



JUNE 2000 EARTHQUAKES IN SOUTH ICELAND: AXIAL CODING ANALYSIS OF SOCIO-STRUCTURAL STRESS AND MITIGATION FACTORS

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SUMMARY

South Iceland was struck by an earthquake sequence in 2000, culminating in two destructive earthquakes on June 17th (the National Day of Iceland) ($M_w = 6,6$) and June 21st ($M_w = 6,5$). The highest recorded peak ground accelerations in these events were, respectively, 64% g and 85% g. A case study of the impact factors of stress and relief in the wake of the South Iceland Earthquakes in 2000 is presented. By applying axial coding analysis, the isolated impact factors were added sequentially to the time axis, and an analytically descriptive time-line thereby emerged, reflecting the victims' conscious and/or unconscious efforts to bring life back to "normal", constantly burdened by a perceived lack of understanding by "outsiders". The process was affected by six main stress factors and three main mitigating factors. The data were obtained through a field survey using standardised questionnaires as well as personal in-depth interviews, photographs and field notes. The analysis of the collected data is both qualitative and quantitative. The data collected are important for vulnerability and risk analysis, at least for the study area.

INTRODUCTION

This paper presents a case study of perceived effects defined as social impact factors and their relation to structural and non-structural damage. The event considered is the South Iceland earthquake sequence in June 2000. The sequence culminated in two destructive earthquakes on June 17th (the National Day of Iceland), at 15:41 ($M_w = 6.6$), and June 21st, at 00:52 ($M_w = 6.5$) [1]. The highest recorded peak ground accelerations in these events were respectively 64% g and 85% g [1]. Both earthquakes were followed by several aftershocks [1]. Fortunately there were no casualties, and only five physical injuries were recorded [1, 2, 3, 22]. However, insurance compensation already paid owing to earthquake-related structural damage to buildings had reached \$US 31 million by October 1st 2002 [23], and the earthquakes evidently

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had some long-term psychological consequences for many earthquake-victims [2, 3]. Observations and a survey [1, 2, 3, 7] indicate that there are two main reasons for the absence of serious injuries or loss of life:

None of the residential buildings exposed to the earthquakes collapsed, although many of them were severely damaged. There are several reasons for this: First, a relatively high percentage of the residential buildings are made of timber, which has proved to be very earthquake-resistant. Second, residential buildings of concrete are traditionally poured in-situ, which yields strong and resistant structures, even in the cases of limited steel-reinforcement. Third, all the buildings in the earthquake area are low-rise, in most cases only one story, where the dimensions of structural elements are not governed by codified strength requirements, the results being buildings with very high specific strength. Finally, a minor fraction of the residential buildings were made of 'masonry' [7, 24].

The first high-intensity earthquake struck (at 15:41) on June 17th, which is the National Day of Iceland, a day of celebration, when a great majority of the Icelanders have the day off [1, 2, 3]. Hence, most of the concerned earthquake victims were absent from their homes celebrating, either out in the open, or inside well-built meetinghouses, therefore fortunately avoiding the observed and recorded life-endangering earthquake-related damage of loose heavy household articles, which were flung onto floors inside many residential houses during the earthquake [1, 2, 3, 7].

With regard to the above social and physical impact of the 2000 South Iceland earthquakes, the objective of the present research is to further analyse stressful societal problems surfacing in the wake of the earthquakes and suggest possible preventive measures regarding future earthquakes. With regard to this objective, we have focused on structural and non-structural damage to selected houses and, at the same time, approached the people living in them (i.e., the earthquake victims) - several of whom, in spite of the celebrations of the National Day of Iceland, were at home and inside their houses during the earthquakes. The aim is to analyze the victims' emotional and physical reactions to the earthquakes and damage. Hence we deal with the victims' fear, their first seeking of relief, their "shocking" first discovery of damage, the relief experienced from visits of rescue teams, the victims' unexpected discovery of progressive structural damage, the insurance auditors' alleged "wounding" through "unwillingness" to acknowledge this kind of damage, perceived "frustrating" economic compensation, and the victims' mutual, ongoing talks every day for purposes of relief. We also attempt to relate some of these impact factors to the victims' earthquake intensity assessments (MMI). We try to account for the alleged lack of understanding of people living outside the affected area. Social research methods (i.e., participant observation, in-depth interviews, and standardized questionnaires) are applied in this research project.

METHODOLOGY, RESEARCH AREA, SAMPLE AND ETHICAL PROBLEMS

Research area and sample selection

The random sample of 168 residential houses was taken from a detailed survey of housing quality and conditions undertaken 1995-1999 [7, 8, 9]. The present research utilizes this previous valuable research by surveying the inhabitants of these same houses who actually became victims of the earthquakes in 2000. Thereby we are in a position to get more reliable assessments of the relationship between the structural effects and social and personal consequences of the quakes. The number of residential houses in the overall affected area is around 5,100, with some 15,000 inhabitants in the South Iceland Lowlands. The sample area selected for detailed investigation is an area of 1700 km² with about 2,400 residential houses and a population of 5,000 (see Figure 1). The sample of houses was also selected to ensure that it would reflect fundamental geographical and structural qualities with regard to the nature of the earthquakes: (1) geographical distribution, (2) age distribution, and (3) distribution of building types as well as building material. However, we added a few more residential houses of special interest to the sample [see also 2, 3]: (1) Houses very close either to the epicentres or causative faults, and (2) houses

equipped with strong motion stations. We deem these additions desirable with regard to the objective of this paper, i.e., the study of the effects perceived by victims and the relationship of such perceptions to actual structural and non-structural damage. The social effects are thus accurately related to the recorded physical qualities.

Methodology

The qualitative methodology produces descriptive data: people's own written or spoken words and observable behaviour, focusing on concepts, insights, and understanding from patterns in the data, rather than collecting data to assess preconceived models, hypotheses or theories. The research design in this part is flexible, with only generally formulated research questions, looking at settings and people holistically. The quantitative methodology relies upon the use of physically recorded data and standardized questionnaire. To a considerable extent the questions were pre-tested and in fact they grew in large part out of the data obtained from previously applied qualitative methods.

Ethical problems

Survey research carried out in the wake of a natural disaster raises some delicate ethical questions. The issues that must be tackled are extremely sensitive and some social research methods of data collection, such as participant observation and in-depth interviewing, can give cause for concern, not least when one is sharing information with victims and observing their everyday life over an extended period. In this project we have therefore carefully attempted to uphold the following ethical principles: (1) The researcher shall approach and deal with the informant and his/her physical property with respect, fairness and delicacy. (2) No one shall be "pressured" or tricked into participating, and no one shall be shamed for not taking part. (3) Those agreeing to participate shall know from the very beginning that they can rely on confidentiality, and that they may remain anonymous. (4) The informants shall always be informed of the real aim of the research at the first meeting. (5) The informants will be neither asked nor tricked into saying or doing anything that can harm their self-respect and interests or that of others. (6) Personal quotations, photos of people, their property and other intimate documentary source material will be neither distributed nor published without formal permission from the informants. (7) The informants' property is dealt with as an extension of their self-image. In addition, we always try to convey our gratitude to informants and explain the applied value of their contribution to the project [4, 5, 6, 7].

SEQUENTIAL ANALYSIS OF POST-EARTHQUAKE SOCIAL STRESS AND MITIGATION FACTORS

It has been observed that the earthquake victims in the whole research area (see Figure 1) feel a lack of understanding from outside people [3]: "People from outside the area don't understand the traumatic and difficult event we went through," one of our interviewed informants in research area 1 said in July 2001 (MMI VIII). This topic was added to the interview scheme for the qualitative part, and, indeed, several other informants interviewed in research area 1 agreed with this feeling [2]. Therefore, a specific question on the topic was also designed and tested in the standardized quantitative part, which was carried out in a survey analysis in the whole research area (see Figure 1) two and a half years after the events, i.e., in late 2002. On the basis of the survey analysis, it can be argued that there is a significant relationship ($P < 0.05$) between the victims perceived "lack of understanding" from people "outside" the area of their traumatic and difficult experience, and the MMI, which is a function of distance from the fault, i.e., the higher the MMI is, the more victims perceive this "lack of understanding" from "outsiders". According to the survey analysis (see Figure 2), 50.7% of the earthquake-victims (38 of 75 sample-victims) in the whole research area feel this (see Figure 2).

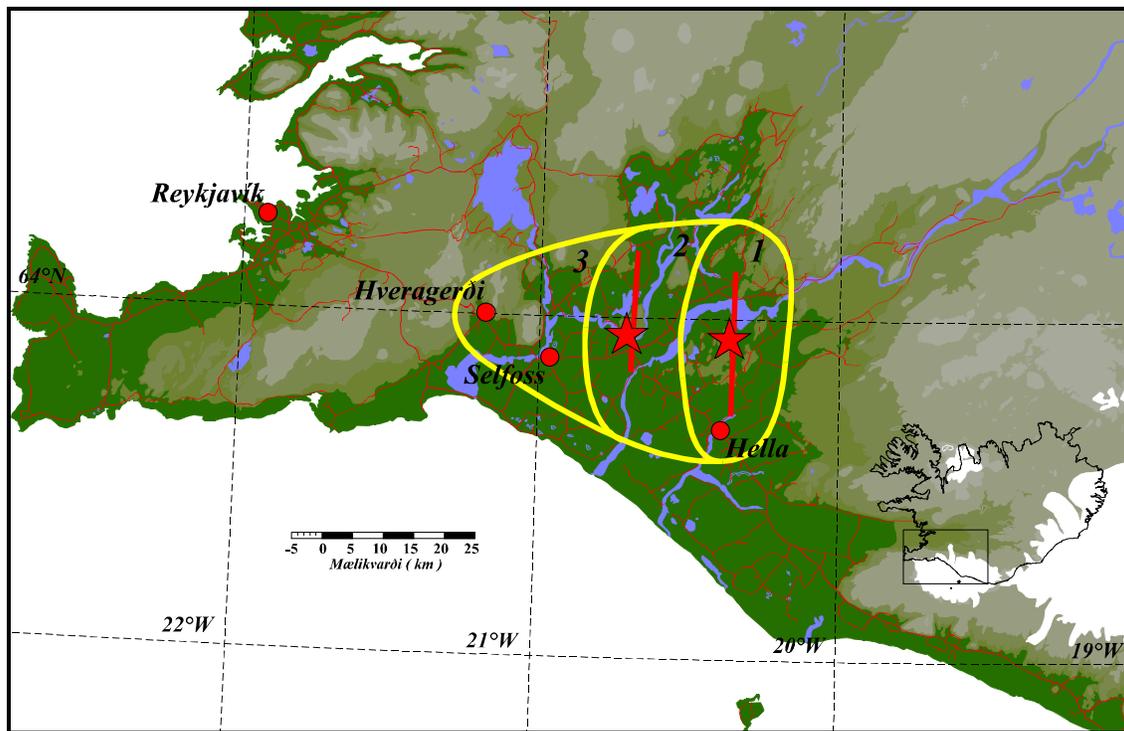


Figure 1: Approximate outlines of the 1700 km² research area with about 2400 residential houses: Research area 1 is an area within 15 km of the June 17th 2000 causative fault (MMI VII-XI). Research area 2 is an area 15 to 25 km from the June 17th fault (MMI V-VI) (also MMI VII-IX in an area 0-15 km from the June 21st causative fault). Research area 3, is an area 25 to 40 km from the June 17th fault (MMI III-V). The red line within area 1 represents the June 17th causative fault, and the red star represents the epicentre. The corresponding line and star in area 2 represent the June 21st causative fault and epicentre. The river running through area 1, and from there also through area 2, constitutes the boundary between the Rangárvellir County, positioned on the east side, and the Árnes County, on the west side.

Further analysis of the “lack of understanding” topic led to a time-line representation, or sequential analysis, additionally covering relations to several other topics and social impact-factors (see Figure 3). Several observations had already been made of the informants’ efforts to build up, return to, and maintain the quality and stability of life they felt they had before the June 2000 earthquakes. On the basis of further analysis, it was then assumed that these two impact factors jointly provided material for axial coding analysis [8, 9]. Observed, analysed, and finally isolated factors of stress as well as relief were then added to the axis, one by one. Consequently, an analytically descriptive time-line emerged, reflecting the victims’ conscious and/or unconscious efforts to bring life back to “normal”, while constantly burdened by a perceived lack of understanding from outsiders. Throughout the process six main stress factors and three mitigating factors were involved (see Figure 3). Observations in research areas 1 and 2 in 2003 and 2004 indicate that many earthquake-exposed victims still feel or perceive an oppressive “lack of understanding” from people “outside” the earthquake area. Further research is recommended.

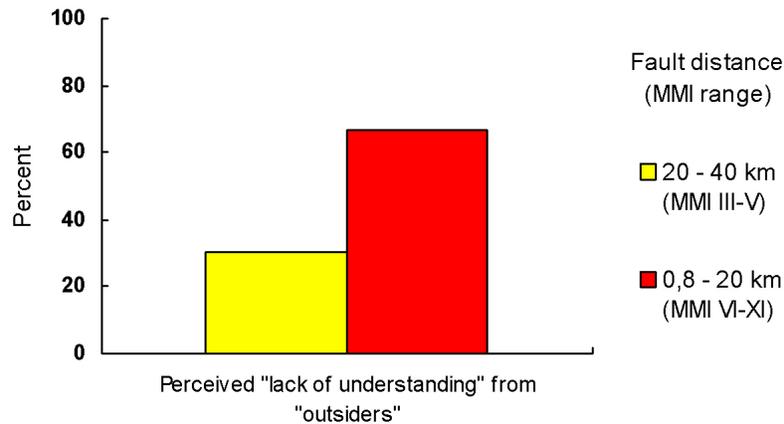


Figure 2: A survey analysis indicates that 66.7% ($\chi^2(1, N = 75) = 9.776, p < 0.05$) of the June 17th 2000 earthquake-victims (28 of 42 sample-victims within MMI-range VI-XI; distance to the fault 0.8-20 km) feel or perceive a “lack of understanding” from people “outside” the earthquake area“ of their traumatic and difficult experience, and 30.3% of the victims (i.e., 10 of 33 victims within MMI-range III-V; distance to the fault 20-40 km) feel this.

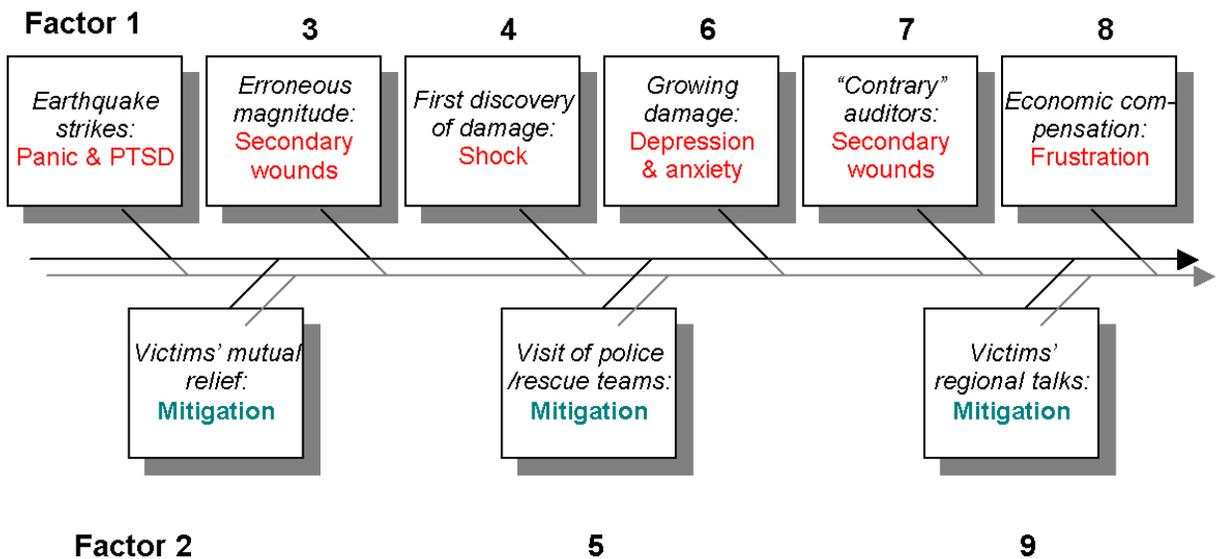


Figure 3: Time-line: An axis of post-earthquake social stress and mitigating factors since the June 17th 2000 earthquake up to 2004. Central axis (i.e., the long arrow): The victims’ efforts to recreate the pre-earthquake quality of life, while constantly burdened by a perceived lack of understanding of their traumatic and difficult experience amongst “outsiders”.

Short- and long-term fear

Factor 1 is the very first and most fateful of the six isolated stress factors. Also, it seems mostly (1) a result of the first earthquake on June 17th 2000, which struck “out of the blue” at 15:41 [1], and (2) a result of the second “high magnitude” one (i.e., over 6 M_w) on June 21st 2000, which struck at 00:52 [1]. Observations and analyses of the in-depth interviews with people out of doors and inside houses on the epicentre of the June 17th earthquake and in a 15-20 km zone around the causative fault suggest that some of them became so terrified [for instance, see 3], that two and a half years later they were still suffering from severe, ongoing fear, best described as Post Traumatic Stress Disorder (PTSD). Some minor earthquakes have struck since the great 2000 earthquakes, and they sometimes cause sudden, severe anxiety [2]. Two and a half years after the events in 2000, the significance of the relationship between MMI assessments (related to the distance from the causative fault) and the victims’ perceived serious, ongoing fear was statistically confirmed by material from the survey analysis. According to this survey analysis ($P < 0.05$, see Figure 4), 29.2% of the earthquake-exposed victims (i.e., 31 of 106 sample-victims) in the whole research area (see Figure 1) had begun to recover from the earthquake-induced fear and anxiety after a considerable time, or that they were still suffering from it (PTSD - Post Traumatic Stress Disorder) two and a half years after the event. Another variable ($P < 0.05$, see Figure 5) indicates that 14.4% of the earthquake-exposed victims (i.e., 16 of 111 victims) in the whole research area are still suffering from fear and anxiety (PTSD - Post Traumatic Stress Disorder) two and a half years after the event.

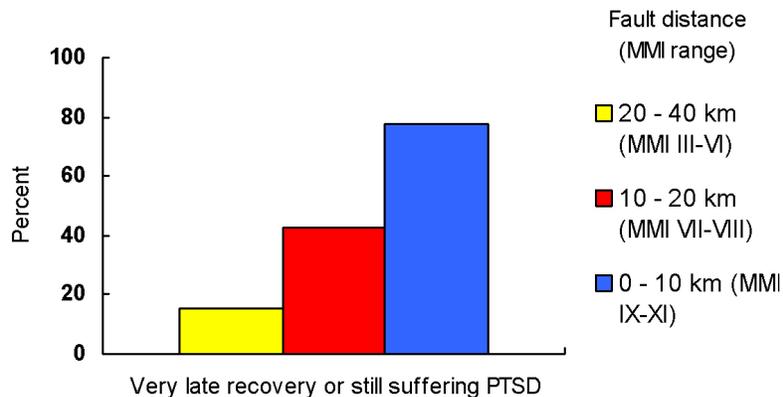


Figure 4: Analysis of a questionnaire survey indicates that (a) 15.6% (10 of 64 sample-victims) within MMI-range III-VI (distance to fault 20-40 km) had begun to recover from the earthquake-induced fear and anxiety after a considerable time, or that they were still suffering PTSD (Post Traumatic Stress Disorder) from it two and a half years after the event. (b) 42.4% (14 of 33 victims) within MMI range VII-VIII (distance to fault 10-20 km) felt this, and finally (c) 77.8% (7 of 9 victims) within MMI-range IX-XI (distance to fault 0.8-8 km) ($\chi^2(2, N = 106) = 18.752, p < 0.05$).

On the basis of this survey analysis, it emerges that there is a significant relationship ($P < 0.05$) between the earthquake-induced short-, and long-term fear, panic and PTSD, and the MMI, which is a function of distance from the fault, i.e., the higher the MMI is, the more fear and panic were aroused in the respective areas. This corresponds to D’Souza [21, p. 142], who claims that “persons living in higher MMI areas score higher than persons living in lower MMI areas on the psychological distress index.” On the basis of the above statistical results and subsequent analysis, it can be stated that a great majority of the 2000 earthquake-exposed victims recovered from their fear or panic early on or after a considerable time, while others, a statistically significant minority, or 14.4% of the total number of victims, most of them residing

in research area 1 (and partly in area 2), still suffer. This group continually suffers severe fear two and a half years after the events, i.e., at the end of 2002. Severe fear or panic seems to be aroused as MMI assessments approach VII, and the fear spreads and heightens as the intensity increases.

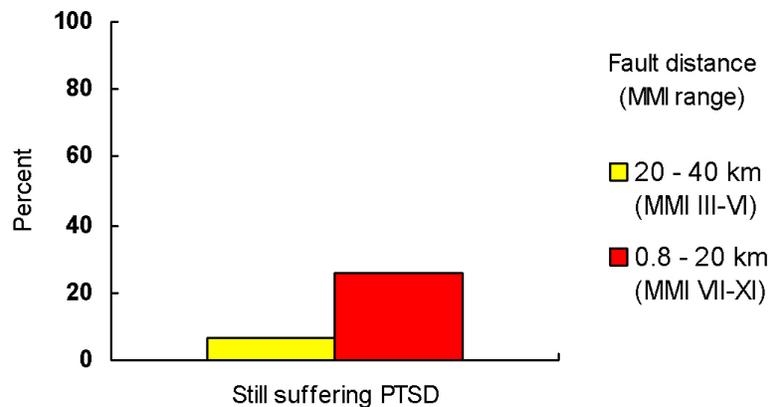


Figure 5: Analysis of a questionnaire survey indicates that 6.3% (i.e., 4 of 64 sample-victims) within MMI-range III-VI (distance to fault 20-40 km) still suffer from fear and anxiety PTSD (Post Traumatic Stress Disorder) two and a half years after the event, and 25.5% (12 of 47 victims) within MMI-range VII-XI (distance to fault 0.8-20 km) ($\chi^2(1, N = 111) = 8.167, p < 0.05$).

Many victims' statements recorded in 2000 through 2003 bear witness to descriptive perceptions of both short-term and long-term fear, although they are most frequently found in research area 1 and in some parts of area 2 (see Figure 1). Examples of such statements are the following: "I have never been so scared in my whole life" (MMI VIII), "The one who claims he didn't get scared is lying" (MMI VIII), "many were crying [...] there was a lot of crying there" (MMI VI – VII), "I have felt insecure after this" (MMI VIII), and "All noise and vibration make me think first that an earthquake is going to strike. This is worse inside than outside. During thundery weather this summer [i.e., in 2002], my first thought was that an earthquake was going to strike." Such descriptive recordings of extreme experiences are indeed in harmony with Edward E. Bryant's [11, p. 7] conclusions about the relationship between humans and natural hazards, including earthquakes, that natural-hazard-derived "disasters can also be viewed from a sociological or humanistic viewpoint." Meichenbaum [12, p. 34] [see also 13, 14] similarly infers that "disasters are traumatic events that are so extreme or severe, so powerful, harmful or threatening that they demand extraordinary coping efforts [...] that subject people to extreme, intensive, overwhelming bombardment of perceived threat to themselves, or to significant others." Meichenbaum [12, p. 34] then finally concludes: "Such traumatic events may overwhelm a person's or a community's sense of safety and security. These events may be brief and powerful, often lasting no more than a few minutes or hours, or they may last for a prolonged, if not an indefinite period [...]. These disastrous events may leave behind long-term secondary stressors." Green [15, p. 318] agrees with Meichenbaum's conclusions in his claims "that disasters have the potential to impact mental health over long periods of time". This is relevant to both adults and children, showing "PTDS-related symptoms from the initial exposure (life threat, loss, prolonged exposure)." This statement also corresponds with Gersie's [16, p. 178] claims regarding "children who are suffering from post-traumatic stress disorder after a natural disaster [...] These include fear of death, separation and further trauma." As evident from the above discussion, the main conclusion is that about 14% of the earthquake's victims in the whole research area were still suffering from the fear or panic, induced during the earthquakes in 2000, two and a half years later, i.e., at the end of 2002. Such

effects are still evident in early 2004. Further comparative research is recommended, and recorded observations at hand indicate that elderly people and children should be of special concern.

The victims' immediate mutual relief

Factor 2 represents the first active mitigating action observed after the first earthquake sequence on June 17th 2000, and it appears to be completely derived from the victims' own efforts to seek relief with each other, with claimed positive results. This involved frequent talking, crying on each other's shoulders, and hugging each other, in the very first moments after the perceived sudden and unexpected shock. This mutual seeking of relief, though, appears to apply primarily to the victims, who were already gathered together in groups and celebrating the National Day of Iceland (June 17th) out in the open when the earthquake struck. This seeking of relief corresponds with Mitchel's findings [10] [see also 16] that as victims' defusing begins directly after the traumatic event, the most effective relief is to start talking about their feelings and sharing their experience intimately with others who have been through the same kind of ordeal. And it appears to be a fact that many earthquake victims intimately shared each other's experiences in the first moments after the earthquake and thus successfully started disburdening and healing themselves from the earthquake-induced trauma. Evidently a great majority of the victims succeeded in their attempts, and they recovered early on. Others, a statistically significant minority, persistently suffer severe ongoing fear and have even developed PTSD, as shown above.

Secondary wounding induced by official pronouncements on low earthquake magnitude

Factor 3 represents secondary wounding. Many responding victims have consistently claimed that they were amazed and thoroughly dismayed at what they perceived as preposterous official pronouncements on an insignificantly low earthquake magnitude, "around 5 on the Richter scale" that were broadcast on the radio in the first minutes and hours after the first June 17th 2000 earthquake. Understandably, concerned radio stations dutifully reported these official low earthquake magnitude pronouncements, among others the Icelandic State Radio (Radio Reykjavík), which has a statutory function to serve as a public medium in times of crisis or disaster (Article 13 of the Broadcast Act, no. 53, 17 May 2000). This made the low magnitude claims more authoritative and practically paralysed many victims who, among other things, sarcastically asked: "What will the big one be like when it strikes? What kind of horrible disaster may we expect, as this 'low-magnitude' earthquake causes such enormous trauma and damage?" [1, 2, 3]. These low-magnitude assertions in radio broadcasts are also said to have been followed up in a rude and humiliating way by an official (frequently mentioned by name) in the subsequent day-after regional meeting (in research area 1), held for official, post-earthquake mitigation purposes. One interviewed victim present at the public meeting claims that after many victims there had openly expressed their view that the earthquake must have been a typical disastrous South Iceland Earthquake, amounting to 6 or more on the Richter scale, and definitely not around 5 as the official claimed, he had reacted by arrogantly answering: "An earthquake occurred." This victim also said that following this "arrogant" statement, many people became outraged and furious, and some of them left the meeting in that state. The victim also claimed that this same official "appeared grinning on the [television] news and said that this was not the big one [i.e., a traditional South Iceland Earthquake expected to strike approximately once in a century], as it was only approximately 5.4 on the Richter scale."

Recorded observations also indicate that radio pronouncements about the low magnitude during the first hours after the June 17th 2000 earthquake negatively affected journalists at the Icelandic State Radio (Radio Reykjavík). On the basis of recorded observations and interviews, it can be argued that at least some of Radio Reykjavík's journalists appeared to think, even several hours after the June 17th earthquake had struck at GMT 15:41 [1], that it was not worthy of special attention.

One representative of the local government in research area 1 (see Figure 1) claimed that the reactions of Reykjavík Radio "left us totally speechless and distressed." However, this representative also claimed that

the day after, i.e., on June 18th, the Director of Radio Reykjavík visited the area, and had obviously become aware of the mistakes from the day before. This representative also said that after the latter earthquake sequence on June 21st at 00:52 [1], Radio Reykjavík journalists “directly harassed us with questions; we were hardly able to hold meetings in the Local Civil Defence Committee”. On the basis of gathered source material, it can be argued that the “Radio Reykjavík-Local Civil Defence process” constituted an independent stress factor in the situation, to be included in sequence line of impacts and mitigations. However, Radio Reykjavík is not to be held responsible for the official low-magnitude claims broadcasted. The claims originated from sources that were supposed to be authoritative but unfortunately failed on this occasion.

With regard to the above analysis, it is also worth noting that Matsakis [17, p. 90-91], in her conclusion on defined “secondary wounds” of disaster victims, or “trauma survivors”, claims that “secondary wounding occurs when the people, institutions, caregivers, and others to whom the trauma survivor turns for emotional, legal, financial, medical, or other assistance” respond in one of the following ways: “Disbelief, denial, discounting”, meaning that “commonly people will deny or disbelieve the trauma in a survivor’s account of the trauma. Or they will minimize or discount the magnitude of the event, its meaning to the victim, its impact on the victim’s life.” Matsakis [17] also discusses “stigmatization” of the secondary wounding, and claims that the “stigmatization occurs when others judge the victim negatively for normal reactions to the traumatic event or for any long-term symptoms he or she may suffer. These judgements can take the following forms: ridicule of, or condescension toward, the survivor.” Matsakis [17, p. 93] then concludes that some secondarily wounded trauma survivors claim “that their secondary wounding experiences were more painful and devastating than the original traumatic event.” It is indeed certain that the concerned authorities’ unconditional and immediate acknowledgement of the experienced disastrous event is a prerequisite of the trauma victim’s recovery.

On the basis of the above observations and analysis, it is argued here that the low-magnitude pronouncements, combined with the claimed derogatory attitude of the official, strongly suggest secondary wounding for a significant number of victims, in particular victims in research area 1 (see Figure 1). The secondary wounding seemingly first occurred when the official pronouncements on an insignificantly low earthquake magnitude, were broadcast on the radio in the first minutes and hours after the first June 17th earthquake. The subsequent stigmatization of the secondary wounding occurred in the day-after regional meeting (in research area 1), when the official expressed “disbelief, denial, [and] discounting” of the victims “high” magnitude claims. However, several victims’ neutral and unemotional reactions to the low-magnitude issue have also been recorded, and some victims seem to have been completely relieved and satisfied, when the Earthquake Engineering Research Centre in Selfoss in South Iceland and some official institutions abroad firmly stated and certified on June 18th that the magnitude of the earthquake was approximately 6.5 on the Richter scale.

The “shocking” first discovery of damage

Factor 4 appears to be a plain, independent stress factor tied up with the victims’ first discovery of damage to their property. According to interviews and observations, many victims got an additional shock, which worsened their earthquake-derived trauma, when they first confronted the damage to their property, i.e., to their seemingly damaged houses as well as articles loose inside the house. In many cases, however, the damage appeared to be worse in the beginning, and this consequently led to at least some relief, where the damage, in the end, turned out to be minor. However, many owner-victims got an additional severe shock as they were forced by the circumstances to face, and immediately start adapting to their severely damaged houses, even totally cracked (though not collapsed), as well as severe damage to loose house articles. Further research on this socio-structural and related socio-economic topics is recommended.

Relief from rescue team visits

Factor 5 provides for the second isolated relief factor. Recorded observations, interviews and questionnaires indicate that unexpected visits from the police and the regional rescue teams in the rural areas and representatives from the Office of the Building Inspector in a village in research area 1 (see Figure 1) the very first hours after the June 17th earthquake, were perceived by the victims as the most appreciated official action taken in the wake of the earthquakes. This action, though, understandably appears to apply primarily to the victims in rural areas. Some rural victims expressed their disappointment at having missed these visits, or because they felt that these visits should have lasted longer than they did. The relief perceived by victims due to visits from the police, rescue teams, and inspectors corresponds with Mitchell's [10] recommendations on the first debriefing, i.e., relieving visits from independent people who understand and know about the potential serious effects of a disaster [see also 16]. We highly recommend relieving visits of this type as an immediate post-earthquake action.

Growing damage, “contrary” auditors, and “frustrating” economic compensation

Factors 6, 7, and 8, all stress factors (see Figure 3), appear to be very interrelated as they pertain to (6) the owner-victims' public acknowledgement of observed progressive increase in the damage to their houses, (7) subsequent “acknowledging” communications with insurance auditors, and (8) “recoverable” loss and compensations, especially in 2002 through 2004. Many owner-victims' claims regarding their gradual discovery of new damage to their buildings have been recorded for the first months and years after the earthquakes. Examples of these discoveries include new cracks or changes in older ones in concrete slabs and walls, “slightly” concave or convex floor-slabs (i.e., cracked floor-slabs); all these are, indeed, a matter of potentially lost structural earthquake resistance, jeopardising peoples' residential security. Later unexpected leakage of water emerged, cold floors, draughts and slight inclination of the house, etc. [also see 2, 3]. These discoveries seem to have taken some of the owner-victims by great surprise, as they obviously were not expecting “cyclical or growing” cracks in their buildings [18, p. 118][see also 3]. However, this is a known and confirmed type of structural damage from earthquakes [for instance, see 19, 20]. However, through such discoveries, many owner-victims seem to have become knowledgeable of this type of damage, though especially in the first three post-earthquake years (2000-2003), or as one of the owners puts it, people “in the region still feel [in April 2003] that everything is still moving about, both the landscape and the buildings, and [...] that the 2000 earthquakes are the cause of these movements” [3]. According to recorded observations, the statutory national insurance auditors frequently visited research areas 1 and 2 (see Figure 1) from late 2000 through 2004. Many owner-victims in this area claim that by then some auditors apparently were unwilling to accept the existence of progressive growth in structural damage, but the owner-victims were nevertheless forced to deal with these auditors, even rude ones, according to several recorded cases during the period 2000-2004. On the basis of the above observations and analysis, it is argued here that the auditors' claimed unwillingness to accept the existence of progressive growth in structural damage strongly suggests secondary wounding for an unknown number of the victims, though especially in research area 1, and partly in area 2 (see also the above discussion on secondary wounding). Victims' claims of “unacceptable” recommendations and authorized decisions on building restorations, in some cases leading to disharmony between the owner-victims and the auditors, have also been recorded and indeed, several owner-victims appear to be pessimistic or depressed because of this psychologically burdensome process; some even talk of violations of trust between them and the authorities and some appear to be frustrated, due to their dissatisfaction with “final” economic compensation. This appears to be worst in the “high-damage” June 17th 2000 MMI VII–XI research area 1, and June 21st 2000 MMI VII–IX research area 2, compared with the “low-damage” MMI III–VI research area 3 (see Figure 1) [see also 2, 3]. This definitely corresponds with D'Souza's [21, p. 142] indications that “persons scoring higher on the severity of residential damage scale score higher on the psychological distress index, when compared with persons rated lower on the damage scale.” However, contrary to the descriptive instances of analysed depression above (Factor 6), violated trust (Factor 7), and frustration (Factor 8), some owner-victims appear to be neutral, i.e., neither satisfied nor

dissatisfied, and some indeed appear to be quite satisfied and show signs of relief (some recorded observations, though, indicate that there are owner-victims in this category, who have not got to know of the “real” structural-economic damage they have actually suffered). It is discernible that as the investigations of the auditors went on, more of them expressed understanding of victims’ claims of progressive growth in structural damage. However, people still suffering from some kind of strain related to Factors 6, 7, and 8 are surely discernible in early 2004. It is indeed certain that the concerned authorities’ unconditional and immediate acknowledgement of perceived and/or experienced economic jeopardy from structural damage is a prerequisite of the trauma victim’s recovery. Further long-term research on the above discussed socio-structural and socio-economic topics is recommended.

Relieving, closed, local or intraregional talks between victims

Factor 9, the last factor of mitigation, represents the inhabitant-victims’ observed conscious and/or unconscious, ongoing local practice of relieving talks with each other, especially in research area 1, and partly in area 2. These talks, which appear to have been engaged in from the first moments after the June 17th earthquake, are still going on in February 2004 in research area 1 and partly in area 2. They appear to be practiced as closed, local or intraregional communications between victims, many of whom claim that they cannot talk about their earthquake experiences with outsiders, as outsiders seem to get tired or irritated as they obviously do not understand the victims’ horrifying experience [see also 2, 3]. The relieving talks correspond with the above results under Factor 2. We recommend that the victims be encouraged to carry on these community-based sessions, which have clearly had soothing or healing effects.

General recovery

Finally, it is important to stress that according to the above analysis of Factors 1 through 9, many earthquake victims in the South Iceland Lowlands in 2000 had definitely not recovered from their earthquake-related trauma in the beginning of 2004, while others, on the contrary, definitely have. These suffering people possibly need some kind of short-term or long-term treatment; as Matsakis [17, p. 144] puts it, when addressing trauma-victims and advising a proper post-disaster PTSD treatment for them: “Healing is a lifelong process. Depending on the intensity and duration of your particular traumatic experience, it may take months or even years to fully remember or gain perspective on the events that trouble you now. Similarly, it may take a long time for much of the anger and pain to diminish. If you have been extremely traumatized, it may take 5, 10, or even 20 years.” Matsakis then encourages trauma victims to go on by claiming that “the main point is that you have begun.” [17, p. 144]. With regard to many elderly victims of the earthquakes, it should not be difficult to conclude that at least some of them, if not quite a few, will never recover from their trauma. Such societal vulnerability should be kept in mind when post-earthquake issues are dealt with in the future.

DISCUSSION AND CONCLUSIONS

In the June 2000 earthquakes in South Iceland, many victims suffered shock and panic. A great majority of the victims recovered from their fear or panic early on; others, a statistically significant minority, consistently suffer severe, ongoing fear. Survey findings suggest that about 14% of the victims in the earthquake area are still suffering from severe, ongoing fear (Post Traumatic Stress Disorder) roughly two and a half years after the events. Within a distance of 20 km from the two causative faults (i.e., on June 17th and June 21st 2000), this applies to about 25% of the respondents. Severe, ongoing fear and anxiety seem to be aroused as MMI assessments approach VII, and fear spreads and heightens as the intensity increases. Further welfare-oriented analytical observations of the post-earthquake victims are recommended in the near future. Children and elderly people should then be of special concern.

The first active mitigating action observed after the first earthquake sequence on June 17th 2000 is the victims’ own successful efforts to seek relief with one another. This general, mutual seeking of relief,

which we hereby highly recommend as an immediate post-earthquake action of mitigation, was most common amongst victims who were gathered together in groups and celebrating the National Day out in the open.

The unexpected visits of the police, the regional rescue teams and representatives of the Office of the Building Inspector in the very first hours after the June 17th earthquake were generally perceived by the earthquake-victims as the most appreciated and most relieving official post-earthquake action. The victims' intimate and immediate contact with disaster rescue teams, and/or fellow-victims, appears to be the most important and most effective immediate relief, and is therefore highly recommended for post-earthquake relief.

The negative experience of public announcements playing down the magnitude of the earthquake on June the 17th indicates that the first step after an earthquake has struck should be to contact victims in person, and their own assessments of the seriousness of the event should be clearly voiced along with those of authoritative commentators.

The owner-victims gradually discovered progressive damage to their buildings the first months and years after the earthquakes, even as late as in 2004. This gradual discovery has amazed many of owner-victims, as they obviously were not expecting that the cause of damage, namely the disastrous strain derived from the earthquakes, was still acting on their buildings. However, through such discoveries, many owner-victims have become knowledgeable of this type of damage. Struggles with insurance auditors have in many cases caused secondary wounds amongst the victims.

The concerned authorities' unconditional and immediate acknowledgement of the experienced (or perceived) disastrous event is a prerequisite of the trauma victim's recovery. Observations recorded as late as in February 2004 indicate that this also applies to official acknowledgement of socio-economic jeopardy from structural damage. Concerned authorities' unconditional and immediate acknowledgement of such perceived and/or experienced economic jeopardy from structural damage is a prerequisite of social and economic recovery. Further long-term research on these interrelated topics is recommended.

The common opinion among the victims in the earthquake area is that "outsiders" really do not realize what difficulties the victims and their property have suffered. About 50% of the victims in the affected region feel this lack of understanding. Within a distance of 20 km from the two causative faults, the same applies to about 67% of the residents who experienced the earthquake. Many of the victims within these areas therefore feel isolated and slighted. We consider this a matter for concern since we assume that the prerequisite for society's proper mitigation through pre- and post-earthquake operations and preventive measures is its understanding of the severity of the event in question. We therefore recommend, as preventive pre- and post-earthquake action, a radical improvement in general societal education about the South Iceland 2000 earthquakes' impact. Insurance auditors should be of special concern. In the post-earthquake societal healing process, the disaster-victims should always enjoy some benefit of doubt.

The research presented in this paper gives an overview of the societal and personal effects of the June 2000 earthquakes in South Iceland. However, further research is necessary to broaden perspective on the impact and to conduct more in-depth analysis of specific topics, for instance, regarding the social impact of structural damage. In this context, it is especially worth looking into the long-term physical and structural social and economic effects of the earthquakes, both on individuals and the community as a whole.

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