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# When Earthquakes Meet COVID-19 Pandemic: The Effects of Simultaneous Large-scale Crises on Psychological Functioning of Adolescents in the Final Year of Upper Secondary Education

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ABSTRACT A unique situation in which Croatia was struck in 2020 with a series of strong earthquakes during the period of the global COVID-19 pandemic allowed for the exploration of simultaneous effects of two large-scale crises on the adolescents' psychological functioning. Faced with the adversity of crises, most adolescents can cope with one or two risk factors in their lives without significant detrimental consequences. The accumulation of risk factors increases the chance for experiencing psychological distress especially for adolescents who are due to their developmental phase more vulnerable to such traumatic events. Focusing on pupils in the final grade of upper-secondary education, the study examines the extent to which the perceived effects of simultaneous large-scale crises are related to adolescent positive psychological functioning (life satisfaction, well-being, resilience and optimism). Furthermore, it provides insights into the role of school location, damage incurred to homes, personal positive resources

and perception of impact of earthquakes on psychological status in predicting fear of earthquakes. Research was carried on the representative sample of 2,579 upper-secondary pupils. The cumulative negative impact of simultaneous large-scale crises seems to have a greater effect on positive psychological functioning than one threat itself. Consistent with previous research, proximity to epicentre and property damage as objective characteristics of the earthquake and lower levels of resilience proved to be significant predictors of fear. Nevertheless, the perceived impact of earthquakes on adolescents' psychological status seems to have a greater effect on fear, thus emphasizing the importance of subjective evaluations of the traumatic event.

*Key words:* earthquake, pandemic, cumulative crises, adolescence, psychological functioning, fear of earthquakes.

## 1. Introduction

The simultaneous occurrence of large-scale crises alongside material damage has the potential to negatively impact psychological functioning of individuals, including lower levels of well-being and life satisfaction, feelings of loss and fear, helplessness, and disruption of life plans (Davidson & McFarlane, 2006). Beside the objective characteristics of devastating events such as suddenness, strength, scope and duration, the nature and intensity of psychological distress is associated with the personal interpretation of the crises and perception of their impact on one's existence (Ajduković et al., 2016; Karanci & Rüstemli, 1995).

In 2020, the unique incidence of two large-scale crises took place in Croatia when the country experienced a series of strong earthquakes during the initial waves of the COVID-19 pandemic. In response to the global threat of pandemic, the Croatian Government imposed an austere lockdown on the 19th of March 2020, which included stringent social restrictions, school closures and severe limitations to economic and out-of-home activities. New challenges emerged on the 22nd of March 2020, when a 5.5 magnitude (Richter scale) earthquake struck the Croatian capital of Zagreb and caused significant material damage. As the citizens were adjusting to the aftermath of a natural disaster and life under pandemic restrictions, a 6.2 magnitude earthquake hit the continental part of Croatia with an epicentre near the town of Petrinja (Sisak-Moslavina County, 58 km from Zagreb) on the 29th of December, 2020. The occurrence of major earthquakes and aftershocks resulting in several human victims and significant damage to buildings including schools may have had traumatic impact on psychological functioning of citizens, especially those from Sisak-Moslavina County and the City of Zagreb, two administrative units and locations differing significantly in terms of the socio-economic indicators and development potential (Prizmić-Larsen et al., 2023; Vukelić et al. 2022).

Evidence from various contexts suggest that adolescents are among the most vulnerable groups to the impact of natural disasters, such as earthquake and pandemic, here understood as a widespread outbreak of disease affecting all segments of society and life (Williams et al., 2008; Gerstner et al., 2020). Large-scale crises significantly disrupt daily routines, often resulting in absences from formal education, losses in learning and thus impacting adolescents' personal and academic development (Peek, 2008). Furthermore, exposure to crises may result in increased behavioural problems, decreased interest in social activities, sleep and eating disorders, somatic complaints, confusion, or lack of concentration (Peek, 2008; Rusmini, 2020). Both the crisis events themselves and the ensuing uncertainty have the potential to elicit prolonged stress, which can result in a range of mental health issues such as anxiety, depression, or post-traumatic stress disorder (PTSD). The most detrimental effects of an earthquake on psychological functioning are experienced by adolescents who witnessed a death or severe injury to family members, and by those who lost their home or whose homes were severely damaged (Raccanello et al., 2017). Other risk factors include proximity to the epicentre, degree of exposure and absence of material and psychological support in the aftermath of an earthquake (Zhang et al., 2011; Forresi et al., 2020). The COVID-19 pandemic was also accompanied by a diverse range of stressors impacting adolescents' psychological functioning, including concerns for personal health and the health status of significant others, bereavement in the case of the loss of close persons, uncertainty regarding personal educational and career plans, and the loss of private space (WHO, 2022). In various contexts, adolescents experienced social isolation, insecurity, and above all a drastic reduction in experiences important for completing developmental tasks. Reviews of studies on the effects of the COVID-19 pandemic indicated a general increase in mental health issues and a decline in adolescent well-being (e.g. Nobari et al., 2021; Racine et al., 2021).

Evidence indicates that during and after an earthquake, people experience a range of strong emotions, with fear being the most intensive and most frequently reported. Experiencing trauma associated with earthquakes can lead to a loss of a sense of perceived control or predictability in the world, resulting in the amplification of feelings of fear, in which traumatized individuals are afraid of traumatic clues and worry about the re-occurrence of negative events (Zhou et al., 2016). Indeed, earthquakes may have a delayed impact on the emotional processing and psychological functioning of adolescents due to the gradually increased awareness of losses and consequences (Raccanello et al., 2017). Karanci and Rüstemli (1995) found that the majority of earthquake victims claimed to have worries about a potential earthquake even sixteen months after experiencing one. Other studies observed symptoms of PTSD in adolescents living in an earthquake affected area up to ten years after the earthquake, indicating the long-term impact of natural disasters on adolescents' psychological functioning (Rusmini et al., 2020; Nygaard et al., 2016). No studies to our knowledge probed the levels and predictors of adolescents' fear of earthquakes at times of global pandemic.

Research evidence suggests that not all individuals exposed to crises develop adverse psychological outcomes and are prone to fear of earthquakes (Fan et al., 2015), and there is also a potential for experiencing positive change or posttraumatic growth following the crisis (Tedeschi & Calhoun, 2004). A range of personal positive resources are associated with adaptation when facing adversity due to crisis, with resilience and optimism proving to be especially important. Resilience can be described as a multisystemic, dynamic process of successful adaption when facing a risk or threat or a process of overcoming difficulties to a point of functioning better than before (Mesman et al., 2021; Rutter, 2013). Levels of resilience differ significantly across individuals, which results in variation in the successful responses to crises among individuals despite experiencing the same traumatic event (Schultze-Lutter et al., 2016). Resilient individuals exhibit a positive outlook on their surroundings, which helps them to make positive re-appraisals of trauma-related cues and to consider the adverse event less threatening (Zhou et al., 2016). Optimism is one of the internal psychological factors affecting resilience, where more optimistic individuals exhibit more protective attitudes, are resistant to stress and are more inclined to use positive coping strategies (Conversano et al., 2010). However, although optimism is commonly believed to be a protective factor, research indicates that this is not always the case. Segerstrom (2006) proposes two possible explanations for this paradox: 1) the disappointment hypothesis claims that uncontrollable stressors reduce the positive expectations typical for optimists, and 2) the engagement hypothesis claims that more optimistic individuals are easily drawn into trying to resolve a problem and thus end up being more exposed to stress.

### *1.1. Present Study*

When faced with the adversity of crises, most adolescents can cope with one or two risk factors without significant detrimental consequences on their positive psychological functioning. However, the accumulation of risk factors increases the chance for experiencing psychological distress (Peek, 2008). This accumulation may be especially evident in the case of the simultaneous occurrence of large-scale crises, as was the case in continental Croatia in 2020 when sudden local natural disasters (earthquakes) occurred during the period of a prolonged global pandemic crisis. Focusing on pupils in the final grade of upper secondary education as they face a choice of continuing education at the tertiary level or entering labour market, this study aims to provide insights into psychological functioning of adolescents when faced with cumulative effects of two large scale crises. The study is relevant not only as a unique insight in adolescent functioning but also as a basis for general policy and school measures and activities in the case of future crises. In line with this, the following questions were formulated:

1. To what extent are the perceived effects of simultaneous large-scale crises (earthquakes and pandemic) of final-year upper secondary pupils from Sisak-Moslavina County and City of Zagreb related to their positive psychological functioning?

Here, we expect that adolescents experiencing cumulative negative effect of both pandemic and earthquake will exhibit lower levels of life satisfaction, well-being, resilience and optimism and that these effects will be more prominent amongst pupils from a location closer to the epicentre of more powerful and more recent earthquake (Sisak-Moslavina County).

Furthermore, we felt it was important to examine predictors of adolescent fear of earthquakes 6 months following the earthquake in Petrinja, and 15 months following the Zagreb earthquake. In line with that, the present paper aims to answer the following research question:

2. To what extent do factors related to the school location, damage incurred to homes, personal positive resources (resilience and optimism) and perception of impact of earthquakes on adolescents' psychological status predict fear of earthquakes among Croatian final-year upper secondary pupils?

Here, we assume that a more negative evaluation of the impact of the earthquake on psychological status and experienced property damage will predict higher levels of fear of earthquakes. In contrast, higher levels of resilience and optimism are assumed to be protective factors for mitigating this fear. Feelings of fear will be more prominent in the location of earthquake with larger magnitude.

## 2. Method

### *2.1. Participants*

The results presented in this paper come from a large-scale national study examining the effects of the COVID-19 pandemic and earthquakes on the Croatian educational system and pupils' lives. Data collection was conducted in May of 2021 in 81 upper secondary schools (representing 19.9% of all publicly funded upper secondary schools in Croatia). This group of schools constituted a random sample stratified by school location and type of upper secondary programmes offered (VET, gymnasium programmes or both). In each school, all pupils in the finishing grade cohort were invited to participate. The number of pupils in a selected school ranged from 33 to 216, and the average participation rate, calculated as the proportion of pupils participating in the present survey out of the total number of all finishing grade pupils at the school, was 94.7%. For the purposes of this paper, only responses from pupils from the earthquake struck regions of the City of Zagreb and Sisak-Moslavina County were included. This

subsample consisted of 2,579 final-year upper secondary pupils (2,183 from the City of Zagreb and 396 from Sisak-Moslavina County) from 23 schools. This sample represents 24.7% of the total number of pupils in the finishing grade cohort in these two locations, and is representative of all types of upper-secondary education. The sample consisted of equal numbers of male (48.9%) and female (51.1%) pupils, with an average age ranging from 17 (for 3-year programmes) to 19 (5-year programmes) years.

### *2.2. Procedure*

The research was carried out in collaboration with school coordinators who administered the questionnaires face-to-face during school lesson time. The average time of completion was 36 minutes. Ethical principles of research with children and young people were fully respected. The research received authorisation from the Croatian Ministry of Science and Education and the approval of the Ethics Committee of the Institute for Social Research in Zagreb (no. 03/2021).

### *2.2. Measures*

#### *POSITIVE PSYCHOLOGICAL FUNCTIONING*

#### *Life satisfaction*

Life satisfaction was measured using an originally developed scale with four aspects: personal health, leisure time, self and life in general (e.g. To what extent are you satisfied with your health?). The participants were asked to indicate their degree of satisfaction on a 5-point Likert-type scale (1=*extremely dissatisfied* to 5= *extremely satisfied*). The results of respondents on four items were calculated as an average ranging from 1 to 5. A principal axis exploratory factor analysis was conducted with varimax rotation yielding a single factor solution explaining 65.85% of the variance with good reliability levels (Cronbach α=.82). Bartlett's test of sphericity ($\chi^2(6) = 4252.99$, $p < .001$) and the Kaiser–Meyer–Olkin measure (KMO = .76) verified the sampling adequacy for the analysis.

#### *Well-being*

Well-being was assessed using the *Mental Health Continuum-Short Form* (Keyes et al., 2008). This 14-item instrument measures emotional (e.g. *"During the past month, how often did you feel happy"*), psychological (e.g. *"During the past month, how often did you feel that your life has a sense of direction or meaning to it"*), and social (e.g. *"During the past month, how often did you feel that people are basically good"*) well-being. The participants responded on a 7-point scale (from 0=*never* to 6=*every day*). Total well-

being score was calculated by summing scores on all items, yielding a total possible score ranging from 0 to 70. The scale demonstrated very high reliability level (α=.*94*).

### *Resilience*

Resilience was measured using the 10-item Connor-Davidson Resilience Scale (CD-RISC-10; Connor and Davidson, 2003). This unidimensional scale has adequate psychometric properties appropriate for use within different cultures, including Croatia (Connor & Davidson, 2003; Pačić-Turk et al., 2020). Each item is rated on a 5-point scale from *not true at all* (0) to *true nearly all time* (4). The total possible score ranges from 0–40. A principal axis exploratory factor analysis was conducted with varimax rotation yielding a single factor solution explaining 56.39% of the variance with high levels of reliability (Cronbach α=.91). Bartlett's test of sphericity ($\chi^2(45) = 38715.05$, $p < .001$) and the Kaiser–Meyer–Olkin measure (KMO = .94) verified the sampling adequacy for the analysis.

### *Optimism*

Dispositional optimism was assessed using Optimism subscale of the *Life Orientation Scale - Revised* (Scheier et al., 1994). This three-item self-report measure assesses generalized expectancies for positive outcome (e.g. *"In uncertain times, I usually expect the best"*). Each statement is rated on a 5-point Likert-type scale (1=*doesn't apply to me at all* to 5=*applies to me completely*). A principal axis exploratory factor analysis of complete bi-dimensional scale was conducted with varimax rotation yielding two-factor solutions (optimism and pessimism) explaining 67.07% of the variance with adequate levels of reliability (Cronbach α=.78 for optimism). Bartlett's test of sphericity ($\chi^2(15) = 12676.26$, $p < .001$) and the Kaiser–Meyer–Olkin measure (KMO = .70) verified the sampling adequacy for the analysis.

## *MEASURES OF THE EFFECTS OF CRISES*

### *Cumulative effect of the COVID-19 pandemic and earthquakes on life*

Cumulative effect of the COVID-19 pandemic and earthquakes on life was measured using two items: "*Please evaluate how the COVID-19 pandemic has affected your life.*" and "*Please evaluate how the earthquakes that hit parts of Croatia in 2020 have affected your life.*". Participants were asked to respond with answers ranging from 1- e*xtremely negative* to 5 – *extremely positive*.

### *Fear of Earthquakes*

A single item (*"Please estimate your current level of fear of earthquakes"*) was used to measure adolescents' current level of fear of earthquakes. Responses were given on a 5-point scale ranging from 1- *very low* to 5 – *very high*.

### *Damage Incurred to the Homes*

A single categorical item was developed to explore the degree of damage incurred to the homes of pupils. Participants were asked: *"Has a home in which you lived prior to the earthquakes that struck Croatia suffered any damage?"* Possible responses were: 1= Home did not suffer any damage (50.6% of participants), 2= Home suffered minor damage (37.3% of participants), 3= Home suffered significant damage, but we did not move out (7.6% of participants), 4= Home suffered significant damage so we temporarily moved out (2.4% of participants), and 5= Home suffered extremely significant damage or was demolished and we had to move out (2.1% of participants).

### *The perceived impact of the earthquakes on adolescent psychological status*

The perceived impact of the earthquake on adolescent psychological status was measured using an originally developed four-item scale focusing on the negative impact of earthquakes on pupils' general mental state, sense of security at home, sense of security at school, and life satisfaction (e.g., *"To what extent have the earthquakes negatively affected your sense of security at home?"*). Participants responded on a 4-point scale ranging from 1=*not at all negatively affected* to 4=*extremely negatively affected*. A principal axis exploratory factor analysis was conducted with varimax rotation yielding a single factor solution explaining 71.98% of the variance with high levels of reliability (Cronbach $\alpha$=.87). Bartlett's test of sphericity ($\chi^2$=5110.93; p<.01) and the Kaiser-Meyer-Olkin measure (KMO=.80) were adequate.

## 3. Results

### *3.1. Cumulative effect of COVID-19 pandemic and earthquakes on adolescents' positive psychological functioning*

Responses of participants on cumulative effect of the COVID-19 pandemic and earthquakes on life are presented in Table 1.

Table 1.
Responses on the items measuring perceived effects of pandemic and earthquakes on life

| | Perceived effect of pandemic | Perceived effect of earthquakes |
|---|---|---|
| | % | % |
| Extremely negative | 16.2 | 19.8 |
| Negative | 41.1 | 31.8 |
| Neither negative nor positive | 35.9 | 43.4 |
| Positive | 5.2 | 3.0 |
| Extremely positive | 1.6 | 2.0 |

51.6% of participants reported negative effects of earthquakes and 57.3% negative effects of pandemic on their lives (*'extremely negative'* and *'negative'* responses). 48.4% of the sample reported non-negative effects of earthquakes and 42.7% non-negative effects on pandemic on their lives (*'neither negative nor positive'*, *'positive'* and *'extremely positive'*). Based on these responses a new categorization with four categories was created by combining responses on both items and used in subsequent analysis (presented in Table 2).

Table 2.
Cumulative effect of pandemic and earthquake on life

| | | Perceived effect of earthquakes | |
|---|---|---|---|
| | | Negative | Non-negative |
| Perceived effect of pandemic | Negative | 35.5 | 21.9 |
| | Non-negative | 16.1 | 26.5 |

In order to examine the extent to which the perceived cumulative effect of large-scale crises are related to adolescents' positive psychological functioning, a two-way multivariate analysis of variance (MANOVA) was conducted. Outcome variables representing adolescent positive psychological functioning were: life satisfaction, well-being, resilience and optimism (all standardized as z-values). Two independent variables were school location (Sisak-Moslavina county and City of Zagreb) and a categorical variable representing cumulative effect of crises. MANOVA indicated a statistically significant main effects of cumulative effect of crises [$F(12,6019.38)=11.58$, $p<.01$; Wilks' $\Lambda=.94$, partial $\eta^2=.02$] and location [$F(4,2275.00)=3.96$, $p<.01$; Wilks' $\Lambda=.99$, partial $\eta^2=.007$] on the combined measure of positive psychological functioning. Interaction effect did not reach a level of statistical significance [$F(12,6019.38)=1.40$, $p=.16$; Wilks' $\Lambda=.99$, partial $\eta^2=.002$].

Univariate ANOVAs revealed statistically significant differences between groups expressing diverse cumulative effect of the pandemic and earthquakes on all outcome

variables: life satisfaction [$F(3,2278)=38.94$, $p<.01$; partial $\eta^2=.049$], well-being [$F(3,2278)=29.48$, $p<.01$; partial $\eta^2=.037$], resilience [$F(3,2278)=10.47$, $p<.01$; partial $\eta^2=.014$] and optimism [$F(3,2278)=5.39$, $p<.01$; partial $\eta^2=.007$]. Estimated marginal means and standard errors on individual dependent variables for each group are presented in Table 3.

Table 3. Estimated marginal means (z-values) and standard errors of cumulative effect groups on the measures of life satisfaction, well-being, resilience and optimism

| | Cumulative effect of pandemic and earthquakes on life | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | E-/P- | | Enon-/P- | | E-/Pnon- | | Enon-/Pnon- | |
| | *M* | *SE* | *M* | *SE* | *M* | *SE* | *M* | *SE* |
| Life satisfaction | -.32 | .041 | .09 | .069 | .16 | .065 | .47 | .066 |
| Well-being | -.30 | .042 | .03 | .069 | .09 | .066 | .41 | .067 |
| Resilience | -.27 | .043 | .06 | .071 | -.02 | .067 | .19 | .068 |
| Optimism | -.14 | .043 | .12 | .072 | .05 | .068 | .11 | .069 |

*Note* E-/P- Negative impact of earthquakes/ Negative impact of pandemic
Enon-/P- Non-negative impact of earthquakes/ Negative impact of pandemic
E-/Pnon- Negative impact of earthquakes/ Non-negative impact of pandemic
Enon-/Pnon- Non-negative impact of earthquakes/ Non-negative impact of pandemic

Separate univariate ANOVAs revealed statistically significant differences between pupils from Sisak-Moslavina County and City of Zagreb only in life satisfaction [$F(1,2278)=9.80$, $p<.01$; partial $\eta^2=.004$; mean z-values were .197 (S-M County) vs. .004 (Zagreb). No statistically significant differences were found on the measures of well-being [$F(1,2278)=2.24$, $p=.13$; partial $\eta^2=.001$], resilience [$F(1,2278)=.52$, $p=.47$; partial $\eta^2=.000$] and optimism [$F(1,2278)=.48$, $p=.49$; partial $\eta^2=.000$].

### *3.2. Predictors of adolescent fear of earthquakes at the time of pandemic*

A three-stage hierarchical regression was conducted to examine the effects of school location, damage incurred to homes, pupils' psychological resources (resilience and optimism) and the perceived impact of earthquakes on adolescent psychological status. An examination of intercorrelations demonstrates that predictors were statistically significantly correlated with fear of earthquakes (Table 4). The multicollinearity analysis suggested the conditions for the regression analysis were met (maximum VIF=1.78).

Table 4.
Correlations of study variables

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| 1. Fear of earthquakes | | -.01 | .07*** | .14*** | .08*** | .11*** | -.19*** | -.08*** | .65*** |
| 2. School location | | | -.06** | -.12*** | -.08*** | -.13*** | .04 | .00 | -.11*** |
| 3. Minor damage | | | | -.22*** | -.12*** | -.11*** | -.03 | -.04 | .11*** |
| 4. Significant home damage, did not move out | | | | | -.04 | -.04 | -.06** | -.07*** | .18*** |
| 5. Significant home damage, moved out | | | | | | -.02 | .01 | .00 | .10*** |
| 6. Demolished home | | | | | | | -.02 | -.02 | .12*** |
| 7. Resilience | | | | | | | | .65*** | -.19*** |
| 8. Optimism | | | | | | | | | -.09*** |
| 9. Perceived impact of the earthquake on psychological status | | | | | | | | | |

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

School location (Sisak-Moslavina County as a reference category) and damage incurred to the homes of pupils were entered at stage one of the regressions to control for the effect of an objective level of experienced distress (the category "no damage" served as a reference category). Positive personal resources of resilience and optimism were entered at stage two. The perceived impact of the earthquake on adolescent psychological status was entered at stage three. The regression analysis statistics are presented in Table 5.

Table 5.
Hierarchical regression analysis of fear of earthquakes

| Variable | *B* | 95% CI for *B* | | *SE B* | β | $R^2$ | Δ $R^2$ |
|---|---|---|---|---|---|---|---|
| | | *LL* | *UL* | | | | |
| Step 1 | | | | | | .062 | |
| Constant | 1.83 | 1.66 | 2.00 | .09 | | | |
| School location | .01 | .00 | .09 | .00 | .05** | | |
| Damage incurred to home | | | | | | | |
| Minor damage | .39 | .28 | .50 | .06 | .15*** | | |
| Significant damage, did not move out | .91 | .71 | 1.11 | .10 | .19*** | | |
| Significant damage, moved out | .97 | .64 | 1.30 | .17 | .12*** | | |
| Demolished home | 1.27 | .91 | 1.64 | .19 | .14*** | | |
| Step 2 | | | | | | .097 | .035 |
| Constant | 2.61 | 2.34 | 2.87 | .14 | | | |
| School location | .01 | .00 | .02 | .00 | .06** | | |
| Damage incurred to home | | | | | | | |
| Minor damage | .37 | .27 | .47 | .05 | .14*** | | |
| Significant damage, did not move out | .86 | .67 | 1.05 | .10 | .18*** | | |
| Significant damage, moved out | .98 | .66 | 1.30 | .16 | .12*** | | |
| Demolished home | 1.28 | .93 | 1.62 | .18 | .14*** | | |
| Resilience | -.34 | -.42 | -.27 | .04 | -.23*** | | |
| Optimism | .12 | .05 | .18 | .03 | .09** | | |
| Step 3 | | | | | | .434 | .338 |
| Constant | .39 | .15 | .63 | .12 | | | |
| School location | .02 | .01 | .02 | .00 | .08*** | | |
| Damage incurred to home | | | | | | | |
| Minor damage | .08 | -.01 | .16 | .04 | .03 | | |
| Significant damage, did not move out | .20 | .05 | .36 | .08 | .04 | | |
| Significant damage, moved out | .30 | .05 | .56 | .13 | .04 | | |
| Demolished home | .50 | .22 | .77 | .14 | .06*** | | |
| Resilience | -.15 | -.20 | -.09 | .03 | -.10*** | | |
| Optimism | .05 | -.00 | .10 | .03 | .04 | | |
| Perceived impact of the earthquake on psychological status | .91 | .86 | .96 | .02 | .62*** | | |

*Note.* N=2452; CI=confidence interval; LL=lower limit; UL=upper limit
*** p < .001 ** p < .01

At the first stage, school location and damage incurred to the homes of pupils contributed significantly to the regression model ($F(5,2446) = 32.32$, $p<.001$) and accounted for 6.2% of the variation in fear of earthquakes. Each of four regression coefficients related to home damage was statistically significant and positive, indicating higher values of fear of earthquake when compared to the reference group. Regression coefficient for school location was statistically significant with pupils from Sisak-Moslavina County responding with higher levels of fear of earthquake.

The addition of resilience and optimism to the model explained a further 3.5% of variation in fear of earthquakes ($F(2, 2444) = 46.83$, $p<.001$). The values of regression coefficients in this model suggests that both resilience and optimism were significant predictors. Higher levels of resilience and lower levels of optimism were associated with lower levels of fear of earthquake. School location and the levels of damage incurred to pupils' homes retained their significance when a set of positive personal resources was added.

Finally, introduction of the perceived impact of the earthquakes on adolescent psychological status to the regression model explained an additional 33.8% of the variation in fear of earthquakes ($F(1,2443) = 1458.26$, $p<.001$). When all independent variables were included in the model, the most salient predictor of fear of earthquakes was the perceived impact of the earthquakes on psychological status. Resilience retained its significance, while optimism was no longer a significant predictor of fear. School location, together with only the highest level of damage incurred to pupils' homes (demolished home) also retained its significance. Together, all independent variables accounted for 43.4% of the variance in fear of earthquakes.

## 4. Discussion

In response to the first research question, our hypothesis was confirmed as adolescents who perceived the effect from both large-scale crises as negative significantly differed from other groups on all examined dimensions of positive psychological functioning, with the largest differences evident in their well-being and general life satisfaction. Contrary to this, participants in the non-negative earthquake/non-negative pandemic effect group had the highest estimations on all measures. The Scheffé post-hoc tests with Bonferroni corrections indicated adolescents in the negative earthquake/ negative pandemic effect group differed from other three categories on all variables, except on resilience and optimism compared to pupils in the non-negative pandemic/negative earthquake effect group. There was no between-group differences among adolescents who perceived effects of only one of the crises as negative. Adolescents in the non-negative earthquake/non-negative pandemic category differed from participants in all other groups except on the measure of optimism, where the significant difference was present only in comparison to negative earthquake/ negative pandemic effect group.

It could be argued that the perceived combined negative effect of dual crises elicits additional pressure and demands on adolescents, consequently reducing their positive psychological functioning, especially those connected with life satisfaction and well-being. This is especially important in light of the argument that adolescents are more vulnerable to traumatic events at this particular developmental stage, during which they must simultaneously deal with various psychosocial changes and developmental tasks (Maeda et al., 2009). Although research efforts on the combined effects of global pandemic and natural disasters are rare, our findings can be related to existing knowledge from the literature that has examined adolescent psychological functioning in relation to natural disasters and pandemic. The findings of the present study are consistent with those who found an inverse association between life satisfaction, well-being and negative life events such as earthquakes (Luechinger & Raschky, 2009; Şekel, 2016; Oishi et al., 2018). Furthermore, numerous studies of the perceived impact of the pandemic among adolescents indicated negative effects on psychological functioning, with resilience and optimism shown to be important protective factors (Nobari et al., 2021, Racine et al., 2021).

There was significant, but small difference between participants from City of Zagreb and Sisak-Moslavina County on the combined measure of positive psychological functioning with the only significant difference being higher levels of life satisfaction in the latter location. These findings should be carefully considered, as the study design did not include measures prior to the earthquakes and pandemic. More important is the finding contradicting our hypothesis, which suggested a lack of differential cumulative effects in the two locations. This is an important finding, as it suggests that the perceived effects of the simultaneous crises were similar and irrespective of the proximity to the epicentre, magnitude and recency of an earthquake.

Whereas our hypothesis regarding the second research question was mostly confirmed, some predictors of adolescent fear of earthquakes were not significant. These results, together with the observation of overall relatively low level of reported fear of earthquake, offer a new and additional contribution to the existing literature in this area. In the first instance, damage caused by earthquakes, regardless of its extent, and school location had a predictive value for fear of earthquakes. However, taken in isolation, these two predictors explained only 6% of the variance in adolescent fear of earthquakes. Oishi et al. (2015) propose a number of reasons to explain why property damage has a detrimental impact on psychological status of adolescents. Firstly, permanent loss of important objects and possessions might be one cause of the prolonged sense of loss and negative affect. Adolescents may feel upset, worry about their family situation, and evaluate the extent to which damage might influence their future. Also, relocation, school displacement, associated changes in everyday life can all exert a negative impact on adolescents. Finally, collapse or damage in one's environments following an earthquake might present various forms of trauma reminders and thus

serve to elicit and maintain a high level of fear (Zhang et al., 2011). Furthermore, attending school in Sisak-Moslavina County, a location with more recent and more powerful earthquake, proved to be a significant predictor of fear thus confirming our hypothesis.

Adding personal psychological resources of resilience and optimism contributes slightly to the prediction of adolescent fear of earthquakes with further 3.5% of variance explained. In line with hypothesis and previous studies, higher levels of resilience predicted lower levels of fear (An et al., 2020; Liu et al., 2021). Individuals with higher levels of resilience tend to experience more positive emotions, even amidst stress and they are more likely to thus use them to their advantage in times of stress (Tugade and Fredrickson, 2004). Resilient people also tend to have better emotion-regulation skills when faced with adversity, which can help them to regulate themselves in the face of negative emotions, reduce feelings of fear and effectively cope with challenges (Zhou et al., 2016; Kalaitzaki et al., 2020).

A somewhat unexpected finding was that pupils with a higher level of optimism reported higher levels of fear of earthquakes. Optimistic people often tend to emphasize the positive aspects of a stressful situation, which can protect them against the psychological effects of crises. While dispositional optimism might be beneficial in adverse times, the associated positive expectations toward the future might be a disadvantage in stressful situations when such positive expectations cannot be met (Fletcher, 2018). In line with the Segerstrom (2006) suggestions it is possible that trauma exposure and the unexpected nature of natural disasters such as earthquakes serve to shake the beliefs of individuals with high dispositional optimism and thus lead them to experience more fear of earthquakes in the future. Experiencing a traumatic event such as an earthquake can lead to a loss of actual control in the post-traumatic world and thus result in a heightened experience of fear. Furthermore, exposure to a traumatic event may provide information about the world that is incongruent with one's assumptions before the trauma, and thus shatter these beliefs (Schuler and Boals, 2016) and elicit a more negative affect.

The final model in our analysis, explaining 43.4% of the variance of adolescent fear of earthquakes, strongly demonstrated the importance of an individual's subjective experience and interpretation of crises in line with Ajduković et al. (2016), where the perceived impact of earthquakes on psychological status had the greatest predictive power for fear of earthquakes. In general, the higher the perceived impact of earthquake, the more intense is the associated feeling of fear. This result emphasises the importance of an individual's perceptions and interpretations. This is congruent with previous research demonstrating that the perceived threat to safety often explains more variance in negative outcomes following an earthquake than objective measures of trauma severity (Gökçen et al., 2013; Pfefferbaum et al., 2008). These results suggest that the

personal interpretation of the traumatic event and ensuing crises becomes a dominant predictor of fear as in this model only the highest level of damage incurred to home remains significant predictor, resilience loses its predictive strength and optimism is not statistically significant predictor of fear.

The present study has several limitations that should be taken into consideration. Firstly, a cross-sectional study design did not allow for establishing a cause-effect relationship among variables, nor provide information about the psychological functioning measures of the participants before the earthquake. Furthermore, although many of the concepts are measured with established and reliable instruments, fear of earthquakes as an outcome was assessed using a single item. Despite the previously mentioned limitations, the current research offers unique insight into the long-term psychological impacts of the earthquakes itself, while also taking into consideration the ongoing pandemic. As such, it represents the rarely researched phenomenon of the impact of double crises or multi-hazard environments on adolescent psychological functioning and fear. The negative effect of simultaneous large-scale crises seems to have a greater impact on psychological functioning than a single threat on its own. The biggest effect is on life satisfaction and well-being of adolescents. Consistent with previous research, school location and property damage as an objective characteristic of the earthquake and personal resilience proved to be a significant predictor of fear. However, the perceived impact of the earthquake on adolescents' psychological status seems to have a greater effect on fear, thus emphasizing the importance of subjective evaluations of the traumatic event. These results, together with previous research in this area, emphasize the importance of much-needed interventions to overcome the negative perceptions of the crises, as well as working through them in order to influence satisfaction and well-being. Schools represent the most appropriate settings for these interventions focusing on the intersection of the both personal and communal effects of large-scale crises and personal and social development of adolescents. Recognition and sharing of emotions and perspectives could be beneficial not only to individuals, but also to wider community.

## DISCLOSURE OF CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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## Appendix

Table A1.
Descriptive statistics of study variables

| Variable | M | SD | Range (Min-Max) |
|---|---|---|---|
| Life satisfaction | 3.72 | .882 | 1-5 |
| Well-being | 49.95 | 16.188 | 14-84 |
| Resilience | 3.51 | .849 | 1-5 |
| Optimism | 3.46 | .939 | 1-5 |
| Perceived impact of the earthquake on psychological status | 2.03 | .858 | 1-4 |
| Fear of earthquakes | 2.27 | 1.258 | 1-5 |

Table A2.
Pupils' responses on variable 'Damage incurred to home' in Sisak - Moslavina County and City of Zagreb

| | Sisak - Moslavina County | City of Zagreb | Total |
|---|---|---|---|
| | % | % | % |
| No damage | 29.2 | 54.2 | 50.4 |
| Minor damage | 44.7 | 36.3 | 37.6 |
| Significant home damage, did not move out | 15.0 | 6.2 | 7.5 |
| Significant home damage, moved out | 5.1 | 2.0 | 2.4 |
| Demolished home | 6.1 | 1.3 | 2.0 |

Izvorni znanstveni rad

# *Kad se susretnu potresi i pandemija COVID-19: Utjecaj istovremenih kriza na psihološko funkcioniranje adolescenata u završnim razredima srednjoškolskog obrazovanja*

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**Sažetak**

Jedinstvena situacija u kojoj je Hrvatsku 2020. godine pogodila serija snažnih potresa tijekom globalne pandemije COVID-19 omogućila je istraživanje istodobnih učinaka dvaju kriza na psihološko funkcioniranje adolescenata. Suočena s nedaćama kriznih situacija, većina adolescenata uspijeva se nositi s jednim ili dva rizična čimbenika bez značajnih štetnih posljedica. Kumuliranje rizičnih čimbenika povećava vjerojatnost doživljavanja psihološkog stresa, posebno kod adolescenata koji su zbog razvojne faze u kojoj se nalaze osjetljiviji na takve traumatične događaje. Usmjeravajući se na učenike završnih razreda srednje škole, u radu se istražuje u kojoj mjeri su percipirani učinci istodobnih kriza povezani s pozitivnim psihološkim funkcioniranjem adolescenata (zadovoljstvom životom, blagostanjem, otpornošću i optimizmom). Osim toga, istraživanje pruža uvid u ulogu školske lokacije, stupnja oštećenja domova, osobnih pozitivnih resursa i percepcije utjecaja potresa na psihološki status u predviđanju straha od potresa. Istraživanje je provedeno na reprezentativnom uzorku 2579 učenika srednjih škola. Kumulativni negativni utjecaj istodobnih velikih kriza čini se da ima veći učinak na pozitivno psihološko funkcioniranje od jedne prijetnje same po sebi. U skladu s prethodnim istraživanjima, blizina epicentra i oštećenje imovine kao objektivne karakteristike potresa te niža razina otpornosti pokazale su se značajnim prediktorima straha. Međutim, veći učinak na strah pokazuje percipirani utjecaj potresa na psihološki status adolescenata, što naglašava važnost subjektivnih procjena traumatičnog događaja.

*Ključne riječi:* potres, pandemija, kumulativne krize, adolescencija, psihološko funkcioniranje, strah od potresa.