

Virtual Reality Supported Intervention Program for Trauma Symptoms of Individuals Who Experienced an Earthquake: An Effectiveness Study

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ABSTRACT

Introduction: This study aimed to develop an effective virtual reality (VR)-based intervention program to improve trauma symptoms of survivors of the 2023 Kahramanmaraş earthquake.

Methods: In line with this aim, the sample of the study consisted of 34 earthquake survivors aged 15–72 years (mean: 38.09, standard deviation (SD): 15.09) who were directly affected by the Kahramanmaraş earthquake on February 6, 2023. A five-stage intervention program (normalization, reinterpretation, creating a safe place, developing problem-focused coping strategies, and social support) was applied to 17 participants (mean: 36.88, SD: 13.65), who constituted the intervention group, using VR technology. All participants assigned to the intervention group received the intervention, which included normalization, reinterpreting the earthquake, creating a safe place, problem-focused coping, and increasing social support, one time in a standardized manner. In the stages of reinterpretation, creating a safe place and problem-focused coping VR technology was used and, the stages of normalization and increasing social support were carried out with psychotherapeutic work involving one-to-one interaction between the researcher and the participant. The five-stage intervention program started to be implemented 51 days after the February 6 Kahramanmaraş earthquakes and all stages of the intervention were completed within seven days. Measurements were taken from the participants at two different times: pre-intervention pre-test and post-intervention post-test. The 17 participants in the control group (mean: 39.29, SD: 16.75) were placed on a waiting list. Data were collected using the “Sociodemographic Information Form”, “Posttraumatic Growth Inventory”, “Scale for Determining the Level of Post-Earthquake Trauma” and “Ways of Coping Scale”.

Results: Before the intervention, the groups were controlled in terms of posttraumatic growth, post-earthquake trauma level, fatalistic coping, social support-seeking coping, and helplessness style coping levels and no difference was observed between them ($p>0.05$). After the intervention, it was found that the posttraumatic growth and social support-seeking coping scores of the earthquake survivors who received VR-supported intervention were significantly higher than the scores of the control group, and the post-earthquake trauma level, fatalistic coping and helplessness style coping scores were significantly lower than the control group scores ($p<0.05$). As a result of the in-group analyses, it is seen that the post-traumatic growth, social support-seeking coping and problem-focused coping scores of the intervention group participants after the VR-supported intervention increased statistically significantly compared to the pre-intervention, while the post-earthquake trauma level, fatalistic coping and helplessness style coping scores decreased statistically significantly compared to the pre-intervention ($p<0.05$). However, it is seen that the scores of the control group participants from all other scales of the Ways of Coping Scale, except for the fatalistic coping subscale, did not change statistically significantly ($p>0.05$).

Conclusion: As a result of the analysis, it is seen that the VR-supported intervention program developed is effective in improving the trauma symptoms of earthquake survivors. The rapid and statistically significant reduction in the trauma levels of earthquake survivors as a result of the developed intervention shows that the relevant intervention can be applied in other trauma areas and suggested for further studies.

Keywords: Earthquake, intervention, normalization, signification, social support, virtual reality

Cite this article as: Kafes AY, Çiller A, Şakiroğlu M. Virtual Reality Supported Intervention Program for Trauma Symptoms of Individuals Who Experienced an Earthquake: An Effectiveness Study. Arch Neuropsychiatry 2024;61:15–23.

INTRODUCTION

On February 6, 2023, at 04:17 and 13:24 with local time, two devastating earthquakes occurred in Pazarcık and Elbistan districts of Kahramanmaraş province, respectively. According to Disaster and Emergency Management Authority (AFAD) data, the intensities of these earthquakes were 7.7 and 7.6. Both of these earthquakes were felt very strongly in an area of 108,812 m² covering 11 provinces. The earthquakes caused more than 50,000 citizens to lose their lives and hundreds of thousands of citizens to be injured in 11 provinces (1). They also affected millions of people indirectly living both in Türkiye and abroad.

Earthquakes are one of the unignorable facts of the world we live in and they are natural events that directly affect human life. On the other hand, earthquakes are natural disasters that cause psychological damage to people who experience, survive and are indirectly exposed to them (2). Earthquakes demonstrate different characteristics from some other traumatic experiences. Particularly, their sudden occurrence affects people's security beliefs towards the world and themselves (3). Psychological effects caused by the earthquake and the severity of difficulties may vary among individuals. Sources of this difference are

Highlights

- Post-traumatic growth level of earthquake survivors can be increased with virtual reality (VR).
- Post-traumatic trauma levels of earthquake survivors can be reduced with VR.
- VR increases social support seeking and problem-oriented coping.
- VR may decrease the use of fatalistic and helplessness style coping.
- VR is an effective intervention in improving acute symptoms in a short time.

variables such as whether the person is prepared for the earthquake, coping methods, personality characteristics, previous experiences, the meaning of earthquake-related losses for the person, social support and history of psychiatric disorders (4). Although these factors affect the severity of earthquake-induced difficulties, some common symptoms are observed in individuals. Fear, frequent thinking about the event, numbness, sleep problems, lethargy, dreaming about the event, dullness, sadness, attention and concentration difficulties, and anger are frequently encountered problems among the early experiences caused by the earthquake (5). In terms of psychological disorders encountered in the long term, it is known that major depressive disorder, acute stress disorder, generalised anxiety disorder and especially post-traumatic stress disorder diagnoses are observed (6). Traumatic experiences cause serious psychological problems in the lives of many individuals. On the other hand, many people who have been exposed to traumatic experiences such as earthquakes may also experience positive psychological changes like psychological adjustment and increased psychological resilience (7). The duration of the emergence of this situation, named as post-traumatic growth, shows differences among individuals. Post-traumatic growth may occur immediately following the traumatic moment or after a very long time (8). The increase in the severity of the traumatic incident affects the emergence time of positive psychological changes after the trauma and causes this change to occur faster (8).

Following the earthquake, psychological interventions to the traumas developed by individuals affected by the earthquake are complicated and complementary interventions. These interventions include normalisation (9), reinterpretation (10), creating a safe space (11), developing problem-focused coping strategies (12) and providing social support (13).

Normalisation

After the disaster, it is necessary for the people to be present in the moment, to continue their lives and to sustain their existence after the disaster. The quality of normalisation activities is directly proportional to the magnitude of the disaster, social disruption and casualties. In this regard; assistance, psychological support and educational activities following the disaster are included in normalisation activities (14). Normalisation can be used in the sense of reactivating the routines of daily life before the earthquake and this may ensure a decrease in earthquake-related stress.

Reinterpretation

When people encounter major disasters, they want to make sense of this situation. In particular, disasters such as earthquakes can cause people's beliefs and views of security towards the world radically (10). In such a situation, the mind can engage in meaning-making activities through re-experiencing. At this point, reinterpretation aims to normalise the reactions of the mind and to reduce the effects of the disaster by

becoming aware of its realities. In particular, studies that increase the sense of trust and that individuals who experience this disaster are not alone, are included in reinterpretation studies (15).

Creating a Safe Space

Working with the trauma of major disasters can be uncomfortable since people are often in a state of alertness and overstimulation. In such cases, individuals are taught certain techniques to relax and control themselves. Creating a safe space is one of these techniques (16). Creating a safe space is to imagine an area where the individual can feel at peace and autonomous, independent of any regulation (17). This way, it is aimed to regulate the emotional states of people easily and generate a feeling of comfort and security in people. When implementing a safe space, it is important to leave the navigation or construction of the space under the control of the person (18).

Problem-focused Coping

People may develop stress and trauma as a result of major disasters. They use different coping strategies to cope with this stress and trauma. Problem-focused coping strategy is the desired coping strategy in people who experience trauma (12). Problem-focused coping strategy is to focus on problem solving ways to reduce or eliminate stress (19). Developing problem-focused coping strategies is an effective method in the process of coping with trauma as well as in the process of growth after trauma. This strategy strengthens social support resources, personal resources and effective coping mechanisms in traumatised individuals (20).

Social Support

The importance of social support for mental health after traumatic events is known (21). Social support is a protective factor especially against post-traumatic stress disorder (22). Having inadequate social resources may lead to an increase in helplessness-themed thoughts and the development of an avoidance-type coping mechanism in people experiencing a traumatic event (23). It is known that people who get adequate social support have high psychological resilience, develop feelings of trust and have lower levels of stress-related physical symptoms (24). In a study conducted after the Marmara earthquake, it was found that the post-earthquake stress levels of individuals who received social support were lower and the trauma levels were lower in parallel (25). There are many studies in the literature that have reached the same conclusion (21–26).

Psychological Intervention with Virtual Reality

Virtual reality (VR) is a technology that allows the user to create replicas of the natural environments that can be controlled in many features and allows the user to actively interact with this environment (27). Its implementation in psychological interventions has become quite widespread in recent years. It is commonly used especially in anxiety-based disorder, however, it is known to have effective results in post-traumatic stress disorder, obsessive-compulsive disorder, eating disorders, alcohol abuse, schizophrenia and depression (28–32). Although VR technology is frequently used for educational purposes related to earthquakes, its use in psychological interventions is also becoming widespread (33–34).

Present study aims to reduce the anxiety and stress levels of people who have experienced the earthquake. For this purpose, it is planned to apply a five-stage intervention (normalisation, reinterpretation, creating a safe space, development of problem-focused coping strategies and social support) to people by using VR technology and to observe the effectiveness of the acute period. We aim that the study will be one of the pioneering studies in our country in reducing the stress and anxiety levels of individuals experiencing earthquake through VR technology.

METHOD

Ethical approval of the study was obtained from Süleyman Demirel University Ethics Committee on 23/03/2023. The document number of the Ethics Committee approval is E-87432956-050.99-469112.

Sample

The sample of the study consisted of 34 earthquake survivors (mean age: 38.09, Standard Deviation (SD): 15.09) who were directly affected by the earthquakes with the epicentre of Kahramanmaraş on February 6, and who met the inclusion criteria among 213 people between the ages of 15–72 who left the disaster area and settled in Aydin Nazilli Municipality student dormitory. The earthquake victims reached through Nazilli Municipality and Nazilli City Council were informed about the study in a conference hall before the study and consent form was presented to 38 volunteers. Four people who did not meet the inclusion criteria were not included in the sample. The inclusion criteria were determined as being directly exposed to the Kahramanmaraş earthquakes, having a score of 52 and above from the Scale that Determines the Level of the Trauma After the Earthquake and having sufficient behavioural control skills to use the VR glasses autonomously. The exclusion criteria were as follows: Having a diagnosis of neurological disorders such as epilepsy and migraine, having a disorder that causes severe visual impairment such as cataracts, having a diagnosis of psychotic disorder or substance abuse disorder that negatively affects the ability to evaluate reality. Thirty-four participants were assigned to the groups by random assignment method considering the equal number of group members. The intervention group consisted of 17 participants between the ages of 15–72 (mean: 36.88, SD: 13.65), while the control group consisted of 17 participants between the ages of 17–72 (mean: 39.29, SD: 16.75). Due to meeting the inclusion criteria and using VR glasses autonomously, participants between the ages of 15–18 at high school level were also included in the study with the consent of their families and themselves. In addition to those who have a kinship relationship between the participants, there are also those who do not know each other. The participants assigned to the control group were informed that they would be contacted later and were placed on the waiting list. There was no loss of participants during the study. The socio-demographic characteristics of the participants are summarised in Table 1.

Research Design

In this study, a randomised experimental research design with pre-test/post-test control group was used. Data were collected from the participants randomly assigned to the groups before and after the intervention and the effectiveness of the intervention used in the study was tested.

Data Collection Tools

Socio-demographic information form

Socio-demographic information form consists of questions prepared by the researchers to gather information about the socio-demographic characteristics of the participants. The form includes questions about the age, education level, socio-economic status, employment status, income level of the participants, as well as questions such as the age of the house they lived in before the earthquake, construction style, and the time of leaving the earthquake zone.

Post-traumatic Growth Inventory

This scale, developed by Tedeschi and Calhoun (1996), was adapted into Turkish by Kağan, Güleç, Boysan and Çavuş (2012) (35–36). The Turkish form of the scale is a five-point Likert-type scale consisting of 21 items. The Turkish version of the scale, the original form of which consists of a 5-factor structure, has a 3-factor structure: change in self-perception, change of life philosophy and change in relationships with others. High scores obtained from the scale show positive psychological change after

the traumatic life event. In this Turkish adaptation study conducted with a sample of 723 people (mean age: 20.19, SD: 2.71), it was reported that the change factor in self-perception of the scale was 0.88, the change factor in philosophy of life was 0.78, the change factor in relationships with others was 0.77 and the Cronbach alpha reliability coefficient of the entire scale was 0.92. The scale explains 64% of the total variance. As a result of the validity analyses, significant positive correlations ranging from 0.93 to 0.53 were reported among the factors of the scale. In summary, as a result of the reliability and validity analyses, it was reported that the Turkish form of the scale met the reliability and validity criteria.

Scale that Determines the Level of the Trauma After the Earthquake

This scale was developed by Tanhan and Kayri (2013) to determine the trauma levels of individuals who experienced an earthquake (37). In the scale development study conducted with 1505 participants between the ages of 15–86 who were affected by the 2012 Van earthquake, a scale consisting of 20 items and 5 factors (behavioural problems, excitement limitation, affective, cognitive structuring, sleep problems) was obtained. It was reported that the scale explained 54.29% of the total variance. It was reported that the behavioural problems factor of the scale had a Cronbach's alpha reliability coefficient of 0.64, the excitability factor 0.75, the affective factor 0.61, the cognitive structuring factor 0.68, the sleep problems factor 0.70 and the whole scale 0.87. Higher scores obtained from the scale indicate a higher level of negative impact from the earthquake. According to the results of the two-stage clustering analysis conducted in the study, it was reported that the 52.38±5.05 point range taken from the scale reflects the threshold value where the earthquake victims are traumatised, and the scores above this range reflect a high trauma level, whereas the scores below this range reflect a low trauma level. In summary, it was reported that the scale which was developed as a result of reliability and validity analyses met the reliability and validity criteria.

Ways of coping scale

This scale, which was first developed by Folkman and Lazarus (1988) to determine which coping method individuals use in stressful situations, was adapted into Turkish by Karancı, Alkan, Akşit, Balta and Sucuoğlu (1999) with 42 items and was used to determine the coping methods of earthquake victims (38–39). In the study of Karancı et al., it was reported that the 42-item scale consisted of a 5-factor structure. It was reported that the Cronbach's alpha reliability coefficient of the three-point Likert-type scale was 0.75 for problem-solving focused coping, 0.78 for fatalistic approach, 0.69 for helplessness approach, 0.59 for seeking social support and 0.39 for avoidance. In summary, Karancı et al. (1999) Turkish form of the scale met the reliability and validity criteria. In this study, the short form of this scale adapted by Karancı et al. (1999) and the factor analysis results of Kesimci's (2003) study were used. Kesimci (2003) defined a 4-factor structure as fatalistic coping, social support-seeking coping, problem-focused coping and helplessness (40). Cronbach's alpha coefficients for the factors were reported as 0.73, 0.61, 0.73 and 0.66, respectively.

Operation

Participants were initially given the Informed Consent Form informing that participation to and completion of the study was voluntary. Then, a questionnaire form including Demographic Information Form, Posttraumatic Growth Inventory, Scale that Determines the Level of the Trauma After the Earthquake and Ways of Coping Scale were given respectively. Oculus Quest 2 (Meta, China) VR glasses were used in the study. The questionnaire form was administered to the participants face to face. Participants who completed the questionnaire form and volunteered to participate in the study were assigned to the intervention

Table 1. Distribution of participants in terms of socio-demographic characteristics

| Variables | | Intervention group | | Control group | | Total | |
|--|----------------------|--------------------|------|---------------|------|-------|------|
| | | n | % | n | % | n | % |
| Gender | Female | 15 | 88.2 | 10 | 58.8 | 25 | 76.5 |
| | Male | 2 | 11.8 | 7 | 41.2 | 9 | 23.5 |
| Age | 15–35 | 6 | 35.3 | 8 | 47.1 | 14 | 41.2 |
| | 36–55 | 9 | 52.9 | 5 | 41.1 | 14 | 41.2 |
| | 56–75 | 2 | 11.8 | 2 | 11.8 | 4 | 17.6 |
| Employment status | Employed | 2 | 11.8 | 7 | 41.2 | 9 | 26.5 |
| | Unemployed | 15 | 88.2 | 10 | 58.8 | 25 | 73.5 |
| Education status | Primary school | 2 | 11.8 | 0 | 0.0 | 2 | 5.9 |
| | Middle school | 6 | 35.3 | 2 | 11.8 | 8 | 23.5 |
| | High school | 8 | 47.1 | 8 | 47.1 | 16 | 47.1 |
| | Associate degree | 1 | 5.9 | 1 | 5.9 | 2 | 5.9 |
| | Licence | 0 | 0.0 | 4 | 23.5 | 4 | 11.8 |
| | Master's degree | 0 | 0.0 | 2 | 11.8 | 2 | 5.9 |
| Marital status | Married | 13 | 76.5 | 10 | 58.8 | 23 | 67.6 |
| | Single | 4 | 23.5 | 7 | 41.2 | 11 | 32.4 |
| Income level | Low | 1 | 5.9 | 2 | 11.8 | 3 | 8.8 |
| | Lower-middle | 2 | 11.8 | 1 | 5.9 | 3 | 8.8 |
| | Middle | 13 | 76.5 | 13 | 76.5 | 26 | 76.5 |
| | Upper | 0 | 0.0 | 1 | 5.9 | 1 | 2.9 |
| Living with | Only spouse | 1 | 5.9 | 2 | 11.8 | 3 | 8.8 |
| | Conjugal family | 11 | 67.5 | 7 | 41.2 | 18 | 52.9 |
| | Extended family | 2 | 11.8 | 3 | 17.6 | 5 | 14.7 |
| | Mother and/or father | 2 | 11.8 | 2 | 11.8 | 4 | 11.8 |
| | Single | 0 | 0.0 | 3 | 17.6 | 3 | 8.8 |
| | Other | 1 | 5.9 | 0 | 0.0 | 1 | 2.9 |
| Experiencing an earthquake before | Yes | 14 | 82.4 | 13 | 76.5 | 27 | 79.4 |
| | No | 3 | 17.6 | 4 | 23.5 | 7 | 20.6 |
| Whose responsibility is it to take precautions | Contractor | 5 | 29.5 | 4 | 23.5 | 9 | 26.5 |
| | Municipality | 1 | 5.9 | 1 | 5.9 | 2 | 5.9 |
| | State | 11 | 64.7 | 11 | 64.7 | 22 | 64.7 |
| | Society | 0 | 0.0 | 1 | 5.9 | 2 | 2.9 |
| Being trapped under rubble | Yes | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| | No | 17 | 50 | 17 | 50 | 34 | 100 |

and control groups using simple random assignment method. We started to implement the 5-stage intervention programme 51 days after the earthquake and all stages of the intervention were completed within seven days. The intervention, which included normalisation, reinterpreting the earthquake, creating a safe space, problem-focused coping and increasing social support, was individually administered to all participants assigned to the intervention group. No complications such as anxiety attacks, nausea, etc. were observed in the participants during the intervention. The content of the interventions applied to the intervention group participants is as follows, respectively:

Normalisation

In this stage, which is the first stage of the intervention programme and allocated 35 minutes, information was obtained from the participants about their ordinary daily activities before the earthquake. Among these activities, the ones that could be carried out in the physical conditions they were in were evaluated together with the researcher and the participant, and the appropriate ones were selected by the participant and the participants were encouraged by the researcher to do these activities. At this stage, which included psychotherapeutic work based on one-to-one interaction with the researcher, VR technology was not used.

Reinterpretation

In this stage, which is the second stage of the intervention programme and allocated 30 minutes, the participants were given information about the scientific causes of earthquakes using visual animations that facilitate imagination through VR technology in order to reconstruct the participants' erroneous understandings about the causes of earthquakes (earthquake happened because of our sinfulness, etc.). At this stage, the interaction between the researcher and the participant was kept at a minimum level because the VR integrated visual animations used at this stage also included standard auditory content and the participant was not distracted. For the VR integrated visual animation content used at this stage, the animation film titled "AFAD Animation Film FLAT" prepared by AFAD was preferred, taking into consideration the criteria of being accessible to everyone and having a scientific content (41).

Creating a safe space

In this stage, which is the third stage of the intervention programme and allocated 25 minutes, four different virtual environments that trigger a sense of trust were presented to the participants using VR technology in order to regulate the participants' earthquake-induced sympathetic nervous system activations and stress reactions, and they were asked to choose the virtual environment in which they felt the safest. Breathing and progressive muscle relaxation exercises were performed in these safe virtual environments. At this stage, the interaction between the



Figure 1. Figures of four different virtual environments presented to the participants.

researcher and the participant was kept to a minimum level since the exercises were implemented through the VR which contains standard auditory instructions. It was aimed that the participant was not distracted. For the virtual environments used at this stage, the virtual environments created by META and integrated into the VR glasses were preferred since they are accessible to every user (42). Visuals of four different virtual environments presented to the participants are presented in Figure 1.

Problem-focused coping

In this stage, which is the fourth stage of the intervention programme and allocated 40 minutes, the participants were taught that there are scientific life-saving measures that can be taken before, during and after the earthquake in order to cope with their helplessness beliefs when they experience an earthquake, and the actions related to how these measures can be applied were taught by using visual animations that facilitate imagination with the help of VR technology. In these animations, the actions people need to take before, during and after the earthquake, such as preparing an earthquake bag before the earthquake, determining the gathering areas, creating a triangle of life during the earthquake, and safe evacuation routes from the building after the earthquake, going to the gathering area, are animated. For the VR integrated visual animation content used at this stage, the animation film titled “Our Mission is Earthquake with Güven Family” prepared by AKUT was preferred, taking into consideration the criteria of being accessible to everyone and having a scientific content (43). The interaction between the researcher and the participant was kept at a minimum level since the VR integrated visual animations used at this stage also included standard auditory content and the participant was not distracted.

Social support

In this stage, which is the fifth and last stage of the intervention programme and allocated 60 minutes, the participants were encouraged to interact socially with people who had experienced earthquakes like them in order to see that they were not alone and to realise that there were others who had experienced similar situations. In conclusion, a social support group was formed by encouraging them to tell each other about their experiences. At this stage, which included psychotherapeutic work based on one-to-one interaction with the researcher and other participants, VR technology was not used.

After the completion of the intervention, post-test data were collected from both the intervention group and the control group participants (seven days after the pre-test data were collected). Following the completion of the data collection process, the control group participants on the waiting list were given training on “ways of coping with earthquake-induced traumatic stress”.

RESULTS

According to the results of the analyses conducted to examine the distribution of the data related to the variables, it is seen that the kurtosis and skewness values of all variables are within the limits of -2 and +2. It is accepted that variables with kurtosis and skewness values within this range meet the assumption of normal distribution. Therefore, it can be said that the variables analysed in this study are normally distributed. The kurtosis and skewness values related to the distribution of the data are summarised in Table 2.

As a result of the analysis conducted to determine whether there was a difference between the intervention and control groups in terms of the variables examined before the intervention, it was seen that there was a statistically significant difference in favour of the intervention group in the problem-focused coping subscale of the Ways of Coping Scale ($p < 0.05$). There was no statistically significant difference between the intervention and control groups in terms of all other variables (post-traumatic growth, post-earthquake trauma level, fatalistic coping, seeking social support, helplessness) except for the problem-focused coping subscale ($p > 0.05$). Therefore, it can be said that the intervention and control groups were equivalent groups in terms of post-traumatic growth, post-earthquake trauma level, fatalistic coping, social support seeking coping and helplessness style coping variables.

As a result of the analysis conducted to determine whether there was a difference between the intervention and control groups in terms of the variables subject to the study after the intervention, it was seen that there was a statistically significant difference between the groups in terms of all variables examined ($p < 0.05$). After the intervention, the scores obtained by the control group participants from the Scale that Determines the Level of the Trauma After the Earthquake, the fatalistic

Table 2. Kurtosis and skewness values for the distribution of data

| Group | Scale | Kurtosis | Standard error | Skewness | Standard error |
|--------------|------------------------|----------|----------------|----------|----------------|
| Intervention | PTGI | 1.96 | 1.06 | -0.83 | 0.55 |
| | SDLPET | -1.16 | 1.06 | -0.52 | 0.55 |
| | Fatalistic coping | -1.35 | 1.06 | -0.34 | 0.55 |
| | Social support search | 0.59 | 1.06 | -0.98 | 0.55 |
| | Problem-focused coping | -0.94 | 1.06 | -0.63 | 0.55 |
| | Helplessness | -0.05 | 1.06 | 0.24 | 0.55 |
| Control | PTGI | 1.19 | 1.06 | 1.11 | 0.55 |
| | SDLPET | -0.86 | 1.06 | -0.17 | 0.55 |
| | Fatalistic coping | 0.40 | 1.06 | 0.58 | 0.55 |
| | Social support search | -0.62 | 1.06 | 0.31 | 0.55 |
| | Problem-focused coping | -0.53 | 1.06 | 1.12 | 0.55 |
| | Helplessness | -1.06 | 1.06 | 0.08 | 0.55 |

PTGI: Post-Traumatic Growth Inventory; SDLPET: Scale for Determining the Level of Post-Earthquake Trauma.

Table 3. Independent sample t-test table according to the scores of the variables before and after the intervention

| | Scale | | n | Mean | Standard deviation | T | Df | P |
|---------------------|------------------------|------------|----|-------|--------------------|-------|----|------|
| Before intervention | PTGI | Experiment | 17 | 61.76 | 13.92 | -0.73 | 32 | 0.47 |
| | | Control | 17 | 65.59 | 16.36 | | | |
| | SDLPET | Experiment | 17 | 67.53 | 15.03 | 0.88 | 32 | 0.39 |
| | | Control | 17 | 62.59 | 17.67 | | | |
| | Fatalistic coping | Experiment | 17 | 30.76 | 5.28 | 1.25 | 32 | 0.22 |
| | | Control | 17 | 28.59 | 4.84 | | | |
| | Social support search | Experiment | 17 | 20.94 | 3.81 | 1.87 | 32 | 0.07 |
| | | Control | 17 | 18.47 | 3.89 | | | |
| | Problem-focused coping | Experiment | 17 | 23.59 | 2.83 | 4.16 | 32 | 0.00 |
| | | Control | 17 | 19.29 | 3.18 | | | |
| | Helplessness | Experiment | 17 | 11.29 | 2.36 | -0.82 | 32 | 0.42 |
| | | Control | 17 | 11.94 | 2.25 | | | |
| After intervention | PTGI | Experiment | 17 | 78.76 | 16.14 | 2.40 | 32 | 0.02 |
| | | Control | 17 | 66.12 | 14.55 | | | |
| | SDLPET | Experiment | 17 | 48.47 | 16.05 | -2.65 | 32 | 0.01 |
| | | Control | 17 | 63.82 | 17.71 | | | |
| | Fatalistic coping | Experiment | 17 | 27.01 | 5.10 | -3.30 | 32 | 0.00 |
| | | Control | 17 | 31.59 | 2.60 | | | |
| | Social support search | Experiment | 17 | 24.59 | 2.37 | 5.02 | 32 | 0.00 |
| | | Control | 17 | 19.82 | 3.11 | | | |
| | Problem-focused coping | Experiment | 17 | 26.59 | 1.01 | 5.90 | 32 | 0.00 |
| | | Control | 17 | 20.53 | 4.11 | | | |
| | Helplessness | Experiment | 17 | 8.94 | 3.63 | -3.61 | 32 | 0.00 |
| | | Control | 17 | 12.59 | 2.03 | | | |

PTGI: Post-Traumatic Growth Inventory; SDLPET: Scale for Determining the Level of Post-Earthquake Trauma.

Table 4. Dependent sample t test table according to pre-test and post-test data related to variables

| | Scale | | n | Mean | Standard deviation | T | Df | P |
|--------------------|------------------------|-----------|-------|-------|--------------------|-------|------|------|
| Intervention group | PTGI | Pre-test | 17 | 61.76 | 13.92 | -4.99 | 16 | 0.00 |
| | | Post-test | 17 | 78.76 | 16.14 | | | |
| | SDLPET | Pre-test | 17 | 67.53 | 15.03 | 3.99 | 16 | 0.00 |
| | | Post-test | 17 | 48.47 | 16.05 | | | |
| | Fatalistic coping | Pre-test | 17 | 30.76 | 5.28 | 4.83 | 16 | 0.00 |
| | | Post-test | 17 | 27.01 | 5.09 | | | |
| | Social support search | Pre-test | 17 | 20.94 | 3.81 | -5.27 | 16 | 0.00 |
| | | Post-test | 17 | 24.58 | 2.37 | | | |
| | Problem-focused coping | Pre-test | 17 | 23.59 | 2.83 | -4.18 | 16 | 0.00 |
| | | Post-test | 17 | 26.58 | 1.01 | | | |
| Helplessness | Pre-test | 17 | 11.29 | 2.36 | 2.32 | 16 | 0.03 | |
| | Post-test | 17 | 8.94 | 3.63 | | | | |
| Control group | PTGI | Pre-test | 17 | 65.59 | 16.34 | -0.10 | 16 | 0.91 |
| | | Post-test | 17 | 66.12 | 14.55 | | | |
| | SDLPET | Pre-test | 17 | 62.58 | 17.67 | -0.38 | 16 | 0.70 |
| | | Post-test | 17 | 63.82 | 17.71 | | | |
| | Fatalistic coping | Pre-test | 17 | 28.58 | 54.86 | -2.27 | 16 | 0.03 |
| | | Post-test | 17 | 31.59 | 2.60 | | | |
| | Social support search | Pre-test | 17 | 18.47 | 3.89 | -1.35 | 16 | 0.19 |
| | | Post-test | 17 | 19.82 | 3.11 | | | |
| | Problem-focused coping | Pre-test | 17 | 19.29 | 3.18 | -0.98 | 16 | 0.33 |
| | | Post-test | 17 | 20.53 | 4.11 | | | |
| Helplessness | Pre-test | 17 | 11.94 | 2.25 | -1.06 | 16 | 0.30 | |
| | Post-test | 17 | 12.59 | 2.03 | | | | |

PTGI: Post-Traumatic Growth Inventory; SDLPET: Scale for Determining the Level of Post-Earthquake Trauma.

coping and helplessness style coping subscales of the Ways of Coping Scale are statistically significantly higher than the scores obtained by the intervention group participants from these scales ($p < 0.05$). However, the scores of the intervention group participants from the Post-Traumatic Growth Inventory, social support-seeking coping and problem-focused coping subscales of the Ways of Coping Scale are statistically significantly higher than the scores of the control group participants from these scales ($p < 0.05$). However, considering that there was a statistically significant difference between the groups in favour of the intervention group before the intervention in terms of the problem-focused coping variable, this statistically significant difference between the groups in terms of the problem-focused coping variable after the intervention cannot be explained by the VR intervention. Therefore, it can be said that the post-traumatic growth and social support-seeking coping scores of the earthquake survivors who received VR intervention were significantly higher than the scores of the control group after the intervention, while the post-earthquake trauma level, fatalistic coping and helplessness style coping scores were significantly lower than the scores of the control group. The results of the analyses of the variables examined before and after the intervention are summarised in Table 3.

Scale that Determines the Level of the Trauma After the Earthquake

As a result of the analysis conducted to determine whether there are intra-group differences in terms of the variables subject to the study, it

is seen that the pre-test and post-test scores of the intervention group participants display a statistically significant difference ($p < 0.05$). After the VR intervention received by the intervention group participants, post-traumatic growth, social support-seeking coping and problem-focused coping scores increased statistically significantly compared to the pre-intervention, while post-earthquake trauma level, fatalistic coping and helplessness style coping scores decreased statistically significantly compared to the pre-intervention ($p < 0.05$). However, it is seen that the scores of the control group participants from all other scales except the fatalistic coping subscale of the Ways of Coping Scale did not change statistically significantly ($p > 0.05$). It is seen that the scores of the control group participants from the fatalistic coping subscale increased statistically in the post-test measurements ($p < 0.05$). While the pre-test and post-test scores of the intervention group from all the variables examined displayed a statistically significant difference, the fact that the control group participants did not demonstrate such a difference in other variables except for the fatalistic coping subscale indicates the effectiveness of the VR intervention. The results of the pre-test and post-test analyses of the variables examined are given in Table 4.

DISCUSSION

When the findings obtained from the study are examined, it is seen that the trauma level of the intervention group decreased significantly compared to the control group. When the scores obtained from the

fatalistic coping and helplessness style coping subscales of the Ways of Coping Scale are examined, it is seen that the scores of the intervention group decreased significantly. In the social support-seeking and problem-focused coping subscales of the same scale, a statistically significant increase was observed in favour of the intervention group. The fact that the intervention group participants appropriately made sense of the disaster they encountered within the scope of the reinterpretation technique, learned appropriate coping strategies and accepted to receive social support from their environment demonstrates that they adopted acceptable coping methods. The finding that people's positive coping styles can be increased with VR technology is important. Here, the fact that VR technology provides 360° visuals and is three-dimensional is thought to be very effective especially for the interpretation step.

When we look at the scores of the Post-Traumatic Growth Inventory, there is a statistical increase in favour of the intervention group. When we look at the factors that contribute to post-traumatic growth, we come across concepts such as social support, coping mechanisms, stress management, emotion regulation and obtaining accurate information (44). The fact that the protocol created is parallel to these concepts explains the increase in post-traumatic growth scores in favour of the intervention group. In literature, findings state that post-traumatic growth is related to problem-focused coping (45). When the problem-focused coping style is strengthened with VR technology, posttraumatic growth can also be expected. When we consider the results of in-group analyses, similar results are observed for the intervention group. It can be said that the applied protocol has positive effects on the development of individuals, reducing their trauma levels, increasing their perception of support, and recovering and strengthening after the trauma experienced.

There are literature findings that the interventions included in the five-stage protocol are effective interventions used in trauma studies. In the study conducted by Chachula and Varley (2022), normalisation study was included in the interventions applied to nursing students with high trauma perception (46). In the study, it was found that normalisation intervention reduced the perception of trauma. In a study conducted by Sarmiento-Marulanda et al. (2021), women who were victims of an armed conflict in Colombia were studied (47). In the study, it was found that the reinterpretation intervention changed the beliefs of the victims about the traumatic event. In the study conducted by Şakiroğlu (2011) with people who experienced the earthquake with the epicentre of Düzce (1999), it was found that the problem-focused coping strategy was effective both in reducing traumatic effects and in post-traumatic growth (45). There are also literature findings that safe space and exercise activities also reduce traumatic effects. In the study conducted by Blake et al. (2020), a digital learning package was developed to reduce the stress and traumatic effects of COVID-19 on health personnel (48). The developed package includes a safe space and exercise intervention, and study findings indicate that the intervention reduces stress and traumatic effects. Again, in a meta-analysis study conducted by Taylor et al. (2020), it was found that awareness-based safe space and exercise interventions reduced traumatic effects ($g=0.45, 0.26$ to $0.64, p<0.001$) (49). Finally, studies on VR intervention in earthquake-related traumas are also available in the literature. In the study conducted by Dünser et al. (2012), it was found that the trauma symptoms of the participants decreased with VR intervention to individuals with earthquake-induced trauma symptoms (50).

In this study, it is aimed to prepare a protocol by bringing together the techniques used in trauma intervention and proven to be effective in the literature. Some of these interventions were aimed to be carried out using technology. In the study, the protocol was applied face-to-face and using VR technology, and as a result, it was concluded that it was effective at the level of trauma and post-traumatic growth.

The study aimed to reduce anxiety, stress and trauma levels of individuals who experienced the earthquake. Within this framework, a five-stage protocol was prepared considering the literature information. VR technology was used in the implementation of this protocol. Studies can be carried out to promote the widespread use of the developed protocol. However, it can be said that utilising VR technology also has a positive effect. The use of VR within the scope of the protocol provided convenience to the participants in terms of visualising the intervention. In addition, it can be said that the imagination difficulties of people who experienced the earthquake and developed trauma had been overcome with VR technology. Future studies can be developed to promote the protocol using of VR technology. It can be thought that a standardised intervention programme to be carried out with VR can make psychological intervention faster and more organised after a possible earthquake in the future. As a result of the intervention, the rapid and statistically significant decrease in the trauma levels of people who experienced an earthquake suggested that interventions with VR could be used in other trauma areas and were recommended for further studies.

Limitations

The sample size can be considered a limitation of the study. The study was conducted only with a group of people who experienced an earthquake in Nazilli district of Aydin province. In addition, the considerable difference between the number of male and female participants in the sample and the low level of education can also be considered a limitation. It may be recommended to include a larger sample group, with equal or close to equal numbers of male and female participants, and participants with higher education levels for further studies. Another limitation is that the participants in the study reside in a dormitory environment, not in a home environment. This situation also caused limitations in the normalisation phase. Being in a home environment could have enabled individuals to enact their activities before the disaster more easily and to fully apply normalisation. Another limitation is that the participants were not asked differentiating questions in terms of the effects of the intervention after the five-stage intervention. In future studies, participants may be asked questions to evaluate the effects of each intervention separately. The last limitation was the software used in the studies. If the software was suitable for the cultural infrastructure of our country, it would have made the study more effective and easier to standardise. In this regard, it can be said that the use of visual spaces identified with our culture is extremely important.

Ethics Committee Approval: Ethical approval of the study was obtained from Süleyman Demirel University Ethics Committee on 23/03/2023. The document number of the Ethics Committee approval is E-87432956-050.99-469112.

Informed Consent: For participants between the ages of 15-18, written informed consent was obtained from both themselves and their families. For participants over 18 years of age, written informed consent was obtained from the participants themselves.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept- AYK, AÇ, MŞ; Design- AYK, AÇ, MŞ; Supervision- MŞ; Resource- AYK, AÇ, MŞ; Materials- (-); Data Collection and/or Processing- AYK, AÇ; Analysis and/or Interpretation- AYK, AÇ, MŞ; Literature Search- AYK, AÇ, MŞ; Writing- AYK, AÇ, MŞ; Critical Reviews- MŞ.

Conflict of Interest: The authors declared that there is no conflict of interest.

Financial Disclosure: No financial support was received.

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