

ORIGINAL RESEARCH

Association between post-earthquake living conditions and children's toothbrushing habits in Hatay, Turkey: a cross-sectional study

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Abstract

Background: This cross-sectional study aimed to assess parent-reported changes in children's toothbrushing habits after the 06 February 2023, earthquakes in Hatay Province and to examine whether these changes were associated with post-earthquake living conditions. **Methods:** The study included 363 parents residing in Hatay Province after the earthquakes, whose children presented to a pediatric dentistry clinic. Data were collected through face-to-face interviews using a structured 21-item questionnaire. Descriptive statistics were used to summarize the data, and categorical variables were compared using the chi-square test. Statistical significance was set at $p < 0.05$. **Results:** A decrease was observed in children's toothbrushing frequency after the earthquake. The rate of brushing once daily declined from 41.32% to 36.64%, and the rate of brushing twice daily or more decreased from 32.23% to 30.30%, whereas the rate of rare brushing increased from 23.97% to 30.58%. Overall, 31.96% of the participants reported a decline in their children's toothbrushing habits. A significant association was found between changes in living environment and changes in toothbrushing habits ($p < 0.05$), with a greater decline observed among children whose living environment had changed four or more times. In addition, the post-earthquake living environment was significantly associated with the primary reason why the child was unable to brush their teeth ($p < 0.05$). **Conclusions:** Children's toothbrushing habits declined after the earthquake, and this decline was particularly associated with changes in living environment and housing conditions. These findings suggest that, in efforts to protect children's oral health after a disaster, the provision of hygiene materials alone may be insufficient, and adequate, stable, and supportive living conditions should also be ensured.

Keywords

Earthquake; Oral hygiene; Toothbrushing habits; Child; Housing instability; Post-disaster; Türkiye

1. Introduction

A disaster is defined as a natural or human-induced event that exceeds a community's capacity to cope and results in extensive losses and destruction. Among different types of disasters, earthquakes have particularly profound effects on society because they occur unexpectedly and cause widespread physical, psychological, and social consequences [1].

Natural disasters may lead to the development of trauma-related somatic and psychological symptoms during childhood [2]. It has been reported that musculoskeletal problems, respiratory issues, gastrointestinal disorders, and sleep disturbances are more frequently observed in child disaster survivors [3]. In addition, displacement, socioeconomic difficulties, and developmental characteristics may influence children's behavioral responses after disasters, and these responses may vary according to the degree of disaster exposure, age, family

environment, and individual coping capacity [4].

Parental attitudes, oral hygiene practices, and the importance attached to oral health within the family play a decisive role in the development of children's oral hygiene behaviors and oral health outcomes throughout childhood and adolescence [5, 6]. Childhood is a critical developmental period during which oral and dental health-related behaviors are established. During this period, regular toothbrushing, appropriate dietary habits, and parental support are among the main determinants of maintaining good oral hygiene [7, 8]. Indeed, inadequate toothbrushing and high sugar consumption have been reported to increase the prevalence of dental caries in children [9, 10]. Studies conducted among preschool children have shown that behavioral factors, including toothbrushing frequency, brushing duration, brushing technique, and parental involvement, are significantly associated with plaque accumulation, gingival health, and caries levels [11]. Similarly,

parents' knowledge and behaviors regarding oral health have been reported to influence their children's toothbrushing habits and consumption of sugary foods [12, 13]. Therefore, parental knowledge, attitudes, and behaviors related to oral health may influence the oral hygiene habits that children develop and maintain throughout life [14, 15].

On 06 February 2023, two large-scale earthquakes that struck Türkiye nine hours apart caused extensive destruction across a wide geographic area [16]. As a result of the destruction caused by the earthquakes, the use of temporary shelters increased in the affected regions, leading to major public health problems such as inadequate housing, deteriorated hygiene conditions, difficulties in accessing clean water and food, and overcrowded living environments [17, 18]. These environmental and social changes may directly affect children's daily routines and self-care habits. In the post-disaster period, factors such as limited access to water, overcrowded living conditions, and disruption of established routines may interrupt children's hygiene practices [3]. However, despite the potential impact of post-disaster living conditions on children's oral hygiene behaviors, studies specifically evaluating this association in Hatay Province remain limited.

Limited access to clean water in post-disaster shelter settings, together with the distribution of high-calorie and sugary foods, may contribute to a reduction in oral hygiene practices and an increase in the prevalence of dental caries among children [19]. In this context, it is important to evaluate how altered living and housing conditions after a disaster may affect children's oral hygiene behaviors. Therefore, this study aimed to evaluate the oral hygiene behaviors of children living in Hatay Province during the post-earthquake period and to examine the effect of different housing conditions on the maintenance of oral hygiene practices. In this respect, the present study may contribute to the limited body of research conducted in Hatay Province by investigating children's oral hygiene habits in relation to housing conditions in the aftermath of a major disaster.

2. Materials and methods

2.1 Study design

This study was designed as a cross-sectional survey to evaluate the association between children's oral hygiene habits and housing conditions during the post-earthquake period. Ethical approval for the study was obtained from the Non-Interventional Clinical Research Ethics Committee of Hatay Mustafa Kemal University (Decision No: 2026/40). The study was conducted between 20 January 2026, and 02 March 2026, among parents whose children aged 2–14 years presented to the Department of Pediatric Dentistry at Mustafa Kemal University for examination and/or treatment and who had experienced the 06 February 2023, earthquakes while residing in Hatay. Participants were considered “affected by the earthquake” if they had experienced disruption in daily living conditions following the disaster. In families with more than one eligible child, only one child was included in the study. If multiple eligible children presented to the clinic

simultaneously, one child was selected randomly to avoid duplicate parental responses and reduce selection bias. A total of 363 parents participated in the study. Written informed consent was obtained from the parents before participation.

2.2 Sample size calculation

As the study data were planned to be statistically compared using categorical variables, the sample size calculation was performed for chi-square analysis evaluating the association between post-earthquake changes in children's toothbrushing habits, classified as decreased or not decreased, and post-earthquake living conditions, classified as stable versus temporary/collective housing. Based on a 5% margin of error, a 95% confidence level, an effect size of Cohen's $w = 0.155$ selected according to Cohen's criteria for small-to-medium effect sizes in categorical analyses, and a theoretical power of 80%, the minimum required sample size was determined to be 327 observations. Considering a possible 10% data loss, the target sample size was increased to 363 participants. The study was completed with a total of 363 parents, exceeding this minimum requirement.

2.3 Inclusion and exclusion criteria

Parents who had been affected by the earthquake, were literate, and agreed to complete the questionnaire were included in the study. However, parents who refused to complete the questionnaire, those who were illiterate, and children and parents who had not been affected by the earthquake were excluded from the study.

2.4 Data collection

The structured questionnaire, used as the data collection tool, consisted of 21 items and was developed in line with the aim of the study, based on relevant literature evaluating children's oral hygiene habits, parent-related factors such as parental education level and parent-reported toothbrushing behaviors, and post-disaster living conditions [7, 8, 10, 11, 13]. The questionnaire consisted of three sections. The first section included 11 questions designed to assess the sociodemographic characteristics of the parent and child. This section included questions on the child's age and sex, the parent completing the questionnaire, parental education level, monthly income status, place of residence before and after the earthquake, relocation outside Hatay after the earthquake, the number of people living in the same household, changes in economic status after the earthquake, and disruption of daily routines.

The second section included six questions aimed at evaluating children's oral hygiene habits. This section assessed toothbrushing frequency before and after the earthquake, changes in toothbrushing habits, whether the child had a personal toothbrush and toothpaste, and the reasons for being unable to brush their teeth after the earthquake. The response category “was already low” was used to describe children who already had infrequent toothbrushing habits before the earthquake and therefore did not demonstrate a further noticeable decline after the disaster. Since the primary aim of the study was to evaluate the deterioration and disruption of oral hygiene behaviors

following the earthquake, an “increased/improved” response category was not included in the questionnaire design. The questionnaire focused on children’s oral hygiene behaviors and post-earthquake living conditions, and parents’ individual oral hygiene habits were not specifically evaluated in the present study.

The third section consisted of four questions designed to evaluate housing conditions. This section examined the type of shelter in which the participants had lived for the longest period during the first 6 months and the last 6 months after the earthquake, the number of changes in the living environment, and whether there was an appropriate place for the child to brush their teeth. The questionnaire items were developed to assess changes in children’s oral hygiene habits following the 06 February 2023, earthquakes and the association of these changes with housing conditions.

The questionnaire forms were distributed to and completed by the parents. Considering the potential for the questionnaire items to evoke earthquake-related trauma in children, the administration process was conducted in an environment where the children were not present.

2.5 Statistical analysis

The data obtained in the study were analyzed using IBM SPSS Statistics for Windows, Version 21.0 (IBM Corp., Armonk, NY, USA). Categorical variables were presented as frequencies and percentages. The chi-square test was used to examine associations between nominal variables. In cases where expected cell counts were insufficient in 2×2 tables, Fisher’s exact test was applied. For larger $R \times C$ contingency tables in which more than 20% of expected cell frequencies were below 5, Pearson chi-square analyses with Monte Carlo simulation were performed to ensure the validity of the statistical assumptions. Potential confounding variables, including post-earthquake economic changes and disruptions in children’s daily routines, were included in the binary logistic regression model. Child age was included as a continuous variable in the binary logistic regression model to adjust for its potential confounding effect. Statistical significance was set at $p < 0.05$.

3. Results

The study included 363 children aged 2–14 years and their parents. The mean age of the children was 8.87 ± 2.52 years. Of the participating children, 208 were girls and 155 were boys, accounting for 57.30% and 42.70% of the sample, respectively. Most questionnaires were completed by mothers ($n = 246$, 67.77%), followed by fathers ($n = 86$, 23.69%) and other family members or caregivers ($n = 31$, 8.54%). Regarding parental education level, primary education was reported by 96 participants (26.45%), secondary education by 86 participants (23.69%), high school education by 83 participants (22.87%), university education by 82 participants (22.59%), and postgraduate education by 16 participants (4.41%). Monthly income was below 28,075 Turkish Lira (TL) in 150 participants (41.32%), between 28,075 and 56,150 TL in 124 participants (34.16%), and above 56,150 TL in 89 participants (24.52%).

The number of people living in the same household ranged from 2 to 40, with a mean of 5.2 ± 2.7 and a median of 5 (Table 1).

TABLE 1. Sociodemographic characteristics of the children and responding parents.

Variables	n	%
Gender		
Female	208	57.30
Male	155	42.70
Parent		
Mother	246	67.77
Father	86	23.69
Other	31	8.54
Education Level		
Primary education	96	26.45
Secondary education	86	23.69
High school	83	22.87
University	82	22.59
Postgraduate education	16	4.41
Monthly Income Level		
<28,075 TL	150	41.32
28,075–56,150 TL	124	34.16
>56,150 TL	89	24.52
Number of People Living in the Same Household, Min–Max, Mean $\pm$ SD (Median)	2–40	5.2 ± 2.7 (5)

Other: grandparents, aunt/uncle, or older brother/sister; TL: Turkish Lira; SD: Standard Deviation.

Table 2 shows the distribution of participants’ residential location before and after the earthquake. Before the earthquake, 155 participants (42.70%) lived in the provincial center, 119 (32.78%) lived in a district, 73 (20.11%) lived in a village, and 16 (4.41%) lived in another province. After the earthquake, the proportion of participants living in the provincial center decreased to 32.23%, whereas the proportions living in villages and another province increased to 28.65% and 7.71%, respectively. Overall, 232 participants (63.91%) reported that they had not moved out of Hatay after the earthquake, while 130 (35.81%) had moved out temporarily and only one participant (0.28%) had moved out permanently.

The post-earthquake shelter conditions are presented in Table 3. During the first 6 months after the earthquake, tents were the most commonly reported shelter type. However, during the 6 months immediately preceding the survey, more than half of the participants were living in their own undamaged or slightly damaged homes. Most ($n = 193$, 53.2%) participants reported at least one change in living place after the earthquake.

Table 4 presents children’s toothbrush/toothpaste availability and toothbrushing habits before and after the earthquake. Although most children had access to a toothbrush and toothpaste both before and after the earthquake, toothbrushing frequency decreased after the disaster. The proportion of children

TABLE 2. Residential location before and after the earthquake.

Housing/Shelter Status	Types of housing	n	%
Place of Residence Before the Earthquake			
	Provincial center	155	42.70
	District	119	32.78
	Village	73	20.11
	Another province	16	4.41
Place of Residence After the Earthquake			
	Provincial center	117	32.23
	District	114	31.40
	Village	104	28.65
	Another province	28	7.71
Did you move out of Hatay after the earthquake?			
	No	232	63.91
	Yes, temporarily	130	35.81
	Yes, permanently	1	0.28

TABLE 3. Post-earthquake shelter conditions and changes in living place.

Variables	n	%
Where did you live for the longest period during the first 6 months after the earthquake?		
In our own home (undamaged/slightly damaged)	61	16.80
With relatives/friends	50	13.77
Tent	142	39.12
Container	32	8.82
Dormitory/collective shelter	9	2.48
Another city	61	16.80
Other	8	2.20
Where have you lived for the longest period during the 6 months immediately preceding the survey (current living period)?		
In our own home (undamaged/slightly damaged)	193	53.17
With relatives/friends	26	7.16
Container	71	19.56
Tent	44	12.12
Dormitory/collective shelter	0	0.00
Another city	9	2.48
Other	20	5.51
How many times have you changed your living place (home/shelter) since the earthquake?		
None	95	26.17
Once	110	30.30
Twice	138	38.02
Three times	10	2.75
Four or more times	10	2.75

TABLE 4. Children's toothbrush/toothpaste availability and toothbrushing habits before and after the earthquake.

Variables	n	%
Did your child have a toothbrush and toothpaste before the earthquake?		
Yes	348	95.87
No	15	4.13
Does your child have a toothbrush and toothpaste after the earthquake?		
Yes	341	93.94
No	22	6.06
How often did your child brush their teeth before the earthquake?		
Once a day	150	41.32
Twice a day or more	117	32.23
Rarely	87	23.97
Never	9	2.48
How often does your child brush their teeth after the earthquake?		
Once a day	133	36.64
Twice a day or more	110	30.30
Rarely	111	30.58
Never	9	2.48
Was there any change in your child's toothbrushing habit after the earthquake?		
Decreased	116	31.96
Did not change	205	56.47
Was already low	42	11.57
What is the main reason your child is unable to brush their teeth after the earthquake?		
Difficulty accessing clean water	64	17.63
No toothbrush/toothpaste available	22	6.06
The living environment was not suitable	82	22.59
The child did not require dental care	44	12.12
I did not think it was necessary	3	0.83
There was no established habit	37	10.19
Other	111	30.58

Other responses included lack of motivation, disruption of daily routines, psychological distress, and other unspecified reasons.

brushing once daily or twice daily or more decreased, whereas rare toothbrushing became more frequent. Overall, 31.96% of parents reported a decrease in their child's toothbrushing habits after the earthquake.

As shown in Table 5, no statistically significant association was found between the shelter type used for the longest period during the first 6 months after the earthquake and changes in children's toothbrushing habits ($p > 0.05$). Although tent accommodation was common among children whose toothbrushing habits decreased, this pattern did not reach statistical significance.

A borderline association was found between the number of post-earthquake changes in living environment and changes in children's toothbrushing habits ($p = 0.048$) (Table 6). To identify the cells contributing to this association, an adjusted standardized residual (ASR) analysis was performed, and the results showed that children who had not changed their living environment were more likely than expected to report

no change in toothbrushing habits (ASR = 2.7), whereas decreased toothbrushing habits were less frequent than expected in this group (ASR = -2.1). In contrast, children who had changed their living environment four or more times were more likely than expected to report decreased toothbrushing habits (ASR = 2.6), and no change in toothbrushing habits was less frequent than expected in this group (ASR = -2.4). No statistically significant residuals were observed in the remaining categories ($|ASR| < 1.96$).

A significant association was found between the post-earthquake living environment and the main reason why the child was unable to brush their teeth ($p < 0.05$) (Table 7). ASR analysis showed that "the living environment was not suitable" was reported more frequently than expected among participants living in tents (ASR = 3.6), dormitories/collective shelters (ASR = 2.4), and with relatives or friends (ASR = 2.1). In contrast, this response was reported less frequently than expected among those living in their own homes (ASR =

TABLE 5. Association between shelter type during the first 6 months after the earthquake and changes in children's toothbrushing habits.

Variables	Was there any change in your child's toothbrushing habits after the earthquake?			<i>p</i>
	Decreased n (%)	Did not change n (%)	Was already low n (%)	
Where did you live for the longest period during the first 6 months after the earthquake?				
In our own home (undamaged/slightly damaged)	17 (14.7)	38 (18.5)	6 (14.3)	0.301
With relatives/friends	15 (12.9)	29 (14.1)	6 (14.3)	
Tent	55 (47.4)	69 (33.7)	18 (42.9)	
Container	8 (6.9)	20 (9.8)	4 (9.5)	
Dormitory/collective shelter	3 (2.6)	5 (2.4)	1 (2.4)	
Another city	16 (13.8)	41 (20)	4 (9.5)	
Other	2 (1.7)	3 (1.5)	3 (7.1)	

TABLE 6. Association between number of changes in living place and changes in children's toothbrushing habits after the earthquake.

Variables	Was there any change in your child's toothbrushing habits after the earthquake?			<i>p</i>
	Decreased n (%)	Did not change n (%)	Was already low n (%)	
How many times have you changed your living place (home/shelter) since the earthquake?				
None	22 (19)	65 (31.7)	8 (19)	0.048
Adjusted residual	−2.1	2.7	−1.1	
Once	32 (27.6)	63 (30.7)	15 (35.7)	
Adjusted residual	−0.8	0.2	0.8	
Twice	51 (44)	70 (34.1)	17 (40.5)	
Adjusted residual	1.6	−1.7	0.3	
Three times	4 (3.4)	5 (2.4)	1 (2.4)	
Adjusted residual	0.6	−0.4	−0.2	
Four or more times	7 (6)	2 (1)	1 (2.4)	
Adjusted residual	2.6	−2.4	−0.2	

Values with $|ASR| > 1.96$ were considered statistically significant.

-2.9) and in containers ($ASR = -2.3$).

Binary logistic regression analysis showed that increasing child age and female sex were associated with higher odds of decreased toothbrushing habits after the earthquake. Compared with residence in the provincial center, post-earthquake residence in a village was associated with lower odds of decreased toothbrushing habits. In addition, partially worsened and markedly worsened post-earthquake economic status were significantly associated with an increased likelihood of decreased toothbrushing habits. Children who did not have a toothbrush or toothpaste after the earthquake were also more likely to show decreased toothbrushing habits (Table 8).

4. Discussion

Oral and dental health is an important component of children's overall health, and disruption of regular oral hygiene practices may contribute to adverse outcomes, including dental caries, gingival problems, pain, and reduced quality of life [20]. After

disasters such as earthquakes, difficulties in accessing clean water and hygiene materials, together with crowded and temporary shelter conditions, may interfere with the maintenance of routine oral care [21]. At the same time, families may understandably prioritize safety, shelter, food, and other basic needs, which may cause preventive health behaviors, including oral hygiene, to receive less attention during the post-disaster period [22]. Disrupted access to dental services may further contribute to the progression of existing oral health problems [23]. Therefore, children's oral health after a disaster should be evaluated not only as an individual behavioral issue, but also in relation to environmental conditions, household stability, and disruption of daily life [21, 23].

The 06 February 2023, Kahramanmaraş-centered earthquakes caused extensive destruction in southeastern Türkiye, resulting in large-scale displacement and widespread use of temporary shelters [24, 25]. Consistent with these post-disaster conditions, the present study showed that children's oral hygiene behaviors deteriorated after the earthquake,

TABLE 7. Association between post-earthquake shelter type and reported reasons for being unable to brush teeth.

Variables	In our own home (undamaged/ slightly damaged) n (%)	With relatives/ friends n (%)	Tent n (%)	Container n (%)	Dormitory/ collective shelter n (%)	Another city n (%)	Other n (%)	<i>p</i>
What is the main reason your child was unable to brush their teeth after the earthquake?								
Difficulty access- ing clean water	11 (18)	8 (16)	28 (19.7)	8 (25)	1 (11.1)	8 (13.1)	0 (0)	
Adjusted Residual	0.1	-0.3	0.8	1.1	-0.5	-1	-1.3	
No tooth- brush/toothpaste available	1 (1.6)	2 (4)	15 (10.6)	1 (3.1)	0 (0)	3 (4.9)	0 (0)	
Adjusted Residual	-1.6	-0.7	2.9	-0.7	-0.8	-0.4	-0.7	
The living envi- ronment was not suitable	5 (8.2)	17 (34)	46 (32.4)	2 (6.3)	5 (55.6)	7 (11.5)	0 (0)	0.004
Adjusted Residual	-2.9	2.1	3.6	-2.3	2.4	-2.3	-1.5	
The child did not require dental care	12 (19.7)	7 (14)	12 (8.5)	2 (6.3)	1 (11.1)	9 (14.8)	1 (12.5)	
Adjusted Residual	2	0.4	-1.7	-1.1	-0.1	0.7	0	
I did not think it was necessary	1 (1.6)	0 (0)	2 (1.4)	0 (0)	0 (0)	0 (0)	0 (0)	
Adjusted Residual	0.8	-0.7	1	-0.5	-0.3	-0.8	-0.3	
There was no es- tablished habit	6 (9.8)	5 (10)	10 (7)	4 (12.5)	1 (11.1)	10 (16.4)	1 (12.5)	
Adjusted Residual	-0.1	0	-1.6	0.5	0.1	1.8	0.2	
Other	25 (41)	11 (22)	29 (20.4)	15 (46.9)	1 (11.1)	24 (39.3)	6 (75)	
Adjusted Residual	1.9	-1.4	-3.4	2.1	-1.3	1.6	2.8	

Other responses included disruption of routine, psychological distress, lack of motivation, and other unspecified reasons.

TABLE 8. Binary logistic regression analysis of factors associated with decreased toothbrushing habits after the earthquake.

Variables	OR	95% CI	<i>p</i> value
Child age	1.161	1.023–1.317	0.021
Female sex	2.149	1.240–3.725	0.006
Post-earthquake residence: village	0.307	0.106–0.888	0.029
Post-earthquake economic status: partially worsened	3.636	1.633–8.098	0.002
Post-earthquake economic status: markedly worsened	9.678	3.745–25.009	0.001
No toothbrush/toothpaste after the earthquake	5.524	1.525–20.008	0.009

OR: Odds Ratio; CI: Confidence Interval. Reference categories were male sex, residence in the provincial center, unchanged economic status, and availability of toothbrush/toothpaste after the earthquake.

and this deterioration appeared to be particularly related to instability in living conditions.

In the present study, the proportion of participants living in the city center decreased from 43% before the earthquake to 32% after the earthquake, whereas the proportion living in villages increased from 20% to 29%, and the proportion living in another province increased from 4% to 8%. Although 64% of the participants did not move out of Hatay after the earthquake, this does not necessarily indicate that their daily

living conditions remained stable, as many families experienced changes in shelter type, household environment, and daily routines within the province. Therefore, the effects of the disaster should not be interpreted only in terms of relocation outside Hatay, but also in relation to the broader disruption of children's living environments and self-care routines [20, 21, 23]. The findings on oral hygiene behaviors support this interpretation. Before the earthquake, 32% of the children brushed their teeth twice daily or more and 41% brushed

once daily; after the earthquake, these rates decreased to 30% and 37%, respectively, while the rate of rare toothbrushing increased from 24% to 31%. Although the absolute decrease in regular toothbrushing may appear modest, the increase in rare toothbrushing and the finding that approximately one-third of parents reported a decrease in their child's toothbrushing habits indicate a meaningful deterioration in oral hygiene behaviors after the disaster. In contrast, the proportion of children who had a toothbrush and toothpaste decreased only slightly, from 96% to 94%, suggesting that the deterioration in toothbrushing habits cannot be explained solely by a lack of hygiene materials. Rather, it may also reflect disruption of daily routines, changes in housing conditions, and instability in the living environment. This finding is consistent with the Malatya study [26], which reported a decrease in children's toothbrushing habits after the earthquake, and with previous evidence showing that oral hygiene routines may be markedly disrupted in temporary shelter settings [23].

No significant association was found between the living environment during the early post-earthquake period and changes in children's toothbrushing habits ($p = 0.301$). Although tent accommodation was common among children whose toothbrushing habits decreased, this pattern was also observed in children whose habits did not change or were already low, suggesting that deterioration in toothbrushing habits cannot be explained by shelter type alone. This finding indicates that, in the post-disaster context, the effect of living conditions on oral hygiene behaviors may be related not only to the type of shelter, such as a tent, container, or collective shelter, but also to broader factors including disruption of daily routines, lack of a suitable environment for hygiene practices, and interruptions in access to oral healthcare [21, 23]. In this regard, the present findings suggest that children's oral hygiene behaviors after disasters should be evaluated not only according to shelter type, but also in relation to the stability and adequacy of the living environment [26, 27]. Similar findings have been reported in international post-disaster oral health studies. Studies from Japan have shown that temporary housing and disrupted living conditions after major earthquakes may negatively affect oral hygiene and increase oral health complaints among disaster survivors [27, 28]. In addition, a study conducted after the 2015 Nepal earthquake reported that oral hygiene practices and nutritional habits were adversely affected in earthquake-affected areas [29]. These findings are consistent with the present study and suggest that disruption of oral hygiene after disasters may represent a broader public health problem related to shelter instability, limited access to hygiene resources, and disruption of daily routines, rather than a problem attributable to one specific shelter type alone.

In contrast, an association was observed between the number of post-earthquake changes in living environment and changes in children's toothbrushing habits. This finding suggests that instability and repeated relocation after the earthquake may have contributed to disruption of children's oral hygiene routines. In particular, children who had not changed their living environment were more likely to maintain their toothbrushing habits, whereas those who had changed their living environment four or more times were more likely to show decreased toothbrushing habits. This pattern indicates that the conti-

nunity and stability of the living environment may be more relevant to the maintenance of oral hygiene behaviors than the shelter type alone. Previous studies have also reported that uncertainty in living conditions, temporary shelter processes, and disruption of daily routines after disasters may negatively influence oral health behaviors and daily self-care practices [23, 26–28]. In this context, the present findings suggest that providing shelter alone may not be sufficient to protect children's oral health, and that stable, predictable, and continuous living conditions may also be important for preserving regular toothbrushing habits [20, 21]. The regression analysis further showed that worsening post-earthquake economic conditions and the absence of a toothbrush or toothpaste were associated with a higher likelihood of decreased toothbrushing habits. These findings indicate that post-disaster oral hygiene behaviors may be influenced not only by instability in the living environment, but also by socioeconomic difficulties and limited access to basic hygiene materials [20, 21, 23]. The regression analysis also demonstrated that older age and female sex were independently associated with a higher likelihood of decreased toothbrushing habits after the earthquake. One possible explanation for the age-related finding is that older children may have experienced greater disruption of daily routines and psychosocial well-being during the post-disaster period. Previous studies have reported that displaced children often face psychological distress, uncertainty, overcrowded living conditions, and disruption of self-care behaviors, all of which may adversely affect oral hygiene practices [30]. The association observed among girls may reflect gender-related differences in how post-disaster living conditions influence hygiene-related behaviors. In emergency and temporary shelter settings, female children and adolescents may encounter additional challenges related to privacy, safety, and access to appropriate sanitation and hygiene facilities [31]. Such barriers may interfere with the maintenance of regular personal hygiene routines, including toothbrushing. Although the underlying mechanisms cannot be fully explained within the scope of the present study, these findings suggest that older children and girls may represent particularly vulnerable groups with regard to maintaining oral hygiene after disasters. Future post-disaster oral health programs should therefore consider age- and gender-specific needs when designing preventive interventions and support strategies.

The post-earthquake shelter environment may have influenced not only whether children's toothbrushing habits were disrupted, but also the reasons underlying this disruption. Adjusted standardized residual analysis showed that the response "the living environment was not suitable" was reported more frequently than expected among children living in tents, dormitories/collective shelters, and with relatives or friends, whereas it was reported less frequently than expected among those living in their own homes and in containers. This finding suggests that unstable or temporary living arrangements may create practical environmental barriers that interfere with the maintenance of regular oral hygiene routines. Therefore, disruption of toothbrushing after the earthquake should not be interpreted solely as a matter of individual unwillingness or lack of motivation, but also as a consequence of structural difficulties encountered in the post-disaster living environ-

ment. These difficulties may include lack of privacy, crowded living conditions, limited access to water, and the absence of an appropriate space for daily hygiene practices. Previous studies on oral health after disasters have similarly emphasized that temporary and inadequate shelter conditions may make routine oral care more difficult [21, 23, 27]. Accordingly, interventions aimed at protecting children's oral health after disasters should include not only the provision of toothbrushes, toothpaste, and hygiene education, but also efforts to create suitable physical environments in which children can maintain daily oral care [20, 22].

Overall, the findings of this study indicate that children's oral hygiene behaviors after the earthquake were affected by multiple interrelated factors, particularly shelter inadequacy, instability in living conditions, disruption of daily routines, socioeconomic difficulties, and limited access to basic hygiene materials. These findings suggest that children's oral health in the post-disaster period should not be addressed only as an individual behavioral issue, but should also be considered within the broader context of environmental and structural conditions [21]. Therefore, preventive oral health programs for disaster-affected children should emphasize the provision of hygiene materials, the availability of appropriate living environments, the re-establishment of daily care routines, and improved access to basic oral health services [20, 23]. Such integrated approaches may help children maintain regular oral hygiene during the post-disaster period and may reduce the risk of subsequent oral health problems.

5. Conclusions

This study showed that toothbrushing habits were adversely affected among children living in Hatay after the 06 February 2023 earthquakes. The decrease in toothbrushing habits in approximately one-third of the children indicates that the sustainability of oral hygiene behaviors weakened in the post-disaster period. The findings suggest that this deterioration was associated not only with a lack of hygiene materials, but also with changes in shelter conditions, instability in the living environment, and the absence of a suitable physical environment for toothbrushing. In particular, the increased likelihood of decreased toothbrushing habits among children who experienced repeated changes in living environment highlights the importance of stable living conditions for children's oral health after a disaster. Therefore, oral and dental health services for children after a disaster should not be limited to hygiene material support and individual education, but should also include preventive approaches aimed at ensuring appropriate shelter conditions and re-establishing daily self-care routines. These findings indicate that children's oral health should not be neglected in disaster management and should be regarded as a public health priority. Therefore, oral and dental health services planned for the post-disaster period should not be limited to individual education and hygiene material support, but also include multidimensional interventions that support the stability of living conditions and ensure the sustainability of daily self-care routines.

6. Limitations

This study has several limitations. Since the research was conducted with the parents of children who presented to a pediatric dentistry clinic, the generalizability of the findings to the entire population of children affected by the earthquake is limited. In addition, because the survey was conducted nearly three years after the 06 February 2023, earthquakes, retrospective evaluation of changes in children's oral hygiene behaviors may have been subject to recall bias. Furthermore, because children's oral hygiene behaviors were reported by parents rather than directly observed, proxy reporting bias may have occurred, particularly in cases where children spent substantial time away from the responding parent. Another potential limitation is the lack of information regarding parental influence on children's toothbrushing habits, since parents' own oral hygiene practices and motivational behaviors were not specifically evaluated. In addition, the 21-item questionnaire was adapted from previous literature and did not undergo formal validity or reliability testing prior to data collection. Nevertheless, the study's strengths include providing field data from the post-disaster period and addressing children's oral health through environmental and structural factors. Future studies involving longitudinal follow-up and community-based sampling may provide a more comprehensive understanding of the long-term effects of disasters on children's oral hygiene behaviors and access to oral healthcare services.

AVAILABILITY OF DATA AND MATERIALS

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

AUTHOR CONTRIBUTIONS

BT—designed the study, performed the data collection and analysis, and wrote the manuscript. AMÇ—contributed to the organization of the study and provided support during the data collection process; critically reviewed the manuscript and contributed to editorial revisions. Both authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval for this study was obtained from the Hatay Mustafa Kemal University Non-Interventional Clinical Research Ethics Committee (Decision No: 2026/40). Written informed consent was obtained from the parents of all participating children prior to inclusion in the study.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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