

Stress, Floods, and Other Disasters: Impact of Multiple Crisis Events on Physical and Mental Health

Marko Toth, University of Applied Sciences Velika Gorica, Croatia

Tea Ramljak, University of Applied Sciences Velika Gorica, Croatia

Kristina Perišić, University of Applied Sciences Velika Gorica, Croatia

Tamara Čendo Metzinger, University of Applied Sciences Velika Gorica, Croatia

Address for correspondence: Marko Toth, University of Applied Sciences Velika Gorica, Croatia, e-mail: marko.toth@vvg.hr

DOI: <https://doi.org/10.51381/adrs.v4i1-2.207>

Abstract

Floods are the most frequent disasters in the world, they are full of stressors, and result in numerous victims and consequences for the physical and mental health of people.

The purpose of this paper is to examine the impact of floods as a crisis event on the physical and mental health of the affected population. During the data collection, two new crises emerged. Part of the sample was affected by the COVID-19 pandemic and devastating earthquakes. Therefore, the paper additionally analyzes the effects of these events on the results.

Data were collected through a field and online survey on a sample of the Croatian population living in the flood-prone area ($n = 42$) and a sample of the population of the nearby area that was not exposed to the floods ($n = 38$). The questionnaire contained questions about the socio-demographic characteristics of the participants, and measures of stress (Physical Stress Reactions and Depression, Anxiety and Stress Scale 21).

The results show that residents of flooded areas showed on average more physical stress reactions ($t(78) = 4.19, p < .01$) and fewer psychological reactions to stress ($t(78) = 5.79, p < .01$) compared to residents of non-flooded areas. Participants affected by the pandemic and earthquake on average showed significantly more symptoms of psychological stress, especially depression and anxiety compared to participants unaffected by these crises ($t(78) = 2.96 - 5.46, p < .01$), while the difference in the intensity of physical symptoms did not appear.

The obtained results are difficult to interpret due to the interference of three crisis events and factors that may have influenced the results. However, this specific and unplanned research situation leads to the conclusion that crisis events have a significant stressful impact and consequences on the physical and mental health of the affected population.

Keywords

stress, health, flood, earthquake, COVID-19

1. Introduction

Although they seldom reach national and global proportions, global catastrophes occur on average every day (Norris et al., 2006). Disaster is universally defined as: “The widespread disruption and damage to a community that exceeds its ability to cope and overwhelms its resources.” (Mayner & Arbon, 2015, p. 24). Such events can simultaneously affect many people and have high stressful potential which may include the threat of losing one's life and physical integrity, exposure to death and dying of others, great losses, grief, disruption of society and community, and long-term hardship (Norris et al., 2002).

Although not usually perceived as dangerous and dramatic as earthquakes, tsunamis, or forest fires, floods account for almost half of the world's disasters and are took the largest number of human casualties (Du et al., 2010). Floods are characterized by temporary water coverage of land not otherwise covered by water, caused by overflows of rivers, torrents, temporary watercourses, lakes, and ice accumulation, as well as seawater in coastal areas and excess groundwater (*Zakon o vodama*, 2019). According to the time, dynamics and manner of water wave formation, we distinguish between calm, torrential, and accidental floods (Abbott, 2011; Toth et al. 2011).

Floods bring numerous interdependent risks around the world. Some of the well-known are: contact with floodwaters, toxins exposure, pathogens and biological hazards, drinking water and food supply interruption, health system and sanitation disruption, endangering livelihoods and property, forced relocation and the like. The consequences on physical health caused by flood risks are numerous - injuries, drowning, respiratory, gastrointestinal, skin and eye diseases, water- and vector-borne infectious diseases and zoonoses, and malnutrition are some of the most frequently recorded (Few, & Matthies, 2013; Paterson et al., 2018; Saulnier et al., 2017; Tapsell et al., 2002). The long-term health consequences of floods may occur months and years later including disability, mental health problems, and health problems related to impaired socio-economic status (Du et al., 2010). In the post-flood years hypertension, diabetic disorders and diseases, and adult dermatitis exacerbate, as well the malnutrition and stunting of the children (Saulnier et al., 2017), and these disorders may be physical signs of stress. All these risks, deteriorating living conditions, lack of appropriate treatment, and deteriorating physical health can also affect mental health (Bich et al., 2011). Post-traumatic stress disorder, anxiety, and depression can occur and persist for months, and sometimes years after a flood (Hajat et al., 2005). Although most people pass without major psychological and physical consequences, the negative long-term and significant effects of disasters on physical and mental health are possible (Nasir et al., 2012).

Psychological stress is a specific relationship between a person and the environment that a person considers too demanding or exceeds his resources and endangers his well-being (Lazarus & Folkman, 2004). Therefore, it is obvious that floods and their consequences abound in stressful stimuli that can cause stress and thus further endanger human mental and physical health. Often such stress, observed at an individual level, takes over the proportions of a psychological crisis. In psychological terms, a crisis event can be described as a sudden and/or rare event that most people find extremely disturbing and stressful, and which includes the experience of losing or threatening possible loss of persons, things, or values important to an individual and/or group (Ajduković, 2001). Such an event can affect an individual, a group of people, or the entire organization, and, typically, people feel that their usual coping mechanisms cannot overcome the crisis on their own (Ajduković, 2001). An important difference compared to crises and disasters in a broader sense is that a psychological crisis can be observed at the individual level, while from a crisis management perspective crisis is an event that affects more people and the community does not have adequate resources to overcome it.

This paper intends to supplement the existing knowledge about the stressful impact of floods on human physical and mental health with the information gathered from the originally designed research and data available from the literature.

2. Problems and Hypotheses

This paper aims to investigate whether a flood as a crisis event has a stressful impact on the physical and mental health of the affected population, which will manifest in the form of an individual physical and mental symptoms.

For this purpose, the following research problems were formulated:

1. To examine the difference in the intensity of physical reactions to stress between the sample of the population of the flood-affected area and the sample of the population of a similar area not affected by this crisis.
2. To examine the difference in the frequency of psychological reactions to stress between the sample of the population in the flood-affected area and the sample of the population of a similar area not affected by this crisis.

Based on the data from the available literature presented in the introduction, the following hypotheses were formulated:

H1: It is expected that the residents of the flood-affected area will show stronger physical reactions to stress on average, compared to the residents of the similar area not affected by the floods.

H2: It is expected that the residents of the flood-affected area will show on average more psychological reactions to stress than residents of the similar area not affected by the floods.

3. Method

3.1. Characteristics of the Crisis Event

The area of Velika Gorica and its surroundings are located in valleys on soil suitable for floods due to the proximity of the Odra River and the Sava-Odra discharge canal (Hrvatske Vode, 2014; Vlada Republike Hrvatske, n.d.). The record rains in September 2010 in Slovenia rapidly increased the flow of the Sava River, which caused floods in Croatia. About 35 km² and 600 residential buildings in the Velika Gorica area were affected. The surrounding villages of Bukeyje and Čička Poljana were the hardest hit. The peak of the flood occurred in mid-September after which water in most of the floodplain began to recede gradually. An elderly person from the village of Črnkovec was killed, and the material damage was estimated at around 11 million USD. In addition to the damage to family houses, shops and other service industries, farmers, and beekeepers also suffered enormous damage or destruction (*Poplave Save u rujnu 2010.*, 2021; Vlada Republike Hrvatske, 2010). This crisis event heavily affected the inhabitants and it can be assumed that it left consequences on their physical and mental health. Apart from the direct stressful impact of the event and its consequences in the following weeks, almost every year thereafter in this area a constant fear of re-flooding was present, and unfortunately turned out to be justified as the floods recurred in April 2013 and February 2014. Not until 2020, does the construction of the embankment start, which should protect this area from new floods in the future.

3.2. Participants

The research included a total of 80 participants, of which 38 residents from flood-affected areas (Čička Poljana and neighboring towns) and 42 participants from the nearby non-flooded area of Velika Gorica who served as a control group. Velika Gorica and the area of Čička Poljana are about 12 km apart. Table 1 shows the characteristics of the participants in both samples and their average scores on the used measures for mental and physical stress symptoms. Of the total number of participants, half were male, and half were female. Most of the participants, a total of 40, were between 18 and 30 years old. According to the education level, most of them (51) have secondary education, while a smaller number of them (8) have completed lower education.

Table 1. The sociodemographic characteristics of the participants from the flooded and non-flooded areas and their average scores on the applied stress measures

Characteristic	Non-flooded area (Velika Gorica)		Flooded area (Čička Poljana)	
	<i>n</i>	%	<i>n</i>	%
<i>Age</i>				
18-30	17	44.8	23	54.9

31-50	12	31.6	13	31.2
51 and more	9	23.6	6	14.4
<i>M (SD)</i>	36.95 (15.3)		33.19 (15)	
<i>Gender</i>				
Female	18	47.4	22	52.4
Male	20	52.6	20	47.6
<i>Education level</i>				
primary	2	5.3	6	14.3
secondary	26	68.4	25	59.5
high	10	26.3	11	26.2
<i>Total</i>	38	100	42	100
Stress measures	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
<i>PSR</i>	80.9	13.07	117.98	53.09
<i>DASS 21</i>	30.82	4.75	20.74	9.73
Depression	11.18	2.02	7.02	6.11
Anxiety	8.08	2.63	6.41	3.42
Stress	11.55	1.72	7.31	3.07

M = mean; *SD* = standard deviation; *n* = group sample size; *PSR* = Physical Stress Reactions; *DASS21*= *Depression, Anxiety and Stress Scale -21* (Lovibond & Lovibond, 1995)

3.3. Instruments and Materials

The research was conducted with an anonymous field survey, and an online survey distributed through personal contacts and social networks.

The survey contained questions about the socio-demographic characteristics of participants (gender, age, education level, and residence) and existing questionnaires as measures of physical stress reactions, and psychological reactions to stress (depression, anxiety, and distress). Available Croatian versions of the questionnaires were used.

Physical Stress Reactions (PSR) is a list of 32 common bodily stress reactions or symptoms that may occur in stressful situations as cited in the literature (Taylor & Asmundson, 2004) such as cardiovascular activity, pain, cramps, and feelings of restlessness. Each symptom was in addition assessed by participants on an eleven-point scale from 0 (“I don’t have that reaction”) to 10 (“I bother me extremely”). The self-assessment is not related to a specific period but examines the general physical symptoms of stress during the stressful event and after it has passed, which is pointed out in the instructions. The total result was obtained by summing the points of all individual answers. The reliability of the measure was $\alpha = .86$ (Cronbach).

Depression, Anxiety and Stress Scale 21 [DASS-21, (Lovibond & Lovibond, 1995)] measures the incidence of unpleasant emotional states of depression, anxiety, and stress during the last week. The result can be expressed in the three subscales of the same name. Each subscale consists of 7 items that describe the symptoms typical of these three conditions. The task of the participants is to assess how much each statement referred to him in the last week on a scale from 0 (“Did not apply to me at all”) to 3 (“Applied to me very much or most of the time”). The result of each subscale is obtained as the sum of the results of the corresponding items and ranges from 0 to 21. The total score on the scale is obtained by summing the scores

of three subscales and ranges from 0 to 63. The reliability of the scale on the present sample was $\alpha = .69$ (Cronbach).

3.4. Procedure

The survey was conducted in March and April 2020. Participation in the study was anonymous and voluntary. The purpose of the research and the rights of the participants were clearly explained to them, especially the right to withdraw from the research at any time, the right to feedback, and the data protection procedure. All participants in the sample agreed to participate.

At the beginning of the research, the data was collected by the interviewer in the field in the previously flooded area of Čička Poljana and smaller surrounding places and in the nearby area of the city of Velika Gorica which was not affected by the flood. Participants were recruited through the personal contacts of the researchers and the recommendations of other participants. Completed surveys were stored in an envelope which is then sealed until coded in the database.

Unfortunately, the growing epidemic of COVID-19 the Civil Protection Headquarters of the Republic of Croatia (Stožer civilne zaštite Republike Hrvatske, 2020) issued a Decision on measures to limit social gatherings, work in trading and services, sports and cultural events disabled further field data collection. Thus, this was replaced with a customized online survey. The survey was created with the help of the Google Forms application, and the data collected in this way were stored in MS Excel.

3.5. Data Processing

The collected data was entered into a database created in the statistical analysis software SPSS 20.0. for Windows after which statistical analysis was performed. Averages (M) and standard deviations (SD) of used measures were calculated, and samples were compared according to sociodemographic characteristics using a t-test for large independent samples and a chi-square test. The hypotheses were tested with the t-tests for large independent samples. The obtained research results are presented in tables.

4. Results and Discussion

4.1. The Effect of the Floods on Stress Reactions

Before testing the research hypotheses, statistical tests were conducted to determine the differences between the samples in sociodemographic characteristics other than the residence. T-test for large independent samples yield no statistically significant difference in age ($t(78) = 1.12, p > .05$), and chi-square test found no difference in gender ($\chi^2(1) = .201, p > .05$) and level of education ($\chi^2(2) = 1.872, p > .05$) which confirms that these are justifiably comparable groups according to the subject of research.

To answer the first problem and test whether there is a statistically significant difference in the average score on the PSR between the residents of non-flooded and flooded areas, the t-test for large independent samples was conducted (Table 2). The test found that there is a statistically significant difference in the average intensity of physical stress reactions between participants from flooded areas and participants from non-flooded areas ($t(78) = 4.19, p < .01$) and that its effect size is large ($d = .96$). Participants from the flooded areas on average estimated the overall level of stress reactions on the PSR ($M = 117.98, SD = 53.09$) higher than participants from non-flooded areas ($M = 80.92, SD = 13.07$), which confirmed the first hypothesis.

Table 2. T-test values and effect sizes ($df = 78$) in the comparison of the samples of the residents of flooded ($n = 38$) and non-flooded ($n = 40$).

Measure	<i>t</i>	<i>p</i>	<i>d</i>
<i>Age</i>	1.12	> .05	.25
<i>PSR</i>	4.19	< .01	.96
<i>DASS-21</i>	3.97	< .01	1.32
<i>Depression</i>	2.44	< .01	.91
<i>Anxiety</i>	7.51	< .05	.55

<i>Stress</i>	5.79	< .01	1.7
<i>t</i> = <i>t</i> -test values ; <i>df</i> = degrees of freedom; <i>PSR</i> = Physical Stress Reactions; <i>DASS21</i> = Depression, Anxiety and Stress Scale -21 (Lovibond & Lovibond, 1995); <i>d</i> = Cohen's <i>d</i> , effect soze.			

Referring to the second problem, the t-test for large independent samples found a statistically significant difference in the average amount of psychological stress responses expressed on the DASS-21 scale ($t(78) = 5.79, p < .01$). The size effect of this difference was large ($d = 1.32$). However, the direction of the difference turned out to be unexpected. The participants of the control group from the non-flooded areas show on average ($M = 30.82, SD = 4.75$) more psychological reactions to stress than residents of the flooded areas ($M = 20.74, SD = 9.73$). Thus, the second hypothesis was only partially confirmed.

To further investigate the nature of this difference, t-tests for large independent samples also tested the difference on specific psychological reactions (i.e., the subscales of the DASS-21 questionnaire: depression, anxiety, and stress). It turned out that on average the control group had a significantly higher average score than the inhabitants of the flooded areas on all scales, and that these differences had a large effect size for depression and stress, and medium-size for anxiety (Table 2). These differences are fairly and about equally pronounced for the depression and stress symptoms, and somewhat lower for the anxiety symptoms.

Given the significant passage of time since the floods, the long-term health effects such as deteriorating chronic conditions (e.g., asthma) in the community are expected due to trauma exposure but also impaired socio-economic status and thus unhealthy living conditions and adequate health services, and ultimately, mental health problems (Du et al., 2010). It is similar in this sample because some of the physical symptoms included in the PSR may indeed be symptoms of chronic diseases. However, psychological disturbances and disorders such as anxiety, depression, and post-traumatic stress disorder are more likely to persist for such a long period after a flood (Bich et al., 2011; Few & Matthies, 2013; Hajat et al., 2005; Tapsell, 2001). Approximately one-third of those affected usually show long-term psychological symptoms in the long period after a flood (Lamond et al., 2015). A similar result is in the present sample (Table 3). The results of the flooded sample on the DASS 21 subscales categorized according to the recommended cut-off scores for level of severity (Lovibond & Lovibond, 1995), reveal a higher percentage of severe and extremely severe anxiety disturbances (42.9%) and less severe and extremely severe depressive disturbances (12%). However, participants from the non-flooded areas unexpectedly achieved a significantly higher percentage of results in the same severity categories on all subscales and show more symptoms of psychological distress and disturbance than participants from flooded areas. Therefore, other potential causes of such results should be sought.

Table 3. Distribution of the results on the DASS-21 subscales according to the severity of symptoms obtained in the flooded (n = 38) and non-flooded (n = 40) population sample

Symptom severity	depression			anxiety			stress		
	RI	fl	n-fl	RI	fl	n-fl	RI	fl	n-fl
<i>Normal</i>	0 – 4	35.7	0	0 – 3	19	0	0 – 7	50	2.6
<i>Mild</i>	5 – 6	14.2	0	4 – 5	21.4	15.8	8 – 9	28.5	7.9
<i>Moderate</i>	7 – 10	40.5	39.5	6 – 7	16.7	29	10 – 12	19.1	60.5
<i>Severe</i>	11 – 13	9.6	42.1	8 – 9	14.3	31.6	13 – 16	2.4	28.9
<i>Extremely severe</i>	14 +	2.4	18.4	10 +	28.6	23.7	17 +	0	0

RI = DASS-21 reference interval for severity of symptoms (Lovibond & Lovibond, 1995); *fl* = flooded sample; *n-fl* = non-flooded sample

Several factors could explain these results. The most obvious causal factor could be the urban-rural differences between the samples. The examined non-flood sample consists mainly of the urban population, and the flood sample consists of the rural population. Research mostly confirms higher levels of chronic physical illness in rural and remote areas of developed countries (Disler et al., 2020) which is consistent with

our results if we look at physical signs of stress that can also be symptoms of chronic physical illness. However, the direction and characteristics of urban-rural differences may be locally specific and without clear patterns. Rural location affects the availability of health services, emphasizes socio-economic disadvantages, increases the level of personal risks and risks arising from more dangerous environmental conditions, more difficult and physically dangerous working and traffic conditions (e.g. due to travel to the city and non-compliance with traffic regulations) (Smith et al., 2008). Living conditions in the city and the countryside differ which consequently leads to different quality of life. Differences in quality of life are more expressed in less developed countries where the quality of life is perceived as lower in rural areas (Shucksmith et al., 2009). Also, health-related quality of life is poorer in rural areas and may be caused by stress (Oguzturk, 2008). Research also supports our results to some extent when it comes to psychological symptoms of stress because urbanity poses a risk for mental disorders, especially depressive and moderate anxiety disorders (Kovess-Masfety et al., 2005). Therefore, it can be concluded that taking into account urban-rural differences, our results are expected.

However, two unexpected crisis events that occurred during the data collection in this study must be considered as they may have affected the results in several ways and even moderated urban-rural differences. These events are the devastating earthquake (M 5.5.) That affected the area of the city of Zagreb on March 22, 2020. (Markušić et al., 2020) and the global COVID-19 pandemic, which resulted in a lockdown in Croatia in March (Stožer civilne zaštite Republike Hrvatske, 2020).

Quarantine due to the COVID-19 pandemic probably caused people to have a certain level of fear of its consequences. This fear could be heightened by exposure to more contacts in the urban sample. In addition, the urban population could experience quarantine as a greater degree of restriction of personal and civil liberties and thus disruption of everyday quality of life and social contacts compared to the rural population. People in rural areas had significantly greater freedom of movement in a less risky environment, which may have been reflected in symptoms of psychological stress, anxiety, and depression that were more reported in the urban population. Another possible factor that could reinforce these differences is the earthquake, which was felt more significantly in Velika Gorica than in the Čička Poljana area due to its proximity to the epicenter, stronger earthquake experience in taller residential buildings and more likely witnessing potential mass panic in more densely inhabited areas.

There are also some other potential impacts on the results due to urban-rural differences. Among them are ways to cope with stress. It can be assumed that the rural community is much more connected and communicates more than the urban community, which can be a way of ventilating and mitigating stress reactions. Especially communities affected by crisis events, such as floods, develop strong connections, interdependence, altruism, and are more inclined to help each other (Zaki, 2020). One of the reasons why people do not seek help and hide mental problems is the fear of social stigma (Corrigan, 2004; Mojtabai, 2010; Sickel et al., 2014). Mental difficulties can be considered a weakness and result in condemnation and stigmatization of the community, especially in rural areas, while physical difficulties are considered normal and even acceptable to talk about. Therefore, it is likely that participants in the rural sample reported less on mental disabilities and more on physical disabilities compared to the urban sample.

Partially the results may be explained by cultural differences, but also by the multiple traumatizations of the rural sample. It is important to note that the area of Čička Poljana in the 1990s was inhabited mostly by people from Bosnia and Herzegovina who left their houses and property under the threat of war. They have come to rebuild a life in this area, only to face new crises over two decades that have taken away everything achieved.

Given the circumstances, the differences in stress reactions between the population of non-flooded and flooded areas are somewhat expected, however, it is very difficult to distinguish the impact of previous crisis events from the impact of the current stress caused by new crisis events - pandemics and earthquakes.

4.2. The Effect of Earthquakes and the Covid-19 Pandemic on Stress Reactions

Although the comments on the possible impact of earthquakes and pandemics on obtained differences according to hypotheses about the impact of floods on stress reactions are already given, these events created a kind of natural quasi-experiment. These results were worth examining, even though initially the appropriate research problem and hypotheses were not planned and set. In approximately half of the

participants, responses were collected after the earthquake and during the pandemic, and a difference is expected compared to the results of participants whose responses were collected before the earthquake and pandemic.

The earthquake affected and caused the most damage in the Zagreb area, but the ground was tremored also in the city of Velika Gorica and the surrounding area. Also, many citizens work in Zagreb or have relatives or close friends living in Zagreb, so they may have experienced the perception of a threat directly or indirectly. Therefore, it was expected that the stress reactions of the participants could be more expressed after the earthquake and thus mask the obtained result. This particularly refers to psychological reactions that may last for several days (Bergiannaki et al., 2003) to several weeks after the earthquake (Casacchia et al., 2013). Intense acute physical reactions such as increased cardiovascular activity, rapid breathing, and increased sweating are most certainly present during and immediately after the earthquake. But we know this introspectively and retrospectively based on experience because the research of such acute reactions during an earthquake for obvious reasons is not possible.

In addition, such results could be enhanced or masked by the occurrence and spread of the COVID-19 epidemic in Croatia. The COVID-19 pandemic, due to its uncertainty, obscurity, and threat to human health and lives, causes feelings of fear, but even more anxiety, and requires long-term coping mechanisms against immediate defensive reactions (Coelho et al., 2020; Porcelli, 2020), which dominates an immediate feeling of fear accompanied by the so-called fight-or-flight bodily reactions.

To check the possible impact of earthquakes and pandemics on our results, we divided the collected results into the sample collected before the earthquake and the pandemic and the sample collected after the earthquake and during the pandemic (Table 4).

Table 4. The sociodemographic characteristics of the participants whose data were collected before the earthquake and the COVID-19 pandemic and the participants whose data were collected after the earthquake and during the pandemic, and their average scores on the applied stress measures

Characteristic	Before earthquake and pandemic		After earthquake and pandemic	
	<i>n</i>	%	<i>n</i>	%
<i>Age</i>				
18-30	25	56.8	15	41.7
31-50	8	18.2	17	47.2
51 and more	11	25	4	11.1
<i>M (SD)</i>	35.14 (16.98)		34.78 (12.84)	
<i>Gender</i>				
Female	22	50	18	50
Male	22	50	18	50
<i>Education level</i>				
primary	5	11.3	3	8.3
secondary	30	68.2	21	58.4
high	9	20.5	12	33.3
<i>Total</i>	44	100	36	100
<i>Stress measures</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
<i>PSR</i>	92	48.93	110.61	33.58
<i>DASS 21</i>	21.98	9.69	29.86	6.49
Depression	7.55	4.31	10.78	5.48

Anxiety	5.71	3.03	9.03	2.25
Stress	8.73	3.7	10.06	2.4

M = mean; SD = standard deviation; n = group sample size; PSR = Physical Stress Reactions; DASS21 = Depression, Anxiety and Stress Scale -21 (Lovibond & Lovibond, 1995)

First, the chi-square test was performed to check whether there was a significant difference in the share of flood-affected participants in both samples (before and after) and it yielded that this number is about equal ($\chi^2(1) = .89, p > .05$). Then additional chi-square tests were performed to check whether there was a difference between the two samples by gender ($\chi^2(1) = 0, p > .05$), and education ($\chi^2(2) = 1.73, p > .05$), and t-test for the difference by age ($t(78) = .11, p > .05$). All tests proved to be statistically insignificant and the comparison of these two samples according to stress measures is justified. Thus, a series of t-tests were used to compare results on stress measures between two groups of participants - collected before and after the earthquake and lock-down due to the COVID-19 pandemic. The tests showed statistically significant differences in the overall measure of psychological symptoms of stress (total DASS-21 score, $t(78) = 4.17, p < .01$), and in symptoms of anxiety ($t(78) = 5.46, p < .01$) and depression ($t(78) = 2.96, p < .01$) which were more expressed in the participants affected by the earthquake and these differences are characterized by large effect size (Table 5). While for depression the effect size was medium, for anxiety it was large. These tests confirm that the quake may have affected the results. Although the average scores on all used stress measures were higher in the group whose data were collected after the earthquake, the difference in physical symptoms (PSR) was not statistically significant ($t(78) = 1.94, p > .05$). To some extent, this was expected because the data were collected weeks after the earthquake and the acute stress response is predominantly physical and expressed immediately after the stressful event, while later physical effects fade and psychological consequences such as anxiety and fear of possibly repeating events persist. Nasir et al. (2012) well noted that Maslow's hierarchy of needs theory quite explains why psychological problems occur only later. People who have suffered material damage and lost homes first seek to fulfill primary needs - physiological needs and the need for security, while other needs, such as psychological ones, occur only when primary needs are met. That is why in humans we encounter psychological symptoms mostly when the immediate danger passes and in a longer period later when the basic conditions for life are met (food, water, heat, accommodation, etc.). This explanation is applicable to earthquakes, floods, and other disasters as well.

Table 5. T-test values and effect sizes ($df = 78$) in the comparison of the sample whose data were collected before the earthquake and the COVID-19 pandemic ($n = 44$) and the sample whose data were collected after the earthquake and during the pandemic ($n = 36$).

Measure	<i>t</i>	<i>p</i>	<i>d</i>
<i>Age</i>	.11	> .05	.02
<i>PSR</i>	1.94	> .05	.44
<i>DASS-21</i>	4.17	< .01	.96
<i>Depression</i>	2.96	< .01	.66
<i>Anxiety</i>	5.46	< .01	1.24
<i>Stress</i>	1.82	> .05	.42

t = t-test values ; df = degrees of freedom; PSR = Physical Stress Reactions; DASS21 = Depression, Anxiety and Stress Scale -21 (Lovibond & Lovibond, 1995); d = Cohen's d, effect soze.

The obtained differences - increased psychological symptoms of stress, primarily anxiety and depression after earthquakes and during the pandemic can be further explained by the impact of the pandemic and restrictive measures associated with the introduction of lockdown, which is consistent with the literature (Coelho et al., 2020; Hyland et al., 2020; Porcelli, 2020; Rodríguez-Hidalgo et al., 2020). Moreover, if we consider that the COVID-19 pandemic, according to some authors, caused a pandemic of fear, anxiety, and depression (Yao et al., 2020), we could conclude that our results are more significantly affected by the COVID-19 pandemic than earthquakes. However, both events occurred simultaneously and due to the limitations of the research and the lack of relevant data, it is not possible to separate the impacts of these two crisis events.

4.3. Research Limitations

Apart from the already commented influences on the results, unfortunately, this research has other limitations. The current stress reactions, which are presumed to be the cumulative consequence of the floods of ten years ago, have been investigated. Given this, there are possible historical effects on the results of research: maturation of the participants, but also the historical circumstances that affected the community in the same period, such as The financial crisis of 2007–2008. Although the floods in this area have occurred several times in the last decade, a significant period passed since the last one, thus we cannot entirely correlate these results to the floods with certainty.

Other limitations are methodological. Although the results are undoubtedly interesting and significant, they are based on a convenient sample of modest size, which makes it impossible to generalize the results. Part of the data was collected in the field, and part by an online survey, which can have a strictly methodological effect on the results. When it comes to the online sample there is a particular problem of self-selection of participants which undermines the external validity of the results (Fenner et al., 2012).

5. Conclusion

Despite many limitations, the value of this research lies in the fact that it investigates the psychological and health consequences of relatively rare events, which occur even less frequently in the same population in a certain geographical area. The researched population experienced floods, devastating earthquakes, pandemics, and some war casualties. The very nature of such events, which undoubtedly have the characteristics of disasters, does not allow direct and rapid research of such phenomena due to the immediate danger to the target population and researchers.

Although it is not entirely clear how, and in which direction, the results of this research show that crisis events cause stress reactions in people. According to the obtained results, it can be assumed that these reactions are more expressively of a psychological nature (anxiety and depression) than a physical one. Moreover, psychological reactions appear to more likely persist over time since the crisis event, while physical reactions disappear, which is consistent with theoretical knowledge about stress.

This topic, as shown by the results of the research, has great potential for further research to better describe the impact of cumulative and traumatic stress caused by disasters on human mental and physical health. To achieve this goal a broader sample and more precise data collection methodology should be included.

In any case, this research emphasizes the importance of the shortest possible response time and greater flexibility of the often inert research community to gather relevant empirical data on the impact of disasters on human mental and physical health. The development of a research protocol and training of staff and data collection technology would enable research of disasters to be conducted in the shortest possible time from the occurrence, greater validity, and relevance of the collected data.

6. References

Abbott, P. L. (2011). *Natural disasters*. New York: McGraw Hill.

Ajduković, M. (2001). Critical Incidents and Crisis as a Psychological State. In L. Arambašić (Ed.), *Psychological Crisis Intervention* (pp. 35–60). Society for Psychological Assistance.

Bergiannaki, J. D., Psarros, C., Varsou, E., Paparrigopoulos, T., & Soldatos, C. R. (2003). Protracted acute stress reaction following an earthquake. *Acta Psychiatrica Scandinavica*, *107*(1), 18–24.
<https://doi.org/10.1034/j.1600-0447.2003.01467.x>

Bich, T. H., Quang, L. N., Thanh Ha, L. T., Duc Hanh, T. T., & Guha-Sapir, D. (2011). Impacts of flood on health: epidemiologic evidence from Hanoi, Vietnam. *Global Health Action*, *4*(1), 6356.
<https://doi.org/10.3402/gha.v4i0.6356>

Casacchia, M., Bianchini, V., Mazza, M., Pollice, R., & Roncone, R. (2013). Acute Stress Reactions and Associated Factors in the Help-Seekers after the L'Aquila Earthquake. *Psychopathology*, *46*(2), 120–130.
<https://ojs.vvg.hr/index.php/adrs/article/view/207/72>

<https://doi.org/10.1159/000339459>

Coelho, C. M., Suttiwan, P., Arato, N., & Zsido, A. N. (2020). On the Nature of Fear and Anxiety Triggered by COVID-19. *Frontiers in Psychology, 11*. <https://doi.org/10.3389/fpsyg.2020.581314>

Corrigan, P. (2004). How stigma interferes with mental health care. *American Psychologist, 59*(7), 614–625. <https://doi.org/10.1037/0003-066X.59.7.614>

Disler, R., Glenister, K., & Wright, J. (2020). Rural chronic disease research patterns in the United Kingdom, United States, Canada, Australia and New Zealand: a systematic integrative review. *BMC Public Health, 20*(1), 770. <https://doi.org/10.1186/s12889-020-08912-1>

Du, W., FitzGerald, G. J., Clark, M., & Hou, X.-Y. (2010). Health Impacts of Floods. *Prehospital and Disaster Medicine, 25*(3), 265–272. <https://doi.org/10.1017/S1049023X00008141>

Fenner, Y., Garland, S. M., Moore, E. E., Jayasinghe, Y., Fletcher, A., Tabrizi, S. N., Gunasekaran, B., & Wark, J. D. (2012). Web-Based Recruiting for Health Research Using a Social Networking Site: An Exploratory Study. *Journal of Medical Internet Research, 14*(1), e20. <https://doi.org/10.2196/jmir.1978>

Few, R. & Matthies, F. (Eds. . (2013). *Flood hazards and health: responding to present and future risks*. Taylor & Francis.

Hajat, S., Ebi, K. L., Kovats, R. S., Menne, B., Edwards, S., & Haines, A. (2005). The Human Health Consequences of Flooding in Europe: a Review. In M. B. Kirch W., Bertollini R. (Ed.), *Extreme Weather Events and Public Health Responses* (pp. 185–196). Springer-Verlag. https://doi.org/10.1007/3-540-28862-7_18

Hrvatske Vode. (2014). *Karte opasnosti od poplava*. Retrieved July 6, 2021, from. [https://preglednik.voda.hr/?topic=Opasnosti od poplava&lang=hr&bgLayer=hr.raster.tk-crno-bijeli&layers=hr.rpj.granica_rh,hr.fd.podrucja-izvan-potencijalno-znacajnih-rizika-od-poplava,hr.fd.granica-podrucja-potencijalno-znacajnih-rizika-od-poplava,hr.fd.na](https://preglednik.voda.hr/?topic=Opasnosti+od+poplava&lang=hr&bgLayer=hr.raster.tk-crno-bijeli&layers=hr.rpj.granica_rh,hr.fd.podrucja-izvan-potencijalno-znacajnih-rizika-od-poplava,hr.fd.granica-podrucja-potencijalno-znacajnih-rizika-od-poplava,hr.fd.na)

Hyland, P., Shevlin, M., McBride, O., Murphy, J., Karatzias, T., Bentall, R. P., Martinez, A., & Vallières, F. (2020). Anxiety and depression in the Republic of Ireland during the COVID-19 pandemic. *Acta Psychiatrica Scandinavica, 142*(3), 249–256. <https://doi.org/10.1111/acps.13219>

Kovess-Masféty, V., Alonso, J., de Graaf, R., & Demyttenaere, K. (2005). A European Approach to Rural—Urban Differences in Mental Health: The ESEMED 2000 Comparative Study. *The Canadian Journal of Psychiatry, 50*(14), 926–936. <https://doi.org/10.1177/070674370505001407>

Lamond, J. E., Joseph, R. D., & Proverbs, D. G. (2015). An exploration of factors affecting the long term psychological impact and deterioration of mental health in flooded households. *Environmental Research, 140*, 325–334. <https://doi.org/10.1016/j.envres.2015.04.008>

Lazarus, R. S., & Folkman, S. (2004). *Stres, procjena i suočavanje*. Naklada Slap.

Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour Research and Therapy, 33*(3), 335–343. [https://doi.org/10.1016/0005-7967\(94\)00075-U](https://doi.org/10.1016/0005-7967(94)00075-U)

Markušić, S., Stanko, D., Korbar, T., Belić, N., Penava, D., & Kordić, B. (2020). The Zagreb (Croatia) M5.5 Earthquake on 22 March 2020. *Geosciences, 10*(7), 252. <https://doi.org/10.3390/geosciences10070252>

Mayner, L., & Arbon, P. (2015). Defining disaster: The need for harmonisation of terminology. *Australasian Journal of Disaster & Trauma Studies, 19*(Special Issue), 21–25. http://trauma.massey.ac.nz/issues/2015-IRDR/AJDTS_19-IRDR_Mayner.pdf

Mojtabai, R. (2010). Mental illness stigma and willingness to seek mental health care in the European Union. *Social Psychiatry and Psychiatric Epidemiology, 45*(7), 705–712. <https://doi.org/10.1007/s00127->

009-0109-2

- Nasir, R., Zainah, A. Z., & Khairudin, R. (2012). Psychological Effects on Victims of the Johor Flood 2006/2007. *Asian Social Science*, 8(8). <https://doi.org/10.5539/ass.v8n8p126>
- Norris, F. H. , Galea, S., Friedman, M. J., & Watson, P. J. (eds. . (2006). *Methods for disaster mental health research*. The Guilford Press.
- Norris, F. H., Friedman, M. J., Watson, P. J., Byrne, C. M., Diaz, E., & Kaniasty, K. (2002). 60,000 Disaster Victims Speak: Part I. An Empirical Review of the Empirical Literature, 1981–2001. *Psychiatry: Interpersonal and Biological Processes*, 65(3), 207–239. <https://doi.org/10.1521/psyc.65.3.207.20173>
- Oguzturk, O. (2008). Differences in quality of life in rural and urban populations. *Clinical & Investigative Medicine*, 31(6), 346. <https://doi.org/10.25011/cim.v31i6.4920>
- Paterson, D. L., Wright, H., & Harris, P. N. A. (2018). Health Risks of Flood Disasters. *Clinical Infectious Diseases*, 67(9), 1450–1454. <https://doi.org/10.1093/cid/ciy227>
- Poplave Save u rujnu 2010. (2021). Wikipedia. https://hr.wikipedia.org/wiki/Poplave_Save_u_rujnu_2010.
- Porcelli, P. (2020). Fear, anxiety and health-related consequences after the -19 epidemic. *Clinical Neuropsychiatry: Journal of Treatment Evaluation*, 17(2), 103–111.
- Rodríguez-Hidalgo, A. J., Pantaleón, Y., Dios, I., & Falla, D. (2020). Fear of COVID-19, Stress, and Anxiety in University Undergraduate Students: A Predictive Model for Depression. *Frontiers in Psychology*, 11. <https://doi.org/10.3389/fpsyg.2020.591797>
- Saulnier, D. D., Brolin Ribacke, K., & von Schreeb, J. (2017). No Calm After the Storm: A Systematic Review of Human Health Following Flood and Storm Disasters. *Prehospital and Disaster Medicine*, 32(5), 568–579. <https://doi.org/10.1017/S1049023X17006574>
- Shucksmith, M., Cameron, S., Merridew, T., & Pichler, F. (2009). Urban–Rural Differences in Quality of Life across the European Union. *Regional Studies*, 43(10), 1275–1289. <https://doi.org/10.1080/00343400802378750>
- Sickel, A. E., Seacat, J. D., & Nabors, N. A. (2014). Mental health stigma update: A review of consequences. *Advances in Mental Health*, 12(3), 202–215. <https://doi.org/10.1080/18374905.2014.11081898>
- Smith, K. B., Humphreys, J. S., & Wilson, M. G. A. (2008). Addressing the health disadvantage of rural populations: How does epidemiological evidence inform rural health policies and research? *Australian Journal of Rural Health*, 16(2), 56–66. <https://doi.org/10.1111/j.1440-1584.2008.00953.x>
- Stožer civilne zaštite Republike Hrvatske. (2020, March 19). Odluka o mjerama ograničavanja društvenih okupljanja, rada u trgovini, uslužnih djelatnosti i održavanja sportskih i kulturnih događanja. *Narodne Novine*. https://narodne-novine.nn.hr/clanci/sluzbeni/2020_03_32_713.html
- Tapsell, S. (2001). The hidden impacts of flooding: experiences from two English communities. In P. S. Marino, A. M.; Simonovic (Ed.), *Integrated Water Resources Management* (pp. 319–324). International Association of Hydrological Sciences.
- Tapsell, S. M., Penning-Rowsell, E. C., Tunstall, S. M., & Wilson, T. L. (2002). Vulnerability to flooding: health and social dimensions. *Philosophical Transactions of the Royal Society of London. Series A: Mathematical, Physical and Engineering Sciences*, 360(1796), 1511–1525. <https://doi.org/10.1098/rsta.2002.1013>
- Taylor S.; Asmundson, & G.J.G. (2004). *Treating Healt Anxiety: A congitive-behavioral approach*. Guilford Press.

Toth, I.; Čemerin, D., i Vitas, P. (2011). *Osnove zaštite i spašavanja od katastrofa*. Veleučilište Velika Gorica; Visoka škola za sigurnost.

Vlada Republike Hrvatske. (n.d.). *Procjena rizika od katastrofa za Republiku Hrvatsku*. [https://civilnazastita.gov.hr/UserDocsImages/DOKUMENTI_PREBACIVANJE/PLANSKI_DOKUMENTI_I_UREDBE/Procjena rizika od katastrofa za RH.pdf](https://civilnazastita.gov.hr/UserDocsImages/DOKUMENTI_PREBACIVANJE/PLANSKI_DOKUMENTI_I_UREDBE/Procjena_rizika_od_katastrofa_za_RH.pdf)

Vlada Republike Hrvatske. (2010). *Izješće o poplavama 17.-22. rujna 2010. godine*. <https://vlada.gov.hr/UserDocsImages//2016/Sjednice/Arhiva//82-2.pdf>

Yao, H., Chen, J.-H., & Xu, Y.-F. (2020). Patients with mental health disorders in the COVID-19 epidemic. *The Lancet Psychiatry*, 7(4), e21. [https://doi.org/10.1016/S2215-0366\(20\)30090-0](https://doi.org/10.1016/S2215-0366(20)30090-0)

Zaki, J. (2020). Catastrophe Compassion: Understanding and Extending Prosociality Under Crisis. *Trends in Cognitive Sciences*, 24(8), 587–589. <https://doi.org/10.1016/j.tics.2020.05.006>

Zakon o vodama. (2019, July 5). https://narodne-novine.nn.hr/clanci/sluzbeni/2019_07_66_1285.html

Copyright (c) 2022 Annals of Disaster Risk Sciences



This work is licensed under a [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/).