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The relationship between post-earthquake trauma levels and semen quality in adult men: a cross-sectional study from Turkey

Çiğdem Karaca[1,*], Selin Kenan[2], Aliye Bulut[3], Ayşe Gülüşür[2], Şerife Küçükhüyük[1]

[1]Department of Histology Embryology, Gaziantep Islam Science and Technology University, 27010 Gaziantep, Türkiye
[2]Department of Histology Embryology, Gaziantep City Hospital, 27470 Gaziantep, Türkiye
[3]Department of Public Health, Gaziantep Islam Science and Technology University, 27010 Gaziantep, Türkiye

***Correspondence**
cigdem.karaca@gibtu.edu.tr
(Çiğdem Karaca)

Abstract

Background: The study aimed to evaluate the semen quality of male patients who received infertility treatment after the earthquakes using the Post-Earthquake Trauma Level Determination Scale. **Methods**: The Post-Earthquake Trauma Level Determination Scale (PETLDS) was applied to 148 male patients who presented to the Assisted Reproductive Technologies (ART) Center in the 6 months after 06 February 2023, to evaluate the semen parameters. **Results**: The city where the study was conducted had relatively less destruction compared to other cities in the earthquake area, and the average score obtained from the PETLDS among our patients was 39.52 ± 15.75. It was found that, with high post-earthquake trauma levels, behavioral problems ($r = 0.738$, $p < 0.001$), emotional limitation level ($r = 0.842$, $p < 0.001$) and sleep problems ($r = 0.816$, $p < 0.001$) increased, and forward progressive sperm counts decreased ($r = -0.162$, $p < 0.05$), while other semen parameters were not affected. **Conclusions**: It was understood that emotional limitations and sleep problems were more common in individuals with high Post-Earthquake Trauma Levels, the psychological impact was greater, and the physical reflection of stress was also high in these individuals, and this effect could cause a decrease in the number of progressively motile sperm in the male reproductive system.

Keywords

Earthquake; Post-psychological trauma; Semen analysis

1. Introduction

The earthquakes with the epicenter of Kahramanmaraş on 06 February 2023 and felt very strongly in the city of Gaziantep had devastating effects. Based on official figures, 53 thousand people lost their lives, and 107 thousand people were injured in the region. As a result of the damage assessments, it was reported that 35 thousand buildings collapsed, 17 thousand buildings needed to be demolished urgently, 180 thousand buildings were severely damaged, 40 thousand buildings had moderate damage, and 430 thousand buildings had minor damage [1]. The individuals who survived experienced physical and psychological traumas, and for this reason, many families were separated or had to break the unity of the family. Permanent effects such as limb loss and multiple organ damage were observed in many individuals who escaped from under the rubble, and psychological diseases such as depression, anxiety, and Post-Traumatic Stress Disorder were triggered in most earthquake survivors. Studies in the literature show that psychological disorders such as alcohol use, drug addiction, and anxiety increase after devastating disasters [1, 2]. These effects alter fertility and reproductive behavior by changing fertility preferences, impairing access to contraception, increasing exploitation of women and girls, and increasing economic uncertainty [3]. Although some studies reported an increase in fertility following natural disasters because of limited access to reproductive health services and the impact of child mortality, others reported a decline associated with socioeconomic changes and limited access to health services [4–7]. Post-disaster factors such as malnutrition, reproductive tract infections, psychological stress, and economic hardship were also reported to directly or indirectly affect reproductive health. Disasters are often shown to cause reduced fertility, but these events often recover in the years following the event [8].

In men, the most important indicator of fertility is semen parameters. Based on the World Health Organization (WHO) data, semen volume, pH, sperm concentration, total sperm count, motile sperm count, progressively motile sperm count, sperm morphology, agglutination, and semen viscosity are among the data evaluated in semen parameters [9]. These factors are affected by many parameters, from basic factors such as lifestyle, nutrition, age, and race to psychological factors such as stress and anxiety [10–17]. Although it is already known that lifestyle and stress trigger many morphological

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changes in sperm cells, including meiosis errors, and are therefore an additional risk factor for infertility [18]. It has been reported that semen parameters are also negatively affected in war environments where intense stress periods are experienced [19, 20]. Semen parameters will inevitably be affected in natural disasters where intense stress is experienced. In the study conducted after the 2008 Wenchuan Earthquake, it was reported that the loss of life and severe housing damage caused by the earthquakes negatively affected semen quality, which was especially evident in the first year, and this difference was significant in the 2nd and 3rd years [21].

The Kahramanmaraş Pazarcık (7.7) and Elbistan (7.6) Earthquakes that occurred on 06 February 2023, caused many casualties and property losses. It has been reported that the total population of the 11 cities affected by these earthquakes was 14 million, which corresponds to approximately 14% of the total population of Turkey, and for this reason, the earthquakes had devastating psychosocial impacts on a wide geographical area [22]. In this respect, it is important to investigate the physio-pathological impacts of the earthquakes. Based on this information, we aimed to shed light on the effects of the earthquakes on the male reproductive system by performing semen analysis on adult men who presented to the *In Vitro* Fertilization (IVF) Center after the Kahramanmaraş Earthquakes in Gaziantep.

2. Method

The study had a descriptive cross-sectional design. The study population consisted of the men who presented to Gaziantep Cengiz Gokcek Woman Birth and Child Diseases Hospital Assisted Reproductive Treatment Center (ARTC) Clinic within 6 months after the 06 February 2023, earthquakes. The sample included men who wanted to have a spermiogram evaluation, who wanted to receive IVF treatment, and who volunteered to participate in the study. These individuals were reached with the Purposeful Sampling Method. For the adequacy of the sample size, a *Post-Hoc* Analysis was made in the bivariate normal model statistical test with the G*Power 3.1 program (Faul, Erdfelder, Lang, & Buchner, Heinrich Heine University Düsseldorf, Düsseldorf, NRW, Germany). Within the scope of the two-way hypothesis on 148 male participants, the ρ H1 was determined as 0.36, and Power ($1 - \beta$ err prob) was 0.99.

2.1 Inclusion and exclusion criteria

Individuals who received at least one IVF treatment were included in the study, provided that they were literate. Those with cognitive-sensory barriers, psychiatric diagnoses, substance users, and those who attended any psychological support groups were excluded from the study.

2.2 Data collection tools

The data collection tool consisted of two parts. The first part included the Personal Data Collection Form and consisted of 26 questions on socio-demographic data, men's sperm results, and earthquake effects. The second part consisted of 20 questions in the Post-Earthquake Trauma Level Determination Scale.

Post-Earthquake Trauma Level Determination Scale (PETLDS): The scale aimed to measure the trauma levels of individuals after the earthquakes in a culturally sensitive manner using the self-report method. It was developed by Tanhan and Kayri (2013) and consisted of 5 sub-dimensions and 20 items. Behavioral Problems (BP), Cognitive Structure (CS), and Affective (A) dimensions consisted of 4 items, Emotional Limitation (EL) consisted of 5 items, and Sleep Problems (SP) consisted of 3 items. The scale had a 5-point Likert design. The scale was scored as I do not agree at all—1, I slightly agree—2, I moderately agree—3, I very much agree—4, and I completely agree—5. The possible score from the scale was between 20–100 points, and there was no reverse scoring for any item. Increasing scores indicate that the earthquake's influence levels also increase. Tanhan and Kayri reported the Cronbach alpha internal consistency coefficient as 0.64 for BP, 0.75 for EL, 0.61 for A, 0.68 for CS, 0.70 for SP, and 0.87 for all PETLDS items [23]. In this study, Cronbach's alpha internal consistency coefficients were 0.69 for BP, 0.83 for EL, 0.66 for A, 0.75 for CS, 0.86 for SP, and 0.91 for all items of PETLDS.

2.3 Semen sampling and semen analysis

Semen samples were obtained from the patients by masturbation after 2–5 days of sexual abstinence. The semen sample was kept in the incubator until the semen was liquefied (minimum 20 min, maximum 60 min). After the liquefaction stage, the volume of the homogenized semen sample was recorded and evaluated in the Makler Chamber. Sperm concentration, total sperm count, motile sperm count, forward progressive sperm count, *in situ* motile sperm count, and sperm morphology were evaluated and recorded.

2.4 Data analysis

The data of the study were evaluated with the SPSS-26 Version 26.0 (IBM Corp., Armonk, NY, USA) statistics program. Descriptive statistics of continuous variables are shown with mean, standard deviation, minimum, and maximum values, and descriptive statistics of categorical variables are shown with frequency and percentage. Before normality analysis, missing data and extreme value elimination were performed, and histogram drawings were made for compliance with normal distribution. Skewness and kurtosis values were examined, and Kolmogorov-Smirnov analysis was performed, since normality assumptions were not met. The Mann-Whitney U-Test, the Kruskal-Wallis Test, and the Spearman Correlation Analysis were used as statistical analyses. Statistical significance was accepted as $p < 0.05$.

3. Results

The mean age of the participants was found to be 31.99 ± 4.96 (Median: 31.50, Minimum (Min): 22, Maximum (Max): 46) and the mean age of their spouses was 28.99 ± 5.41 (Median: 28.00, Min: 20, Max: 47). Some descriptive characteristics of the participants in terms of sociodemographic data are given in Table 1, some descriptive characteristics of their reproductive characteristics are given in Table 2, and some descriptive characteristics of their earthquake stories are given in Table 3.

TABLE 1. The distribution of the socio-demographic descriptive characteristics of the participants (N = 148).

Variables	Characteristic	n	%
Education situation			
	Primary school	21	14.2
	Middle school	47	31.8
	High school	50	33.8
	University	30	20.3
Spouse's education situation			
	Primary school	35	23.6
	Middle school	40	27.0
	High school	39	26.4
	University	34	23.0
Working status			
	Yes	145	98.0
	No	3	2.0
Spouse's working status			
	Yes	22	14.9
	No	126	85.1
Profession			
	Employee	99	66.9
	Officer	24	16.2
	Free Job	24	16.2
	Unemployed	1	0.7
Social security status			
	Yes	122	82.4
	No	26	17.6
Income status			
	Income < expenses little	61	41.2
	Income = expenses	72	48.6
	Income > expenses	15	10.1
Residence			
	City	104	70.3
	District	29	19.6
	Village	15	10.1
Family type			
	Elementary family	112	75.7
	Extended family	36	24.3

TABLE 2. The distribution of the descriptive characteristics of the participants regarding reproductive characteristics (N = 148).

Variables	Characteristics	n	%
Are there people in your family or your spouse's family who are infertile?			
	Yes	8	5.4
	No	140	94.6
Who supports you regarding the treatment you are receiving?			
	Family	83	56.1
	Spouse's family	7	6.9
	Relatives	7	6.9
	Friends	4	4.1
Is the support you receive from your close circle sufficient?			
	No	39	26.4
	Insufficient	29	19.6
	Sufficient	80	54.0

TABLE 3. The distribution of the descriptive characteristics of the participants regarding earthquake stories (N = 148).

Variables	Characteristics	n	%
Which city/district were you in during the earthquakes?			
	Gaziantep	134	90.5
	Kilis	2	1.4
	Adiyaman	3	2.0
	Kahramanmaraş	5	3.4
	Elazig	1	0.7
	Hatay	3	2.0
Where do you live now?			
	House	142	95.9
	Tent City	2	1.4
	Container	3	2.0
	At a relative's house	1	0.7
Did you lose any loved ones in the earthquakes?			
	I did not lose	111	75.0
	Mother/Father	4	2.7
	Brother	3	2.0
	Aunt/uncle/aunt/uncle	5	3.4
	Cousins	6	4.1
	Close friend/neighbor	13	8.8
	Other	6	4.1
Did you face material losses in the earthquakes?			
	Yes	56	37.8
	No	92	62.2

TABLE 3. Continued.

Variables	Characteristics	n	%
Were you under debris in the earthquakes?			
	Yes	2	1.4
	No	146	98.6
Did you face any health problems after the earthquakes?			
	Yes	6	4.1
	No	142	95.9
How do you feel now?			
	Happy	6	4.1
	Unhappy	34	23.0
	Neutral	52	35.1
	Tired	11	7.4
	Desperate	12	8.1
	Panic	33	22.3
Did you receive any social support after the earthquakes?			
	Yes	9	4.1
	No	139	93.9

The average number of years of marriage of the participants was 5.89 ± 4.07 (Median: 5.00, Min: 1, Max: 23), the average number of years of not having children was 5.25 ± 4.02 (Median: 4.00, Min: 0, Max: 23) and the average number of years of infertility treatment was 2.75 ± 2.94 (Median: 2.00, Min: 0, Max: 18).

Participants were asked to define the earthquakes with one word, and 29.7% (44 people) said scary, 11.5% (17 people) said frightening, 14.2% (21 people) said disaster, 14.2% (21 people) said apocalypse, and 30.4% (45 people) said catastrophe. All participants stated that they did not lose any limbs after the earthquakes.

It was found that 90.5% of the participants were in Gaziantep City during the earthquakes, 95.9% stayed in their own homes after the earthquakes, only 4.1% stayed in shelters such as tent cities and containers, 75% of the participants did not suffer any loss of relatives in the earthquakes, and 37.8% of the participants only suffered financial loss. The fact that the losses in our city center were less compared to other cities supports our results (Table 3).

The distribution of participants' PETLDS and sub-dimension scores and descriptive characteristics of sperm characteristics are given in Table 4.

The distribution of some characteristics of the participants on PETLDS and total sperm count is given in Table 5. There were significant differences between the variables "where the participant currently lives" (p = 0.044), "how s/he feels" (p = 0.001), "whether s/he received any support after the earthquakes" (p = 0.041), and the PETLDS median values, but the differences were not found to be significant for the total sperm count. On the other hand, the variable "Are there any infertile people in your family or your spouse's family?" created a statistically significant difference in the total sperm count (p = 0.005) but did not create a significant difference between the PETLDS median values (Table 5).

Table 6 shows the correlations between various demographic and clinical characteristics of the participants, such as age, duration of marriage, duration of infertility, and duration of infertility treatment, and the Post-Earthquake Trauma Level Determination Scale (PETLDS) and semen quality parameters (semen volume, sperm count per milliliter, total progressive motile sperm count, total progressive motile sperm density, and total sperm count).

Based on the data calculated using Spearman Correlation Coefficients, a linear relationship was found between the age of the individuals and their duration of marriage ($r = 0.511$, $p < 0.001$), duration of infertility ($r = 0.474$, $p < 0.001$), duration of infertility treatment ($r = 0.212$, $p < 0.001$), level of emotional limitation ($r = 0.177$, $p < 0.05$) and sleep problems ($r = 0.183$, $p < 0.05$) (Table 6).

TABLE 4. The descriptive characteristics of the participants' PETLDS, sub-dimension scores, and sperm characteristics (N = 148).

Scale	Mean ± SD	Min–Max	IQR
BP	6.29 ± 2.83	4.00–16.00	4.00
EL	8.73 ± 4.62	5.00–25.00	6.00
A	9.47 ± 3.86	4.00–20.00	5.00
CS	9.50 ± 4.49	4.00–20.00	6.00
SP	5.52 ± 3.46	3.00–15.00	5.00
PETLDS	39.52 ± 15.75	20.00–96.00	18.75
Semen Volume (mL)	3.17 ± 1.63	0.3–8.0	2.0
Number of sperms per milliliter (million)	57.28 ± 65.36	0.0–600.0	71.5
Total Progressive Motile Sperm Count (TPMSC) (million)	91.54 ± 134.48	0.0–1188.0	4.44
TPMSC/Semen Volume = TPMSC Density (million/mL)	27.39 ± 30.10	0.0–198.0	39.1
Total sperm count (million)	185.75 ± 323.52	0.0–3600.0	203.3

BP: Behavior Problems; EL: Emotional Limitation; A: Affective; CS: Cognitive Structure; SP: Sleep Problems; PETLDS: Post-Earthquake Trauma Level Determination Scale; IQR: Interquartile Range; Min: Minimum; Max: Maximum; SD: Standard Deviation.

TABLE 5. The distribution of the characteristics of the participants on the post-earthquake trauma level determination scale and total sperm count (N = 148).

Variables	Characteristics	PETLDS Median (IQR)	Test Value	TSC Median (IQR)	Test Value
Age (yr) range					
	Between 22–30	36.00 (18.00)		142.00 (204.5)	
	Between 31–40	37.00 (22.00)	0.924	108.00 (196.0)	0.937
	Over 41 years old	39.50 (32.50)		152.50 (214.5)	
Education status					
	Primary school	36.95 (20.00)		150.00 (201.3)	
	Middle school	40.00 (22.00)	0.312	155.00 (188.0)	0.772
	High school	36.50 (20.50)		106.00 (198.0)	
	University	33.50 (14.50)		127.00 (209.3)	
Working status					
	Yes	36.00 (18.50)	0.304	187.31 (202.5)	0.775
	No	33.00 (-)		135.00 (-)	
Profession					
	Employee	36.00 (22.00)		135.00 (207.0)	
	Officer	33.50 (17.75)	0.468	94.00 (113.5)	0.255
	Free	35.50 (23.25)		169.50 (233.5)	
Income status					
	Income little	39.00 (26.50)		132.00 (162.0)	
	Equal	35.00 (15.00)	0.569	130.50 (234.8)	0.946
	Income more	38.00 (23.00)		134.00 (216.0)	
Residence					
	Province	36.00 (18.00)		130.00 (207.3)	
	District	36.00 (22.00)	0.777	150.00 (173.0)	0.293
	Village	40.00 (26.00)		86.00 (184.0)	
Are there people in your family or your spouse's family who are infertile?					
	Yes	43.00 (22.75)	0.587	340.50 (132.3)	0.005
	No	36.00 (18.75)		123.00 (181.8)	
Residence					
	House	36.00 (18.25)		135.00 (201.8)	
	Tent City	22.00 (-)	0.044	87.00 (-)	0.591
	Container	47.00 (-)		88.00 (-)	
Did you face material losses in the earthquakes?					
	Yes	37.00 (21.50)	0.288	116.00 (179.5)	0.868
	No	36.00 (21.50)		135.50 (205.5)	
Were you under debris in the earthquakes?					
	Yes	51.50 (-)	0.195	50.45 (-)	0.198
	No	36.00 (19.00)		134.50 (200.3)	
Did you face any health problems after the earthquakes?					
	Yes	56.50 (27.25)	0.082	205.00 (385.6)	0.903
	No	36.00 (19.00)		133.00 (190.0)	
How do you feel now?					
	Happy	29.50 (23.25)		349.50 (264.8)	
	Unhappy	33.50 (17.00)		158.50 (248.0)	
	Neutral	34.00 (18.50)	0.001	10.30 (196.0)	0.081
	Tired	25.00 (27.00)		87.00 (122.0)	
	Desperate	49.00 (33.75)		99.00 (141.5)	
	Panic	43.00 (18.00)		165.00 (201.0)	
Did you receive any social support after the earthquakes?					
	Yes	47.00 (21.00)	0.041	196.00 (276.0)	0.227
	No	36.00 (19.00)		132.00 (193.0)	

TSC: Total Sperm Count; PETLDS: Post-Earthquake Trauma Level Determination Scale; IQR: Interquartile Range.

TABLE 6. Some characteristics of the participants, the relationship between the post-earthquake trauma level determination scale and its sub-dimensions, and semen data (N = 148).

Variables	Age (yr)	DM	DNHC	DRIT	BP	EL	A	CS	SP	PETLDS	SV	MSS	TPMSC	TPMSC Density	TSC
Age (yr)	1.000														
DM	0.511**	1.000													
DNHC	0.474**	0.915**	1.000												
DRIT	0.212**	0.585**	0.656**	1.000											
BP	0.860	−0.062	−0.048	−0.055	1.000										
EL	0.177*	−0.002	−0.012	0.007	0.568**	1.000									
A	0.073	−0.072	−0.051	−0.024	0.472**	0.542**	1.000								
CS	0.043	−0.112	−0.106	−0.114	0.542**	0.586**	0.690**	1.000							
SP	0.183*	0.033	0.006	−0.047	0.549**	0.668**	0.499**	0.627**	1.000						
PETLDS	0.138	0.054	−0.053	−0.057	0.738**	0.842**	0.796**	0.862**	0.816**	1.000					
SV	−0.095	−0.180*	−0.196*	−0.023	−0.048	−0.001	0.007	0.037	−0.062	−0.010	1.000				
MSS	0.054	−0.101	−0.137	−0.102	−0.063	−0.061	−0.129	−0.154	0.070	−0.120	0.055	1.000			
TPMSC	−0.057	−0.158	−0.225**	−0.148	−0.156	−0.102	−0.130	−0.154	−0.131	−0.162*	0.424**	0.800**	1.000		
TPMSC Density	−0.022	−0.124	−0.192*	−0.130	−0.114	−0.053	−0.166*	−0.148	−0.083	−0.137	0.096	0.887**	0.837*	1.000	
TSC	0.031	−0.123	−0.151	−0.105	−0.102	−0.096	−0.092	−0.150	−0.110	−0.136	0.322**	0.872**	0.917**	0.737**	1.000

**: Significant relationship at the 0.05 level; **: significant relationship at the 0.001 level. DM: Duration of marriage; DNHC: Duration of Not Having Children; DRIT: Duration of Receiving Infertility Treatment; BP: Behavioral Problems; EL: Emotional Limitation; A: Affective; CS: Cognitive Structure; SP: Sleep Problems; PETLDS: Post-Earthquake Trauma Level Determination Scale; SV: Semen Volume; MSS: Sperm Count per Milliliter; TPMSC: Total Progressive Motile Sperm Count; TPMSC Density: Total Progressive Sperm Count Density; TSC: Total Sperm Count.*

It was found that as the duration of marriage increases, semen volume decreases ($r = -0.180$, $p < 0.05$), and as the period of inability to have children increases, semen volume ($r = -0.196$, $p < 0.05$), progressively motile sperm count ($r = -0.225$, $p < 0.001$) and progressively motile sperm density ($r = -0.192$, $p < 0.05$) decrease (Table 6).

Behavioral problems ($r = 0.738$, $p < 0.001$), emotional limitation level ($r = 0.842$, $p < 0.001$), and sleep problems ($r = 0.816$, $p < 0.001$) increased with the high level of trauma after the earthquakes. There were significant relationships between post-earthquake trauma levels and progressively motile sperm count ($r = -0.162$, $p < 0.05$) among semen parameters, while other parameters were not affected (Table 6).

4. Discussion

Like other natural disasters, earthquakes are disasters that cause destruction in nature as well as loss of natural habitats and therefore cause many psychological and physiological damages to people. Although survival is at the forefront in the acute period, continuation of life and normalization gain importance in the long term. Reproductive health is also affected by both physiological and psychological reasons after natural disasters. These impacts can be different in the acute and chronic periods. The basic indicator of reproductive health in men is the evaluation of semen parameters. It is already known that stress affects reproductive behaviors and results in changes in semen parameters. It was reported in the study conducted by Fenster *et al.* [24] that stress at work did not affect semen quality, but the recent death of a close family member was associated with a decrease in progressively motile sperm count and an increase in the rate of sperm with larger and more pointed nuclei. They emphasized that these results suggest that the fertility of men experiencing the stress of the death of a family member may temporarily decrease [25]. Similarly, it was reported that emotional stress caused meiotic and structural changes in sperm cells and that this situation improved after the therapy session, indicating that stress is an additional risk factor for idiopathic infertility [18]. In another study conducted in the 7 years following Hurricane Katrina, which hit the Gulf Coast region of the USA on 29 August 2005, and caused major floods in New Orleans and the Gulf region, semen parameters were evaluated and it was reported that although significant differences were observed in terms of motility, morphology, white blood cell count, immature germ cell count, pH and the presence of sperm agglutination, there was no significant difference in sperm count. They reported that a major natural disaster with accompanying environmental problems could affect semen motility and morphology and affect the fertility potential of the population [25]. Also, in a study conducted on refugees who emigrated from their country during periods of war, which had devastating effects such as natural disasters, semen parameters were examined, and it was determined that total motile sperm counts, and forward progressive sperm counts decreased [26]. In a study conducted during the Lebanese Civil War, it was observed that there was a significant decrease in sperm counts per milliliter (sperm concentration) and that this decrease was because of increased stress during the war [19]. It was also emphasized that exposure to pollution caused by physical and chemical agents used during the war could create significant differences in semen parameters. In a study conducted in Syria, it was reported that men exposed to chemical agents during the war had a significant increase in semen Malondialdehyde levels and Superoxide Dismutase activity, and that the percentage of abnormal sperm count increased significantly [27]. In a study conducted with American soldiers who were veterans in Iraq during the Iraqi Civil War, it was reported that a decrease in total sperm motility was detected in veterans diagnosed with post-traumatic stress disorder or major depression [28]. Environmental effects experienced after earthquakes and the abandonment of living spaces because of the disruption of natural life and the establishment of new lives trigger exposure to stress for a long period. Studies on changes in semen quality because of these effects are quite limited. Chen and his colleagues reported a magnitude 8 earthquake in 2008 that had devastating effects. In a long-term study conducted among the survivors of the Wenchuan earthquake, they emphasized that semen concentration, percentage of progressively motile sperm, total motile sperm count, and normal morphology sperm count decreased in the first 3 years. They reported that this effect could be attributed to the high post-traumatic stress disorder in the survivors because of the great losses and damage caused by the earthquakes being so severe, and the separation of families [21]. In the present study, which was conducted in the 6-month period following the severe earthquake in our region, the stress levels of men were evaluated with the post-earthquake trauma scale, and it was found that the increase in stress levels was associated with a decrease in the progressively motile sperm count. The present study was conducted in Gaziantep city, a region relatively less affected by the Kahramanmaraş Earthquakes, and in this region, the destruction was quite minimal, and the return to normal life was faster than in other regions. It was observed that 95.9% of the participants in the study did not experience any health problems after the earthquakes, 75% did not have any losses in their relatives, 98.6% did not get trapped under the rubble, and 62.2% survived the earthquakes with only financial losses. Based on these data, it is understood that the participants in the present study were participants who were not affected by the earthquakes to a destructive extent. Therefore, the fact that only the post-earthquake stress levels and the progressively motile sperm count were affected in the present study can be attributed to this situation. In the study conducted by Chen *et al.* [22], the destructive effect of the earthquakes was high, and the study period covered a longer period after the earthquakes, and the effect on semen parameters was large. Fukuda *et al.* [29], who found similar results to the present study, divided the earthquakes into regions according to the magnitude of the impact after the Kobe earthquake and separately considered the regions affected by magnitudes less than 4 and magnitudes above 6 on the Richter scale. It has been reported that men from districts with a magnitude of <4 on the Richter Scale did not show any difference in sperm concentration and motility before and after the earthquakes, and men from districts with a magnitude of >6 whose houses were not damaged did not show any significant change in sperm concentration and motility, whereas those whose houses were partially or completely de-

stroyed had significantly lower sperm motility after the earthquakes than before. They speculated that this difference was because of stress levels changing according to the severity of the destruction, and that this could be a possible reason for the decrease in sperm motility [29, 30]. The effect of stress on semen quality has been emphasized in many studies. This is because stress changes the hormonal order. It also affects physiology. Trauma-related stress activates the hypothalamic-pituitary-adrenal (HPA) axis, leading to hypercortisolemia, which can disrupt the hypothalamic-pituitary-gonadal (HPG) axis by suppressing gonadotropin release and impairing spermatogenesis. Recent evidence indicates that chronic stress also promotes oxidative stress and mitochondrial dysfunction in sperm, increasing DNA fragmentation and reducing motility [31, 32]. Elevated cortisol and systemic inflammatory mediators further alter the testicular microenvironment, thereby compromising sperm quality [33]. Moreover, psychosocial stress has been shown to negatively affect semen quality parameters through epigenetic alterations and dysregulation of the stress–reproduction axis [34]. These biological mechanisms may therefore underline the observed association between trauma severity and impaired sperm motility in this study.

The present study is among the very limited studies in the literature that evaluated semen parameters in the post-earthquake period. Two separate earthquakes of 7.7 and 7.6 magnitudes occurred in our region according to the Richter Scale. Although the city where the present study was conducted was a place where the earthquakes were felt strongly, the destruction and loss were less than in other cities. A relationship was observed between those with high Post-Earthquake Trauma Levels and emotional problems, emotional limitations, and sleep problems. This shows that the physical reflection of stress is also high in people with a greater psychological impact. A decrease in progressively motile sperm count, a very important parameter in infertility, was detected in those with high Post-Earthquake Trauma Levels.

5. Conclusions

To evaluate male fertility after an earthquake more comprehensively, studies with broad participation are needed in regions where the devastating effects of the earthquakes were felt more severely. The present study can shed light on studies to be conducted in this regard. With the increase in similar studies, the negative effects of disasters on reproductive health and fertility can be revealed strikingly, precautions can be increased, and necessary state policies can be developed.

AVAILABILITY OF DATA AND MATERIALS

The data that support the findings of this study are available from the corresponding author ÇK upon reasonable request.

AUTHOR CONTRIBUTIONS

ÇK—Concept; Writing. ÇK, AB, SK—Design; Analysis. ÇK, AB—Supervision. SK, AG—Materials; Data Collection and/or Processing. ÇK, ŞK, AG—Literature Review. SK, AB—Critical Review.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was approved by the Gaziantep Islam Science and Technology University Non-Interventional Clinical Study Ethics Committee with the ethics number 2023-2ONP-0127. The present study was supported by voluntary written consent from the participants. The confidentiality and anonymity of the participants were protected throughout the study process. All participants were informed that their participation was completely voluntary, that they could withdraw at any time, and that this would not have any negative consequences. Possible risks and benefits were shared with the participants, and transparency was provided regarding the use of the data. Funding sources and potential conflicts of interest were clearly stated in the study. The study was conducted with an approach that protects the rights of the participants and prioritizes scientific integrity.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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