of students who had experienced a devastating earthquake found that "survivors who were still experiencing financial difficulties linked to the earthquake almost six months later had a lower QoL in the physical and environmental domains than those with no current financial difficulties linked to the earthquake" (pp. 525–526). Put in terms of subjective social status, the earthquake not only affected the income and livelihoods (i.e., in objective economic terms) of many participants, but also indicated the social meaning and significance of post-disaster financial difficulties relative to others.

Adding subjective social status is potentially useful not only because lower levels indicate deprivation relative to other members of one's society (or specific groups within it), but also it affords a personal, family or household rather than group-level estimation of one's standing (i.e., it overcomes a potential limitation of viewing communities in individualistic or collectivist terms) and may indicate that social identification does not necessarily mediate this relationship. In disaster contexts, perceptions of individual social status relative to a national group (rather than existing subgroups) may help to explain why people resist relocation (i.e., because a loss of status will result) and continue to live close to a highly dangerous, active volcano. Averaged across a given group, such a subjective evaluation of one's life, circumstances and standing is consistent with the conceptual and policy focus on equitable resilience in disaster preparedness and recovery [10]; that is, an approach which "starts from people's own perception of their position within their human-environmental system, and accounts for their realities, and of their need for a change of circumstances to avoid imbalances of power into the future" (p. 198). Relative deprivation has been examined in health, social justice and political research to examine group inequalities and their social and material (e.g., income) bases [42], but to our knowledge its connections with multidimensional QoL have not been explored in low-income or developing nations [43], especially in relation to disasters (cf. [22]).

1.4. The present study and hypotheses

Our research aims to contribute to the literature on disaster impact on individuals and communities by exploring similarities and specificities about volcanic and other disasters, examining differences between groups in the context of chronic rather than acute volcanic activity, and exploring the current circumstances of communities after 5 years of eruptions; that is, where current circumstances represents a combined experience of home location at the time of the initial activity and subsequent disaster management of groups of villagers. By integrating literature from the abovementioned disparate lines of research and theorizing, we generated the following hypotheses.

First, we expected that communities which have been displaced for extended periods would report higher levels of symptoms associated with trauma or psychological distress (H1) compared to people who have been relocated but also to those who remain in villages close to the volcano.

Second, because post-traumatic growth has also been found in communities exposed to eruptions [31] and indicates psychological resilience and individual well-being [29], we expected that personal resilience levels would be higher in communities still living by the active volcano (H2) compared to people who had been relocated and no longer faced the ongoing threat of eruptions [6,13,28].

Third, because displacement takes place in conditions that are often unsanitary, disruptive of previous forms of life and livelihood provision, and reduce economic and social capital (e.g., access to health services, opportunities for leisure, availability of information needed to live in daily life) [6], we expected that environmental quality of life would be lowest in the displaced group (H3) in comparison to the remaining and

relocated groups.

Fourth, we hypothesized that subjective social status which included a sense of one's location as special or valuable would be retained for communities who were able to remain in their villages near the volcano, but would be reduced in the case of displaced people (who might never return to their villages) and lower in relocated communities (i.e., an attachment to their relocation place would need to be formed and active to contribute to perceived social status relative to others in one's nation; H4).

Fifth, following Tobin et al.'s [30] criticisms of the impact of forced evacuations, we predicted that villagers who continued to live in their original locations would have reduced levels of trust in community leaders and authorities in comparison to the other two study groups because these respective actors could potentially be responsible for organizing their removal (H5).

Sixth, consistent with social identity theory [35–37] we expected *identification with the community now* would be lower in the relocation group due to conflicts over the allocation of new resources and the difficulties forming a new shared identity from three former villages (H6).

Seventh, consistent with the social identity literature [35], we expected *identification with the community at the time of the eruption* to be positively related to *providing emotional support* (H7), *a sense of common fate* (H8) and *subjective social status* (H9). The last predicted relationship between social identification and SSS was based on the view that even though there are high levels of collectivism in Indonesian society, we would still expect that people who identified more highly with their community especially during an eruption would view their own personal or household situation as higher relative to others in their nation because "shared identity... allows survivors to orient towards shared goals, increases expectations as well as the provision of social support, increases collective efficacy, and empowers collective action" (p. 493 [36]).

Eighth, we wanted to examine whether the inclusion of the social and environmental dimensions of QoL would explain differences in a social indicator of current circumstances (i.e., subjective social status) that had not previously been used in disaster research. Accordingly, we hypothesized that a model combining location/disaster management category, followed by psychological and social/environmental variables (i.e., community social identification now, community-level factors (e.g., collective empowerment, social cohesion), and the environmental dimensions of QoL income would significantly predict higher SSS (i.e. lower levels of relative deprivation; H10).

Ninth, following previous research on the important role of social identification, we expected that identification with the community would mediate the relationship between environmental QoL and SSS (H11).

1.5. Mount Sinabung's volcanic activity, impact and disaster management

In an international geographical comparative study, the four national locations of the Island of Martinique (France), Colombia, Guatemala and Indonesia accounted for more than 84% of volcano-related fatalities [1]. Indicating their vulnerability to volcanic activity, Smith and Naumann [44] described three regions, Central America, Japan and Southeast Asia, as showing "a pronounced coincidence of dense population and persistent recent volcanism" (p. 101). In Indonesia, Mount Merapi on the Island of Java is one of the ten most populous active volcanoes in the world. A further five volcanoes on this list are located in Indonesia (i.e., Gede, Tangkubanparahu, Sundoro, Kelud and Galunggung). Eruptions of Mount Merapi in 2006 and 2010 have resulted in extensive studies of the health and mental health impact on surrounding communities [28,31,38,45–47]. In contrast, Mount Sinabung on the Indonesian island of Sumatra [see Fig. 1] resembles the Eyjafjallajökull volcano in Iceland because both volcanoes were dormant, respectively, for 400 and 189 years. The unexpected nature of

the eruption of Sinabung in late 2010 and no previous history of eruptions in the area meant that spoken traditions did not exist among local residents to warn them about the dangers of an eruption [48].

Activity levels of the volcano designated by the National Disaster Management Authority (BNPB) have moved back and forth from Level II *Waspada* (vigilant), Level III *Siaga* (alert) and Level IV *Awas* (danger). Sinabung was recategorized in June 2015 from a Type B volcano—which meant that it was dormant for centuries but still had some volcanic activity—to a Type A: active, with frequent activity. Exclusion zones were created based on the potential threat from volcanic activity. Measured in distance from the summit, the zones were south to south-east (7 km), southeast to east (6 km), north to northeast (4 km) and other zones (3 km) (see Fig. 2 [49]). Villagers within the 3 km exclusion zone were relocated from the villages of Sukameriah, Bekerah and Simacem in February 2014. These three villages were destroyed and 40 other villages were affected by eruptions [see Figs. 3 and 4]. A Local Disaster Management Agency (BPBD) was established in the Karo district to manage the situation as well as to reduce the impact of future eruptions. After the 2014 eruptions, the Karo BPBD and the BNPB formulated the Mt. Sinabung Post-eruption Action Plan for the years 2015–2017 to initiate and stimulate recovery for key infrastructure and economic activities that had been heavily impacted by the eruptions [50].

However, the plan did not accurately capture which villages were affected or report on the conditions in the camps for displaced villagers. Our study is therefore important in its use of a multidimensional QoL measure to examine current indicators of the impact of eruptions on affected communities and provide an evidential basis for evaluating government disaster management policies such as ongoing displacement and relocation. It is also important to consider features of the Mount Sinabung situation that are different from other regions of Indonesia (cf. [45,46]). In addition, some positive effects of the eruptions have been noted. For example, Andreastuti et al. [51] found that the ongoing activity of Sinabung has resulted in frequent contact between local government officials, scientists and community members that has improved communication and created better understanding of relevant hazards and threats. In our study, we were able to evaluate this general assessment by examining levels and sources of trust in authorities in the three location/disaster management categories and also by measuring the environmental QoL domain.

When phreatic eruptions began on August 27, 2010 [52], two people were killed and an estimated 30,000 people were displaced. Many villagers had their land destroyed by ash and pyroclastic flows, leaving them without any money or livelihood [53]. Displacement continued until eruptions stopped on September 24, 2010 and the government announced that the volcano was no longer a threat [52]. However, on September 15, 2013, eruptions resumed and in this period until May 2016, there were three further highest level alerts [54]. In January 2014, displaced people numbered 28,715 which represented 9045 households [55]. According to this situation update, families displaced from 33 villages were temporarily relocated to 42 displacement centres (see Figs. 5–7). Sixteen people were killed on February 1, 2014 when they were overcome by pyroclastic flows within the exclusion zone. OCHA reported that after eruptions on November 17, 2015, this renewed activity led to the continued displacement of 9320 people [56]. Seven people were killed and two injured in May 2016 (one week after this study) when the mountain erupted and pyroclastic flow covered the area 4 km from the summit in which these people were farming [57,58]. Of the villagers displaced to or dependent on temporary camps (Posko) and designated as Internal Displaced Persons (IDPs), by the end of March 2014 some 15,773 IDPs were living in 33 displacement centres. The Karo Regent requested funds to support the independent relocation of 1903 households [59]. However, in July 2016 it was reported that attempts to relocate to land available in Lingga village 8 km south of Mount Sinabung were opposed by local residents and could potentially create social conflict [60]. Approximately 1683 families from the Berastepu, Gamber, Gurukinayan and Kuta Tonggal villages were



Fig. 1. Location of Mt. Sinabung in Sumatra, Indonesia.

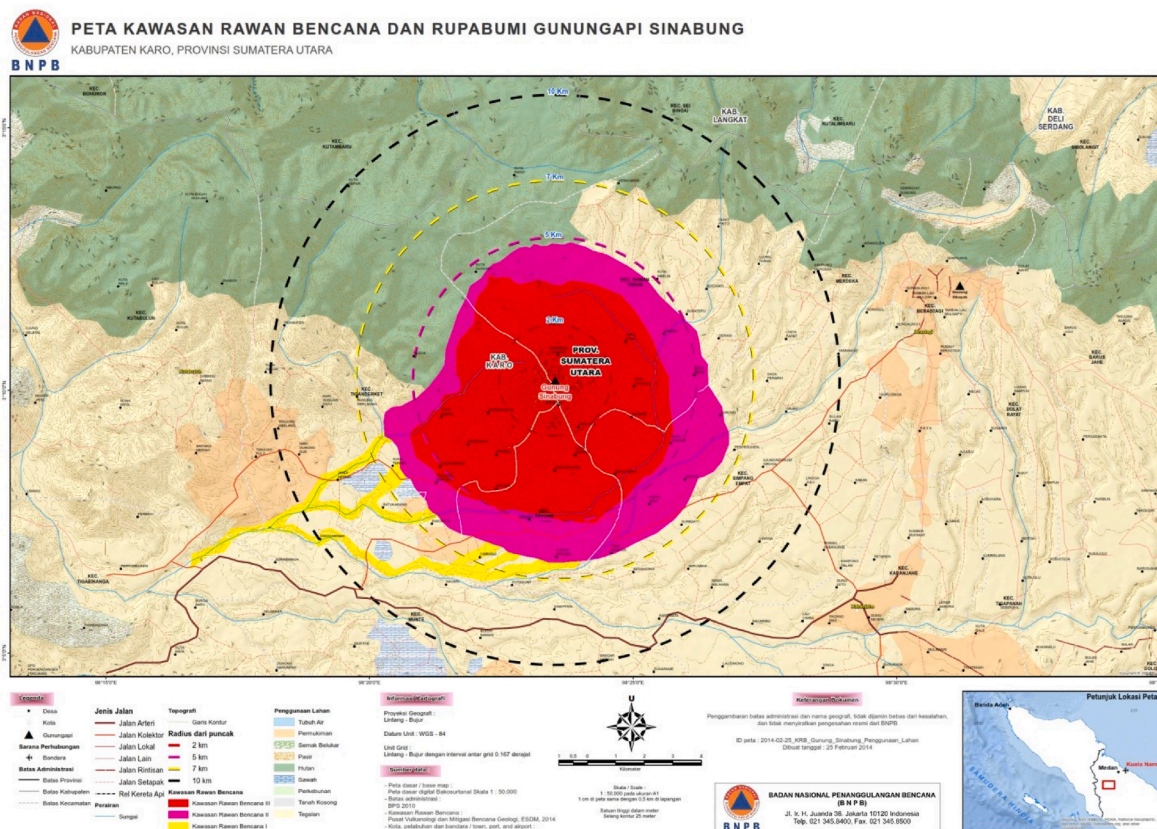


Fig. 2. Map of Mt. Sinabung hazard zone (source: BNPB Indonesia).



Fig. 3. Eruption of Mt. Sinabung viewed from Kabanjahe city.



Fig. 4. Relocated village.



Fig. 5. Camp for displaced villagers.

affected by the difficulty in finding available accommodation and were supported by the government through rental assistance payments [59, 61]. Relocation of 370 households from the three abandoned villages in the Red Zone (see Fig. 4) to Siosar (located approximately 27 km south of the summit of Mount Sinabung) were completed late 2016 (see Figs. 8 and 9 for images and Fig. 10 for location).

2. Method

2.1. Study design

A cross-sectional survey was undertaken from May 7th to May 17th, 2016. Participants completed pen and paper questionnaires distributed by a team of 11 researchers (see Acknowledgements). Participant Information Sheets and Informed Consent forms were provided to all



Fig. 6. Displacement camp facilities.



Fig. 7. Tent interior in displacement camp.



Fig. 8. Siosar relocation village and surrounding reclaimed pine forest.

participants and the researchers verbally explained the purposes and conditions of the research and answered any other questions.

2.2. Study population

360 participants aged 16 years (with parental permission) and over completed questionnaires ($m = 41.03$, $SD = 13.88$; 158 women, 195 men; age 16–85 years). Demographic characteristics of participants are summarized in Table 1. The sample population consisted of three location/disaster management categories: those initially evacuated but now



Fig. 9. New community buildings and houses in Siosar relocation village.

returned to their villages with no plans for relocation (Remaining), evacuation shelter inhabitants who will eventually relocate independently (Displaced), and permanently relocated people (Relocated). The last of the three groups had moved to a new settlement 27 km south of Mt. Sinabung called Siosar (see Fig. 3, Lokasi Relokasi). The relocation was assisted by the government and military; this category consists of villagers who were located at very close proximity to the crater within the 3 km exclusion zone (see Fig. 4). For the second displaced category, the government provided financial and bureaucratic aid to villages not initially living as close to the crater as the third relocated group (but closer than the remaining group) and organized temporary housing. These villages were not in any immediate danger during an eruption or in a hazard path (i.e., from pyroclastic flows and/or lahars), but they had been evacuated nevertheless and their occupants were not yet permitted to return. At the time of our study this displaced group still lived in evacuation shelters (also known as refugee camps) waiting for further instructions from the government, despite some having lived for five

years in a camp without any clarity from the authorities about when they would be able to go home. The third remaining category included people who were temporarily displaced during eruptions but had then returned to life in their villages. These people lived on the flanks of the volcano, about 5–10 km from the summit. However, their villages were not directly affected when the eruptions occurred. Thus, although they should be alert when an eruption occurs, their houses were not heavily damaged like those in category three (relocated).

2.3. Data collection

Use of a random sampling method from the three groups was not feasible because permission to invite participants had to be given by community leaders who often also selected people the research sub-teams could speak to. Accordingly, participation in the study was invited by a personal approach in the field from one of the researchers over 7 days of data collection and snowball sampling; that is, participants were invited to suggest anyone else who might be interested in taking part. Arrangements were then made to return at an appropriate time, thereby insuring that the samples were not limited only to people present at the time the researchers initially visited. The pen and paper survey was 15 pages and took between 20 and 40 min to complete (see below for item descriptions).

All participants were asked for their current location and status with regard to the three location/disaster management categories (see Table 1 for descriptive statistics). The survey gathered data about psychological, social and community-level variables identified by the researchers as relevant to eruptions from a survey of the natural hazard impact literature. All survey items not available in Bahasa Indonesia were translated into Indonesian and backtranslated into English. The survey included measures of the number of times participants had been exposed to eruptions of Mount Sinabung. Occurrences of seven symptoms connected with trauma (dizziness, anger, loneliness, nightmares,

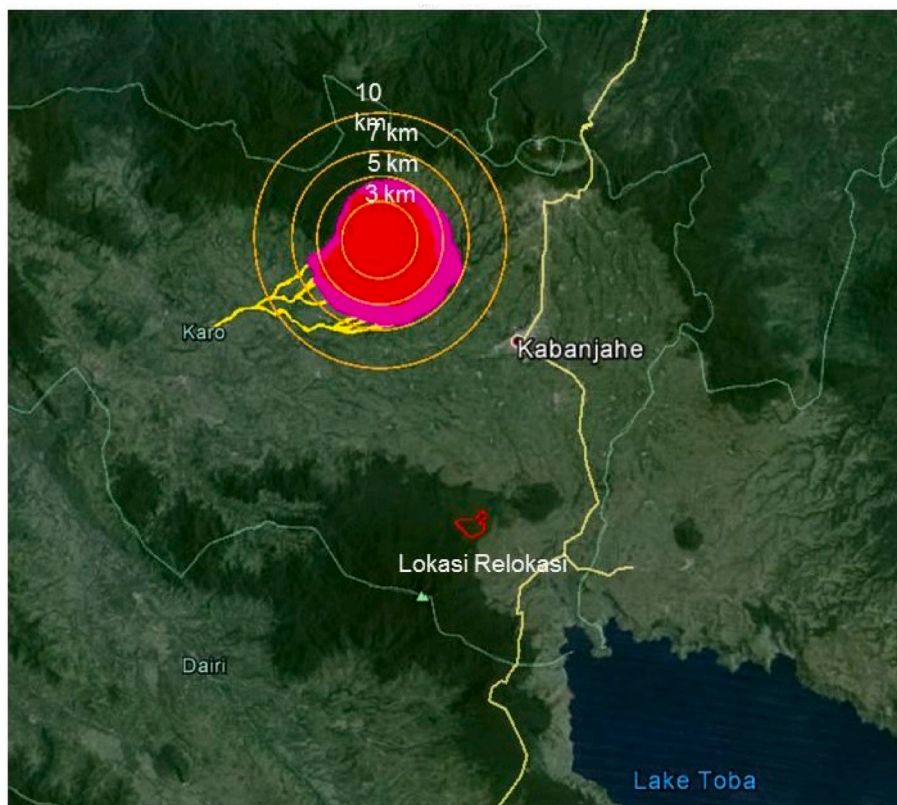


Fig. 10. Relocation site (Lokasi Relokasi) Siosar and the hazard zones of Mt. Sinabung.

Table 1
Demographic characteristics of the remaining, displaced and relocated groups.

	Remaining	Displaced	Relocated	Total
<i>Female</i>	66.6% (42)	49.7% (112)	63% (41)	195
<i>Male</i>	33.3% (21)	50.3% (113)	37% (24)	158
Total	100% (63)	100% (225)	100% (64)	
Education				
<i>None</i>	1.5% (1)	2.7% (6)	0.0% (0)	7
<i>Elementary School</i>	3.8% (2)	17.5% (39)	18.5% (12)	53
<i>Junior High School</i>	17.6% (12)	26.9% (60)	16.9% (11)	83
<i>Senior High School</i>	63.2% (43)	45.3% (101)	55.4% (36)	180
<i>Diploma III</i>	4.4% (3)	1.8% (4)	1.5% (1)	8
<i>S1</i>	8.8% (6)	4.9% (11)	7.7% (5)	22
<i>Other</i>	1.5% (1)	0.9% (2)	0.0% (0)	3
Total	100% (68)	100% (223)	100% (65)	
Occupation (Head of Household)				
<i>Farmer</i>	83.3% (55)	88.1% (199)	93.8% (60)	314
<i>Manual Labourer</i>	1.5% (1)	4.9% (11)	1.6% (1)	13
<i>Civil Servant</i>	4.5% (3)	3.1% (7)	1.6% (1)	11
<i>Entrepreneur</i>	10.6% (7)	2.7% (6)	3.1% (2)	15
<i>Other</i>	0.0% (0)	1.3% (3)	0.0% (0)	3
Total	100% (66)	100% (226)	100% (64)	
Average Income per Month				
<i><500K IDR</i>	16.4% (11)	38.4% (84)	42.2% (27)	122
<i>500K-1 Million IDR</i>	41.8% (28)	40.6% (89)	31.3% (20)	137
<i>1-2.5 Million IDR</i>	32.8% (22)	16% (35)	17.2% (11)	68
<i>2.5-5 Million IDR</i>	7.5% (5)	5% (11)	9.4% (6)	22
<i>>5 Million IDR</i>	1.5% (1)	0.0% (0)	0.0% (0)	1
Total	100% (67)	100% (219)	100% (64)	
Home Ownership				
<i>Own Home</i>	57.6% (38)	43.9% (90)	57.6% (53)	181
<i>Rent</i>	31.8% (21)	44.4% (91)	9.4% (6)	118
<i>Other</i>	10.6% (7)	11.7% (24)	7.8% (5)	36
Total	100% (66)	100% (205)	100% (64)	
Marital Status				
<i>Single</i>	7.4% (5)	14.3% (32)	18.8% (12)	49
<i>Married</i>	91.2% (62)	72.2% (161)	71.9% (46)	269
<i>Divorced</i>	0.0% (0)	2.2% (5)	0.0% (0)	5
<i>Widow/er</i>	1.5% (1)	11.2% (25)	9.4% (6)	32
Total	100% (68)	100% (223)	100% (64)	
Ethnicity				
<i>Karo</i>	98.4% (60)	98.6% (219)	98.4% (63)	342
<i>Other</i>	7.7% (5)	1.4% (3)	1.6% (1)	9
Total	100% (65)	100% (222)	100% (64)	

daydreaming, anxiety, negative feelings; [62]) in the last few months were measured which created a total trauma or distress symptoms scale with high reliability ($\alpha = 0.88$). *Subjective Social Status* (SSS; [19]) was measured using a one item estimate of each participant's evaluation of their own position in society relative to others in Indonesia. The scale is a reliable alternative to objective measures of socioeconomic status and has been found to have strong associations with physical and psychological health [42,63]. When people rate their social status on a ladder as relatively lower to others in their society [18], it represents a kind of averaging or combination of "life-time achievement and socioeconomic status" (p. 340) [63] that can also indicate dissatisfaction. *Multidimensional Quality of Life* was examined using a Bahasa Indonesia (Indonesian language) version of the World Health Organisation multidimensional Quality of Life brief (WHOQoL-BREF; [12]) scale that measures physical, psychological, social and environmental domains of quality of life. It is a short version of the WHOQoL-100 that contains 26 items with five scale points each (e.g., 1 = not at all, 5 = completely) and is designed to be an international, cross-culturally comparable instrument. The scale is preferable to measures of subjective well-being (SWB) and supercedes them by nesting SWB within QoL [16]. The scale also complements objective measures of standard of living and health, and is sensitive to

changes in people's lives and the impact of major life events [16]. In our study, one item in the social dimension which asked about the sex life of participants was substituted by an average score as outlined in the WHOQoL-BREF manual. This item was removed because in the context of Karo culture in Sumatra this is a taboo topic and including a question about satisfaction with your sex life would have offended participants. Social identification, social status and community level measures were added (outlined below) because the social domain of the WHOQoL-BREF has a limited focus on the quality of social relationships. This failure to address social status thoroughly has been confirmed by qualitative interviews about QoL and poverty in which additional issues were highlighted, specifically "respect from others was very important to social life in all countries" and the "ability to move to a higher social status was important" (p. 43) [17]. Procedures outlined in the manual and supporting publications were also used to transform domain total raw scores to a 0 to 100 scale [12,64]. *Personal Resilience* was measured using the 10 item version of the Connor-Davidson Resilience scale [65, 66]. The backtranslated version of the scale demonstrated high reliability ($\alpha = 0.89$). Three measures were used from an earthquake impact study [35]: *Provided Emotional Support* was measured with three items which assessed how frequently people gave emotional support to others during the 2015 eruption (e.g., "Showing respect for others"; $\alpha = 0.67$). *Trust in Authorities* [67] was comprised of six items (e.g., "I trust my local government to respond to meet the needs of its residents") and had high reliability ($\alpha = 0.78$). *Common Fate at Eruption* (in 2015) had three items [35] which had low reliability unless one item was removed ("We all shared the same fate"; $\alpha = 0.54$) leaving two items: "We were all in danger" and "It was all of us against the eruption". However, we used the low reliability, three-item scale because it appeared to be appropriately sensitive to variations between the groups. *Identification with the Community During Last Eruption* (i.e., in 2015) used three items (e.g., "I felt at one with the people around me") from the four item "social identification with others affected by the disaster" scale developed by Drury et al. [35]. Despite indications that not all participants experienced the impact of the eruptions in the same way (and possibly also indicating that they conceived of their group or community very broadly), the scale had high reliability ($\alpha = 0.71$). We also included a measure of *Identification with the Community Now* (which was measured using the same items but worded to reflect current community identification at the time of the survey) in order to assess whether subsequent tensions or conflicts within each community had undermined any positive features of living through previous eruptions together. The Cronbach's alpha score was much lower ($\alpha = 0.36$) with item removal analysis revealing that reliability would increase to 0.81 if the item "I feel that other people are like me" were removed. Again we decided to use the full community identification now scale because it was clearly sensitive to changing community circumstances. Community-level features were assessed with three measures. *Collective Empowerment* was measured using five items (e.g., "power is collective, not individual"; $\alpha = 0.77$) from Speer & Peterson's [68] 27 item empowerment scale. *Social Cohesion* was measured by five items (e.g., "my neighbours are willing to provide advice to me if I ask for it"; $\alpha = 0.84$) from Buckner's [69] 18 item neighbourhood cohesion instrument. *Collective Efficacy* [70] was measured with 10 items (e.g., "community groups can get something done about local problems"; $\alpha = 0.54$).

2.4. Statistical methods

Prevalence of demographic data are presented in Table 1 as a percentage of the total of the remaining, displaced and relocated groups. The analysis excluded three participants due to incomplete data. The study variables were assessed for normality with high positive skewness and high positive kurtosis (i.e., above 3.29 [71]) found only for the Collective Empowerment, Common Fate and Identification with the Community Now measures. Because there were no participants in our sample who had not been exposed to at least one eruption, an adjusted

odds ratio analysis was not used in this study to compare unaffected with affected groups. Chi-square analyses of frequency of demographic data were used to test for differences between the main study location/disaster management group categories. Bivariate Pearson correlations were used to assess the relationships between the study main study variables without correction for multiple comparisons. A one-way *Multiple Analysis of Variance* (MANOVA) was conducted for the study dependent variables by location/disaster management category. A hierarchical multiple regression analysis examined how theoretically important predictor variables were associated with SSS in three steps. In the first step, location/disaster management category and income were entered (collapsed into equal low-, mid- and high-income categories), the latter because it is strongly negatively associated with perceptions of relative deprivation. In the second step, variables from social identity theory and resilience research which were expected to be associated with changes in SSS were included (i.e., psychological QoL, provided emotional support provided to others, personal resilience). In the third step, environmental QoL and measures of current community life (community efficacy, social cohesion) and social identification with the community now were added to the regression. To examine the hypothesized relations between identification with the community now, SSS and environmental QoL, moderation and mediation analyses were performed. All analyses were performed using SPSS version 24 [72] with moderation and mediation analyses conducted using PROCESS Procedure for SPSS Version 3.4.1 [73].

3. Results

Completed questionnaires were received from 360 participants with 5 incomplete surveys and very low levels of refusal to participate (refusal numbers were not recorded). Chi-square analyses were performed to test for the independence of the three study groups for frequency distributions of gender, education, occupation (of head of household), average income per month, home ownership, marital status, and ethnicity in the three locations (see Table 1). A significant interaction was found ($\chi^2(8, N = 350) = 23.16, p < .01$) for average income per month. Incomes were higher for participants remaining in their villages in comparison to those people relocated to Siosar or displaced to evacuation shelters. A further chi-square analysis indicated that there were

fewer men and more women surveyed in the remaining and relocation categories than in the displaced group ($\chi^2(2, N = 353) = 7.66, p < .05$).

Means and standard deviations of the total sample organized by the three location/disaster management categories are presented in Table 2 with correlations for these measures (minus individual Trust scale items) in Table 3. The MANOVA result of Pillai's Trace = 0.60, $F(42,362) = 3.73, p = .000$ showed that there was a significant effect of category location on the variables listed in Table 2. A significant result for Box's test indicated the need to examine Levene's Test of Equality for the dependent variables. Rather than adjust the unequal numbers between groups by random deletion of cases, we chose to interpret results only below 0.01 level of significance. A series of one-way ANOVAs revealed significant differences by location disaster management category for number of eruptions exposed to $F(2,200) = 7.51, p = .001$, trauma symptoms $F(2,200) = 5.91, p = .003$, environmental QoL $F(2,200) = 8.52, p = .000$, social status $F(2,200) = 8.60, p = .000$, trust local government to respond to needs of residents $F(2,200) = 5.58, p = .004$, trust community leaders $F(2,200) = 10.86, p = .000$, trust the media $F(2,200) = 6.03, p = .003$, trust local government to do what is right $F(2,200) = 8.68, p = .000$, confidence in the law to protect and maintain order $F(2,200) = 5.58, p = .003$, collective empowerment $F(2,200) = 5.71, p = .006$ and social status $F(2,200) = 5.17, p = .006$.

In support of H1, Bonferroni post-hoc tests revealed that symptoms of distress or trauma were higher in the displaced group compared to the relocated group ($p = .02$) and the remaining group ($p = .02$). Exposure to eruptions was lower for the relocation group than the remaining ($p = .000$) and displaced groups ($p = .000$), indicating that resettlement had reduced exposure to eruptions and that levels of psychological distress in the displaced group were not solely due to eruption exposure.

In contrast, there was no support for H2 as personal resilience was not highest in the remaining group and did not differ between location/disaster management categories.

The results for environmental QoL supported H3 with post-hoc analysis revealing that the displaced group scores were lower than both the remaining ($p = .01$) and relocated ($p = .002$) groups.

Post-hoc analysis of SSS revealed that levels were lower in both the displaced ($p = .000$) and relocation ($p = .01$) groups compared to the remaining group. There was no difference between the displaced and relocation groups thereby confirming H4.

Table 2

Comparisons of eruption exposure, trauma symptoms, personal resilience, emotional support provided, WHOQoL BREF domains, subjective social status, and trust in authorities between location groups.

	Remaining	Displaced	Relocated	Total
Eruptions exposed to (no.)	2.95 (1.08)	3.07 (0.90)	2.36 (1.10)	2.92 (1.00)**
Trauma Symptoms Total	15.30 (4.21)	17.72 (4.97)	15.25 (5.05)	16.84 (4.97)*
Personal Resilience	2.41 (0.50)	2.54 (0.60)	2.62 (0.64)	2.53 (0.59)
WHOQoL-BREF Domains Transformed (0–100) Scores				
Physical health	52.17 (10.74)	47.10 (12.76)	51.97 (9.87)	48.89 (12.13)
Psychological	53.49 (12.71)	53.82 (14.67)	54.75 (13.03)	53.49 (13.99)
Social	53.72 (17.40)	57.79 (16.27)	60.79 (16.13)	57.57 (16.51)
Environmental	47.72 (15.55)	40.05 (12.96)	49.23 (15.94)	43.08 (14.53)***
Subjective Social Status	3.82 (2.33)	2.72 (1.25)	2.80 (1.91)	2.92 (1.65)***
Trust in Authorities scale items				
Trust local government to meet residents' needs	3.19 (1.33)	3.77 (0.83)	3.56 (0.84)	3.63 (0.96)*
Trust community leaders in my community	3.16 (1.24)	3.88 (0.60)	3.75 (1.00)	3.72 (0.86)***
Trust the media to report fairly	3.32 (1.23)	3.78 (0.80)	3.28 (1.06)	3.61 (0.96)*
Trust local government to do what is right	2.95 (1.22)	3.63 (0.75)	3.42 (0.94)	3.47 (0.92) ***
Trust NGOs	3.84 (1.21)	3.62 (1.03)	3.08 (1.46)	3.56 (1.17)
I have confidence in law to protect and maintain order	3.43 (1.14)	3.94 (0.69)	3.94 (0.79)	3.85 (0.83)*
Trust Total	20.06 (6.05)	22.57 (2.97)	21.05 (4.32)	21.88 (4.00)
Provided emotional support during last eruption	3.53 (0.61)	3.67 (0.78)	3.57 (0.90)	3.62 (0.77)
Common fate at last eruption	4.16 (0.81)	4.30 (1.31)	3.91 (0.58)	4.20 (1.14)
Identification community during last eruption	4.05 (0.74)	4.18 (0.59)	4.02 (0.48)	4.13 (0.60)
Identification with community now	3.95 (0.76)	4.12 (0.75)	3.86 (0.60)	4.04 (0.73)
Collective Empowerment	3.07 (0.78)	3.53 (0.83)	3.34 (0.62)	3.41 (0.81)*
Social Cohesion	3.90 (0.72)	3.79 (0.65)	3.87 (0.51)	3.82 (0.64)
Collective Efficacy	3.89 (0.67)	3.77 (0.56)	3.71 (0.54)	3.78 (0.58)

*p < .01 **p < .001 ***p < .0001.

Table 3
Correlations among eruption exposure, trauma symptoms, psychological variables, social variables, QoL domains, trust total and community level measures (N = 360).

Variable	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Eruptions exposed to	2.87	1.02	-															
2 Trauma symptoms	16.79	4.96	0.07	-														
3 Personal resilience	2.55	0.59	-0.01	-0.08	-													
4 Provided emotion support	3.53	0.80	-0.03	-0.05	0.16**	-												
5 Physical health QoL	49.03	11.81	-0.05	-0.20***	0.12*	0.15**	-											
6 Psychological QoL	53.21	14.19	-0.01	-0.12*	0.17**	0.09	0.56***	-										
7 Social QoL	56.63	16.54	0.01	-0.32***	0.28***	0.34***	0.39***	0.39***	-									
8 Environmental QoL	43.12	2.27	-0.03	-0.40***	0.15*	0.08	0.53***	0.57***	0.53***	-								
9 Subjective social status	2.84	1.79	0.03	-0.14**	0.04	0.13*	0.20***	0.31***	0.25***	0.42***	-							
10 Trust in authorities total	21.87	4.02	0.00	-0.07	0.27***	0.26***	0.05	0.17**	0.22***	0.18**	0.04	-						
11 Common fate at eruption	4.16	0.98	0.03	0.01	0.00	0.20***	-0.07	-0.05	0.03	-0.09	-0.10	0.03	-					
12 Commun. identification at erupt	4.11	0.59	0.06	0.05	0.13*	0.27***	-0.01	-0.13*	0.00	-0.10	-0.07	0.08	0.28***	-				
13 Commun. identification now	4.08	1.17	0.06	0.11*	0.07	0.14*	-0.07	-0.16**	-0.04	-0.18**	-0.12*	0.17**	0.16**	0.27***	-			
14 Collective empowerment	3.74	0.58	0.05	-0.03	0.21**	0.39***	0.06	0.04	0.24***	0.04	0.08	0.31***	0.13*	0.30***	0.23***	-		
15 Social cohesion	3.89	0.59	-0.04	-0.04	0.28***	0.21***	0.09	0.11*	0.15**	0.10	0.05	0.29***	0.02	0.20**	0.19**	0.19**	-	
16 Collective efficacy	3.74	0.58	0.04	-0.05	0.17**	0.25***	0.08	0.06	0.20***	0.00	0.01	0.10	0.12*	0.28***	0.29***	0.31***	0.32***	-

* = p < .05, ** = p < .01, *** = p < .001.

With regard to H5, the results of post-hoc analysis of two scale items partially supported the hypothesis. Levels of trust in local government to meet the needs of residents were lower in the remaining group in comparison to the displaced group (p = .002), but not in relation to the relocated group. Trust in local government to do what is right was similarly lowest in the remaining group compared to the displaced group (p = .000) but not significantly different between the remaining and relocation groups. Group comparisons for trust in community leaders were in agreement with H5 as levels were lower for the remaining group compared to both the displaced (p = .000) and relocated (p = .008) groups.

With regard to H6, there was no significant difference between location/disaster management groups for social identification with the community now.

The correlations in Table 3 between the main study variables provide evidence for hypotheses H7 and H8. As expected, identification with the community at the time of the eruption was positively related (p < .001) to providing emotional support at last eruption, supporting H7, and common fate at the time of the last eruption (p < .01), supporting H8. In contrast, there was no support for the posited positive relationship (H9) between identification at the time of the eruption and subjective social status. This suggests that in our study, SSS measured personal or household social status rather than the place of the community in a social hierarchy [18].

Most of the remaining correlations were expected to be positive and examining them revealed important relationships and also indicated variables for inclusion in the multiple regression analysis.

The bivariate correlations show that the number of trauma symptoms were negatively associated with personal resilience, providing emotion support, all of the WHOQoL domains and subjective social status. There was no positive association of trauma symptoms with eruptions exposed to which provides further clarification of the result reported for H1 (i.e., suggesting that secondary stressors were involved in the higher levels of distress in the displaced group). Moreover, the negative associations between trauma symptoms and physical health QoL, psychological QoL, social QoL, environmental QoL and SSS suggests that the symptoms actually measure general distress and suffering caused, potentially, by lack of support and appropriate treatment resources for physical ill health as well as disruption to livelihoods, loss of place attachment or a combination of these. SSS was positively associated with providing emotional support to others, psychological QoL, social QoL and environmental QoL. However, there were no positive associations between SSS and social identification with the community at the time of the last eruption, collective empowerment, social cohesion or collective efficacy (cf. [35]). A negative association between SSS and social identification with the community now in the whole sample suggested the need to examine and explain sources of previous or emergent groups "decline" [37]. Trust in authorities (Total) was positively associated with personal resilience, providing emotional support, psychological QoL, social QoL, environmental QoL, social identification with community now, collective empowerment and collective efficacy.

Given our interest in the potential for subjective social status to capture group differences in disaster contexts and the similar possibility for multidimensional QoL, a hierarchical multiple regression analysis was performed with SSS/relative deprivation as the dependent variable. With the exceptions of personal resilience, community empowerment social cohesion, and collective efficacy, the predictor variables were statistically correlated with the dependent variable (SSS) thereby indicating that the data would be suitable for examination using multiple linear regression. These variables were chosen based on our review of the previous quantitative and qualitative research on relative deprivation in health, political and disaster research. Analyses were conducted to ensure that assumptions of homoscedasticity, normality and linearity were not violated.

In the first step of the hierarchical stepwise multiple regression, two predictors were entered: location/disaster management category and

income. This model was statistically significant $F(2,231) = 18.91, p < .000$, explaining 14% of the variance in subjective social status. Both location/disaster management category and income made a significant unique contribution to the model (see Table 4). Entry of psychological variables (psychological QoL, personal resilience, provide emotional support to others) in step 2 added to the model, $F(5,228) = 13.36$ and increased the percentage of the variance explained to 23%. Adding environmental QoL, community efficacy, community identification now and social cohesion explained a further 10% of the variance ($F(9,224) = 11.91, p < .000$). In the final adjusted model, four of nine predictor variables were statistically significant with the highest beta value for location category ($\beta = 0.62, p < .000$) followed by monthly income ($\beta = 0.55, p < .000$), emotional support provided to others ($\beta = 0.37, p < .01$) and environmental quality of life ($\beta = 0.04, p < .000$).

A moderation analysis tested the hypothesis that social identification with the community now would mediate the relationship between environmental QoL and SSS. Using the PROCESS Procedure [73] we found that environmental QoL was a predictor of the proposed mediator of current community social identification ($p = .000$), but social identification with the community now did not significantly predict SSS ($p = .391$). H11 therefore was not supported because there was no indirect effect of environmental QoL on SSS via social identification.

4. Discussion

An overarching aim of our study was to examine the impact of 5 years of eruptions of Mount Sinabung on communities in terms of current differences or inequalities between groups representing three main disaster management approaches: remaining as close to the active volcano as is deemed safe by authorities, being displaced with the low possibility of return and high likelihood of eventual self-relocation, or relocation to a newly built village. First, we discuss the evidence for any substantial sources of inequality between these groups before examining how the WHOQoL-BREF can help to address recent policy calls for a greater focus on well-being and equitable resilience in disaster-risk reduction efforts. In the final section, we argue that use of a multidimensional quality of life measure not only improves assessment of disaster management policies in practice, but also makes a valuable theoretical contribution by showing the possible limits of the “social cure” approach in disaster contexts.

On this first issue, our results show that there were significant group differences that arose on the basis of previous location as well as subsequent and ongoing disaster management experiences. The significantly lower number of eruptions exposed to in the relocation group

showed that the resettlement policy had reduced the immediate danger from the volcano for people from several villages, but in the displaced group there were higher symptoms of psychological distress (rather than trauma which was not correlated significantly with number of eruptions exposed to). This indicates that the conditions in which people lived during up to 5 years of displacement and secondary stressors potentially explained other psychological and social measures of current functioning and quality of life. The groups did not differ significantly in their levels of personal resilience, in contrast to research on eruption communities which has found some post-traumatic growth and higher resilience in communities most affected by natural hazards compared to other less affected or control groups [31,35]. However, personal resilience was significantly positively associated with providing emotional support at the time of the eruption, psychological QoL, social QoL, trust in authorities, collective empowerment, social cohesion and collective efficacy. Personal resilience therefore appeared to be highly socially oriented across the groups, reflecting the importance of what we presume was an ongoing collectivist cultural valorization of providing emotional support to others as part of active involvement in community efforts to achieve communal outcomes in a cohesive manner.

In contrast, the findings of group differences for environmental QoL and SSS provide important evidence of inequalities between the groups, albeit with a different pattern to other Indonesian QoL research; that is, it was not the case in our research that the group affected by chronic natural hazards and lowest in terms of income was also highest in our equivalent to a measure of life satisfaction [13].

Instead, our finding of group differences for environmental QoL not only provides support for inclusion of measures in future post-disaster evaluations and field research that are not restricted to psychological distress and well-being, it points also to differences identified previously by Few et al. [74] that “the way impacts subsequently play out for those exposed or affected rests a great deal on access to resources and support” (p. 80). For the displaced group, the intention of the government at the time of the study to financially support them but not to directly organize their relocation did not appear to have reduced the distress of living for several years in temporary dwellings with poor sanitary conditions and limited opportunities to develop sustainable livelihoods [75]. The higher levels of environmental QoL in the remaining and relocation groups indicated for the first group that, despite living closer to the active natural hazard, conditions for the villagers who remained in their original villages retained both economic and social capital; that is, not only were levels of income higher for the remaining group but also they had higher environmental QoL as a group. Furthermore, the lack of a difference in environmental QoL between the remaining and relocation groups contrasted with Whiteford and Tobin’s [76] criticism that the policy of resettlement from volcanic hazards continues to be used despite being “known to destroy peoples’ livelihoods, damage their health, and separate families” (p. 190). There were other challenges for the villagers who relocated to Siosar, but these were not captured by the environmental QoL measure (as discussed in the section on policy implications).

The findings for group differences in subjective social status, which were highest in the remaining group, have some commonality with previous disaster research in Indonesia [13]. Specifically, the highest levels of SSS—or what has been called individual relative deprivation in political psychology research (e.g., Ref. [77])—in the remaining group suggests that they did not perceive themselves to be deprived relative to others in their nation and appears to have captured a range of affective and contextual features of life close to the volcano. In other words, the higher social status that was found among the remaining group that might include but cannot be equated solely with income and material wealth. Rather, it seems to also encapsulate attachment to place, or better, a topophilic appreciation of the natural and cultural features of life on a volcano. The correspondingly lower levels of SSS in the relocation and displaced groups suggest that the relocation group had lost the social status associated with living on the mountain. What were

Table 4
Hierarchical stepwise regression model for variables predicting social status.

Change	R	R ²	R ²	B	SE	β	t
Step 1	.38	.14	.14***				
Monthly income categories				.64	.14	.30	4.74***
Location/disaster management category				.54	.18	.19	3.10**
Step 2	.48	.09	.23***				
Psychological QoL				.03	.01	.26	4.38***
Provided emotional support to others				.26	.12	.13	2.18*
Personal resilience				-.02	.17	-.01	-.13
Step 3	.57	.10	.33***				
Environmental QoL				.04	.01	.32	4.75***
Community efficacy				-.28	.18	-.01	-1.56
Community identification now				-.22	.15	-.01	-1.49
Social cohesion				.02	.16	.01	.09

* = $p < .05$, ** = $p < .01$, *** = $p < .001$.

arguably higher levels of perceived individual relative deprivation in the displaced and relocated groups highlights combined personal losses of ownership of ancestral plots and the livelihood benefits of living on fertile land; losses that were due, it should be noted, to a largely unwanted personal, family and community change. The higher levels of SSS in the remaining group therefore seem to capture the reasons why people would resist being permanently relocated from the mountain (i. e., they know that they would lose the basis for feeling special relative to other Indonesians).

At this point it is useful to compare our findings to those of social identity and social cure theories and approaches for other disasters. The pattern of correlations for SSS in Table 3, shows negative associations with personal distress and social identification with the community now, and positive associations with provided emotional support at the time of the eruption and all domains of the WHOQoL. These findings seem to indicate that SSS/IRD is “linked primarily to outcomes at the interpersonal level” (p. 204 [20]). Moreover, it could be argued that SSS did not correlate with many of the variables that are important in explaining solidary behaviour in disasters such as the Chile earthquake [35] and UK floods [36] because it is not a measure of group-based relative deprivation [20,77]. By way of reply, it is notable that the individual measure aggregated and averaged differences in individual perceptions that were significant between the three study groups. In this respect, conceptualizing and measuring SSS as IRD appears to overcome a limited binary approach to individualism and collectivism evident in some low-income context disaster research.

However, future disaster research should explore whether a specific group-based comparison (e.g., with other eruption affected groups; [18]) informed these individual perceptions. In addition, if SSS were to be measured in terms of group-based relative deprivation (GRD) along with appropriate outcomes at the intergroup level (e.g., support for political protests [20]), we would expect these to be associated with current social identification with one’s community. In this regard, however, it is useful to list the positive associations that we did find between social identification with the community at the time of the last eruption as well as social identification with the community now, because these help to show why including SSS/IRD extends the social identity account (i.e., especially when considered in conjunction with environmental QoL). Consistent with Drury et al. [35], social identification with the community at the time of the last eruption was positively associated with provided emotional support, common fate at eruption as well as collective empowerment and our two measures of social cohesion and collective efficacy.

However, social identification with the community now was positively associated with providing emotional support during the eruption, personal distress (presumably sharing the pain of current community members), the three community-level variables (collective empowerment, social cohesion, collective efficacy) and trust in authorities, but also negatively associated with psychological QoL, environmental QoL and SSS. While this seems to confirm an individualistic (or household) focus for SSS, the negative associations with QoL require explanation. The moderation analysis confirmed that social identification does not mediate the relationship between environmental QoL and SSS, thereby indicating that a decline of social identification was not the relevant mechanism. Instead, the regression showed that the main variables predicting SSS were location/disaster management group, income, psychological QoL, provided emotional support and environmental QoL. In the regression model, only emotional support provided to others in 2015 was a significant social identity related predictor variable for SSS, perhaps indicating that being able to be respectful towards and show concern for others is possible especially when one has access to more financial and material resources or greater financial security.

The correlation and regression analyses highlight an important role for measures of environmental and other QoL domains in extending social identity explanatory accounts of post-disaster community resilience and recovery based mainly on an emergent social identity; that is,

social identity research that has established how a sense of common fate after a disaster contributes to a new social identification with others affected by the disaster and predicts emotional support provided to others [27] (as well as expected from them) shows that one is in a position to help or perhaps offer community leadership and that this makes one feel that one’s status has increased (i.e., in accordance with Karo cultural values). The lack of a positive role for emergent social identity in our analysis might indicate that such changes in social identity are arguably more common and beneficial in nations unlike Indonesia where collectivism is widespread and normative particularly in rural communities [35,36,69]. However, a further interpretation is that while social identity models integrate psychological, social and community-level variables, they cannot account for the role that the environment plays, both in terms of contributing to psychological QoL and also as a significant predictor in our model of SSS/IRD. Emerging or declining social identities may explain levels of social solidarity and help community members to access resources and information, but the significant contribution of environmental quality of life in our study is to suggest that available communal resources and local living conditions play a greater role than social identification in forming a judgement of personal, family or household deprivation relative to others.

While the lack of predictive power of social identification and community-level variables to SSS appears to show the explanatory and practical limits of focusing on changes in social identification, we do not necessarily advocate a social capital explanation. Rather, we believe that more empirical research and theoretical work needs to be done to make explicit the complex connections between social identity, social capital, QoL, and SSS. It is conceivable, for example, that measuring SSS in an Indonesian disaster context elicits individual perspectives and captures the impact of material support as well as resources and infrastructure in the local environment in a way that other objective indicators (e.g., income) or social and community-level measures cannot. A promising research direction therefore would be to explore how social capital and social identity frameworks can be extended by including environmental QoL and aggregate levels of IRD and GRD for particular disaster management groups. Including both in future research might reveal discrepancies and respective emotions, such as feelings of guilt, selfishness or contempt when one’s IRD exceeds GRD, and feelings of envy, anger or resentment where one’s IRD is lower than GRD. Including a measure of GRD might also predict group-based and collective emotions such as pride and shame [78] and determine whether local group comparisons underpin intergroup resentment and conflict.

In addition, while there is evidence that environmental QoL can have an impact on mental health and personal resilience [21], a potential link with social identity theory is where community-based concerns and emotions about features of the environment that are important at personal, household and community levels become the subjects of organized collective action (e.g., environmental activism [21], protests against post-disaster inequalities, etc.). In other words, we believe that it will be useful to identify those features of environmental QoL that can become the focus of collective actions to address the material and environmental needs of a community *as a whole*; that is, in order to overcome what would otherwise appear to be a limitation of social identity or social cure approaches. This would also explain our finding that collective empowerment was higher in the displaced and relocated even though we found no examples of collective environmental or political action. Higher levels of trust in these same groups provides further support for the explanation that displaced and relocated groups expected their needs to be met through the actions of communities leaders and authorities, rather than as a result of their own efforts or those of NGOs and volunteers [79].

4.1. Practical and policy implications

There are several implications of our trust and SSS findings of relevance to disaster interventions and policies. Levels of trust reflect

different communication approaches and, potentially, a lack of participatory decision making. The lower trust of NGOs particularly in the relocation group may reflect experiences after the initial displacement, in evacuation shelters, or current experiences in relation to plans in the new village of Siosar. Many NGOs, whether national or international, attempt to fill the gaps between government aid and community-led recovery in disaster affected communities; in this respect our research appears to confirm previous findings that stakeholders competed to be involved. The finding that remaining villagers have lower levels of trust in local government and community leaders suggests that communication and consultation improvements might increase a sense that the interests of villagers would be given greater consideration in long-term planning. Confidence in the law to maintain order may not necessarily reflect the impact of relationships with national government through, for instance, forced evacuations because it might also reflect people's defiance of restrictions on working within the red zone. The latter issue is a problem because farmers who venture into the red zone to farm their abandoned plots are at significant risk of being killed by pyroclastic flows. This happened one week after our fieldwork visit when seven people from the Gamber village were killed. Further efforts on the part of local government and community leaders are therefore required in order to improve trust, address sources of political instability and potential conflict as well as "show a commitment to communicate, share mitigation program, support disaster mitigation policy and maintain involvement in community activities" (p. 9; [48]).

Our findings are broadly consistent with Andreastuti and colleagues' [48] comparison of Kelud and Sinabung eruption responses, which highlighted that Sinabung "scored lower in: knowledge and disaster experience, coordination and communication in the ongoing crisis management, development of community leaders, trust in government scientists, and in understanding of risk" (p. 12). However, we argue that the people responsible for planning or proposing interventions need to understand how different groups form distinct relationships with authorities and disaster subcultures; depending on how their plight has been managed and any plans for the future have been developed. For example, targeted improvement of resources and support at particular stages in the management of communities could be made on the basis of a suite of measures that includes using multiple QoL domains to generate recommendations about ways in which perceived sources of inequality and injustice can be addressed. Recent qualitative evidence from Sinabung also suggests that community-led initiatives such as volunteer groups may fill a gap between authorities and community members [73]. In addition, other forms of community-led political activity might focus efforts to retain previous village identities and accord with suggestions that having a voice in political matters could become important to the formation of a new community social identity [17].

In practice, this would mean that disaster affected communities should be evaluated using the WHOQoL-Bref and by a measure of anger or dissatisfaction with current levels of IRD and GRD in order to accord with recommendations from the relative deprivation literature [12,20,42,77]). Including SSS, anger about current SSS level, group comparisons with other communities and environmental QoL in evaluation surveys could not only highlight the need to encourage attachment to place in relocation settings, but also it could be used to design interventions to restore perceived individual and potentially group social status to levels similar to appropriate comparison groups (e.g., to remaining groups and those living nearby who have not been affected by the natural hazard). Attempts to improve environmental QoL and SSS should be explored collaboratively in solution-focused work with the community or as a predominantly community-led and sustainable activity, rather than imposed in a top-down manner. Interventions could include training in peer-delivered psychosocial support (e.g., to cope with secondary stressors for people displaced for long periods), and support to develop sustainable livelihoods [44] and generate levels of income that avoid poverty. Further studies should examine whether livelihood-focused interventions in post-disaster resettlement [75,80]

including the development of diverse income streams [81] can eventually overcome loss of place and raise subjective social status back to or even beyond pre-disaster levels. Our results show that displacement has a negative effect on communities and that relocation should, ideally, be undertaken in consultation with communities as soon as it becomes clear that return to home villages is not feasible. Finally, while relocation is certainly disruptive, it did not appear to be as negative for residents of Siosar (as indicated by environmental QoL) as critics have found in other locations [76].

5. Limitations and significant contribution

There are several limitations of our research. The first is that trauma symptoms were self-reported using selected items rather than a more robust and reliable scale. In future research, trauma as well as personal distress and post-traumatic growth should be measured using robust and reliable scales (e.g. the PCL-6; [82]). While physical quality of life did not differ between the research categories, further items tailored to the physical health problems caused by frequent exposure to volcanic dust should be included in eruption impact surveys. Addition of a measure of attachment to place or topophilia would also help to disentangle the relative importance of the multiple factors that contribute to an individual or group-based sense of social status. A further limitation is that we did not include a non-exposed sample living in the same region for comparison; in other words, there were only differences in the degree of eruption exposure and no comparison between affected groups and others nearby not exposed to eruptions and not needing to evacuate. Future research should also explore the longer-term impact of eruptions and the policies to deal with those groups most at risk from chronic volcanic activity using a longitudinal rather than a cross-sectional design. This would give researchers greater confidence in determining how people adjusted to relocation, for instance, and the longer term consequences for individuals and communities of moving from dangerous places; specifically, places that provide a livelihood and are sources of communal identity and social status, but also require high levels of disaster preparedness.

Despite these limitations, our research makes several significant contributions to understanding the current circumstances of communities living on an active volcano and the impact of disaster management policies of displacement and resettlement. Our findings show that QoL and SSS measures not previously considered for research in disaster contexts were sensitive to differences between groups. Moreover, when used in combination with social identity-related measures (e.g., common fate, social identification, provided emotional support), our findings suggested that there are limitations with both social capital and social identity or social cure approaches. SSS as an aggregation of individual relative deprivation appeared to capture inequalities between groups in a way that was positively to environmental QoL rather than to endurance or decline of shared social identity; especially towards the latter period of the 5 years of chronic volcanic activity. The limitation of a social cure approach therefore appears to be that while it can make sense of the mitigating role of expecting and providing social support, feeling that the difficulties one faces are shared and that being part of a group helps to form and maintain supportive social bonds and enhance trust in authorities and community leaders, there are many features of disaster environments that can feel beyond the boundaries of collectives. While we did establish that there are some positive relationships between SSS and social identity factors such as providing emotional support to others, these features of social identification did not seem to have the predictive value of income level, disaster management category and environmental QoL for SSS levels. While those levels might appear to force highly collectivist people to consider their surroundings in largely individual or household terms, we believe that a focus on group relative deprivation would still need to address features of the environment that affect individuals but are perceived as not able to be changed or improved by authorities or community collective action (e.g., see [83]).

6. Conclusion

Our research has led to the following important outcomes and conclusions: 1) it has identified health differences—where health is very broadly conceived to include social and environmental qualities impacting on current forms of life—between groups according to their disaster management, 2) demonstrated the value of going beyond a focus on subjective well-being in disaster and post-disaster contexts, 3) highlighted previously unexamined relationships between QoL domains and theoretically important psychological and social variables (e.g., provided emotional support and environmental QoL), 4) examined social and environmental differences between groups that might be the basis for felt perceptions of relative individual and, potentially, group deprivation (i.e., relative to a range of psychologically important “others” which should be examined in future research), 5) revealed sources of contradiction between social status and environmental conditions that is similar to other research about poor communities living close to natural hazards (i.e., higher environmental QoL but lower SSS for relocated communities compared to those remaining in their original location), 6) demonstrated the value of using a multidimensional QoL measure in disaster contexts to highlight differences in and potential sources of inequality (particularly in low-income nations), 7) provided evidence that the WHOQoL-Bref is sensitive to differences between groups and can be used to evaluate disaster management policies (e.g., displacement for extended periods and resettlement), 8) undertaken the first study, to the authors’ knowledge, of multidimensional QoL in relation to a chronic volcanic natural hazard, 9) reported a regression model of subjective social status which shows the predictive power of combining location/disaster management group, income level, previous provision of emotional support to others and environmental QoL, 10) provided new evidence of the limitations of social capital, social identity theories and social cure approaches to address features of environmental QoL that predict levels of subjective social status and potentially underpin new interventions with disaster-affected communities, and 11) highlighted the importance of further work to theorize connections between environmental QoL and social identity through their relationships with trust, collective empowerment and collective action.

On this last issue, we argued that in contexts where people trust authorities and community leaders to address concerns that create lower levels of environmental QoL, only collective action focused on addressing broad environmental issues might increase previous community social identification or address a decline in shared social identity from early or pre-disaster levels. The lowest levels of environmental quality of life for displaced people represents the area in which authorities and researchers can better understand how natural and material conditions as well as “differences in socioeconomic class, access to resources, ethnic identity, and levels of support all shape the local context in which evacuation and resettlement occur” (p. 191; [33]). We believe that our research shows the practical and theoretical value of including multidimensional quality of life measurement in disaster contexts to evaluate policies and practices that should ultimately aim to promote disaster risk reduction in concert with well-being sustainable development goals.

Ethics approval and consent to participate

The project was approved by the Coventry University Ethical Approval process no. P42921 and reviewed by the Resilience Development Initiative, Bandung, Indonesia.

Authors’ contributions

Professor Gavin Sullivan secured funding and ethical approval for the research. Dr. Sagala and Professor Sullivan planned the design and fieldwork. Dr. Yohana R. Hestyanti provided the trauma symptoms items and Endang Fouriana suggested the Connor-Davidson personal

resilience scale. Evi Syafrida, Petra Omega, Wahyu Lubis, Endang Fouriana, Yusuf Ratuagung, Yasmina Wulandari, Maria Theresia Asti Wulandari, Dr. Yohana R. Hestyanti and Umar Alfaruq assisted with data collection in the field. Umar Alfaruq and Wahyu Lubis assisted with organizational, operational and budgeting on the project. Dr. Sagala wrote a first draft of the manuscript and Professor Sullivan revised and expanded upon the first draft, rewriting the introduction, adding the statistical analyses, and completing the results and discussion sections. Dr. Sagala contributed to the results and discussion sections.

Declaration of competing interest

The authors declare that they have no competing interests.

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Appendix A. Supplementary data

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