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General Surgery

The Impact of the February 6 Kahramanmaraş Earthquake Disaster on Breast Cancer

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Abstract		Original Research Article

Introduction: This study was conducted in a province located in southern Turkey, which experienced extensive destruction due to major earthquakes on February 6, 2023. Since a significant portion of healthcare facilities were destroyed or severely damaged, the remaining healthcare facilities and field hospitals established had to primarily focus on providing emergency medical services. Consequently it became evident that patients with breast-related complaints faced difficulties accessing appropriate healthcare centers. This study was designed to investigate the impact of the earthquake on breast cancer, to enable predictability of outcomes in similar situations, and to take preventive measures. ***Materials and Methods:*** The medical records of breast cancer patients diagnosed and treated at our hospital during the 15-month periods before and after the February 6, 2023, earthquake were retrospectively reviewed. The patients' age and tumor stages were determined and compared. ***Results:*** A total of 274 patients were included in the study, comprising 191 patients diagnosed with breast cancer before the earthquake and 83 patients diagnosed after the earthquake. It was found that the mean age of patients presenting after the earthquake was lower (p<0.005). Additionally, and disease stage were found to be higher in patients presenting after the earthquake (p<0.005). ***Conclusion:*** The observation of breast cancer in a younger age group during the post earthquake period may be attributed to patients with symptoms being unable to Access appropriate healthcare facilities after the disaster or to older age groups being unable to reach healthcare institutions. The increase in disease stage was linked to the unavailability of suitable healthcare facilities following the disaster. To address these issues, mobile healthcare teams should be trained, and well-equipped vehicles should be prepared during disaster preparedness phases.
Keywords: Natural disaster, earthquake, breast cancer.

INTRODUCTİON

On February 6, 2023, two major earthquakes with magnitudes of 7.4 and 7.6 on the Richter scale, centered in Kahramanmaraş, along with aftershocks, caused extensive destruction in southern Turkey and northern Syria. According to information from various sources, 237,000 buildings in 11 provinces in southern Turkey and 10,600 buildings in northern Syria were either destroyed or severely damaged. The earthquakes resulted in over 56,000 deaths and more than 100,000 injuries [1-4]. Hatay, located in the southernmost part of Turkey and home to our hospital, was among the provinces severely affected by the earthquakes. Before the disaster, Hatay had a total of 12 hospitals and 350 primary healthcare facilities. However, during the earthquakes, the majority of primary care facilities and nine of the hospitals sustained damage rendering them inoperable [5].

Cancer is a significant health issue affecting millions of people. To prevent this issue, communities implement various methods such as cancer screening tests, periodic radiological and laboratory examinations based on cancer risk. The primary methods for early diagnosis of breast cancer include physical examination, breast ultrasonography, and mammography. Major treatment approaches include surgical interventions, chemotherapy, and radiotherapy. Devastating natural disasters lead to disruptions in cancer screening programs and delays in patient visits, causing disease stages to progress [6-11].

In this study, the impact of the earthquake on breast cancer stages was investigated by comparing the disease stages of breast cancer patients diagnosed in the 15-month periods before and after the earthquakes in our hospital.

MATERİALS AND METHODS

After receiving approval from the Hatay Mustafa Kemal University Local Ethics Committee dated November 20, 2024 and numbered 36, the medical records of patients treated for breast cancer in our clinic in the 15-month period before and after the February 6, 2023 Kahramanmaraş earthquake were retrospectively reviewed. The study was conducted in accordance with the Declaration of Helsinki.

Data on the patients' age, gender, tumor size, lymph node metastasis, distant organ metastasis, disease stage, and performed surgeries were collected and compared for the pre- and post-earthquake periods. Disease staging was determined using the TNM classification defined by the American Joint Committee on Cancer (AJCC) (Table 1) [12].

Table 1: TNM Staging in Breast Cancer (Tis: In situ tumor, T1: Tumor <2 cm, T2: Tumor 2-5 cm, T3: Tumor >5 cm, T4: Chest wall and/or skin involvement, N0: No lymph node metastasis, N1: 1-3 lymph node metastasis, N2: 3-9 lymph node metastasis, N4: >9 lymph node metastasis; M0: No distant organ metastasis, M1: Distant organ metastasis present)

	Stage 0	Tis	N0	M0
Early Stage	Stage 1	T1	N0	M0
	Stage 2A	T0	N1	M0
		T1	N1	M0
		T2	N0	M0
Locally Advanced Stage	Stage 2B	T2	N1	M0
		T3	N0	M0
	Stage 3A	T0	N2	M0
		T1	N2	M0
		T2	N2	M0
		T3	N1	M0
		T3	N2	M0
	Stage 3B	T4	N (any lymph node	M0
	Stage 3C	T (any tumor)	N3	M0
Metastatic Stage	Stage 4	T (any tumor)	N (any lymph node)	M1

Statistical Analysis

Descriptive statistics, including frequency, percentage, mean, and standard deviation, were used in the statistical analyses. The relationship between two dependent categorical variables and independent categorical variables was evaluated using the Pearson Chi-square test. For continuous variables, the Student's T-test was applied if parametric assumptions were met, and the Mann-Whitney U test was used if nonparametric assumptions were met. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 274 patients were included in the study. 69.7% (N=191) of the patients included in the study were from the pre-earthquake period, and 30.3% (N=83) were from the post-earthquake period. Looking at pathological diagnoses, 95.3% of the patients before the earthquake and 89.2% of the patients after the earthquake had invasive ductal carcinoma, 3.1% of the pre-earthquake patients and 6.0% of the post-earthquake patients had invasive lobular carcinoma, and 1.6% of the pre-earthquake patients and 3.6% of the post-earthquake patients had mixed types. TNM, disease stage, type of surgery, and age-based pre- and post-earthquake conditions are presented in Table 2. When tumor size (T), lymph node (N), metastasis (M), and disease stage were considered as independent variables and pre- and post-earthquake conditions as dependent variables, significant statistical differences were found between these variables (p<0.001). The age of patients who presented before the earthquake was statistically significantly higher than those who presented after the earthquake (p<0.001).

Table 2: Comparison of tumor size, lymph nodes, metastasis, stage, type of surgery, and age between patients who presented before and after the earthquake

Variable	Pre-Earthquake Presentations (N=191)	Post-Earthquake Presentations (N=83)	P*
Categorical Variable	**Column Percentage**	**Column Percentage**	
T (Size)			
T1	44.5	19.3	**<0.001**

Variable	Pre-Earthquake Presentations (N=191)	Post-Earthquake Presentations (N=83)	P*
T2	47.1	51.8	
T3	5.8	20.5	
T4	2.6	8.4	
N (Lymph Node)			
N0	62.3	30.1	**<0.001**
N1	21.5	49.4	
N2	14.1	19.3	
N3	2.1	1.2	
M (Metastasis)			
M0	97.9	86.7	**<0.001**
M1	2.1	13.3	
Stage			
Early Stage	66.5	34.9	**<0.001**
Locally Advanced Stage	31.4	51.8	
Metastatic Stage	2.1	13.3	
Type of Surgery			
BCS+SLND	56.0	56.6	0,926
MRM	44.0	43.4	
Continuous Variable	**Mean±SD**	**Mean±SD**	
Age	56.2±11.3	50.5±11.7	**<0.001****
* Pearson Chi-Square Test ,** Student's T-Test			
BCS: Breast conserving surgery, MRM: Modified radical mastectomy, SLND: Sentinel lymph node dissection			

To examine whether the age variable was a confounding factor on stages, the mean age of patients in each stage was compared across groups. For early-stage patients, the average age of those who presented before the earthquake was 55.6±11.6, while the average age of those who presented after the earthquake was 51.1±9.6 (p=0.037). For locally advanced stage patients, the average age of those who presented before the earthquake was 56.5±10.1, while the average age of those who presented after the earthquake was 49.9±11.8 (p=0.004). For metastatic stage patients, the average age of those who presented before the earthquake was 70.0±9.8, while the average age of those who presented after the earthquake was 51.1±16.7 (p=0.040) (Table 3).

Table 3: Age variable according to stages in pre- and post-earthquake patient presentations

AGE					
	Number	Group	Mean	Standard Deviation	P*
Early Stage	127	Pre-Earthquake	55,6	11,6	**0,037**
	29	Post-Earthquake	51,1	9,6	
	156	Total	54,8	11,4	
Locally Advanced Stage	60	Pre-Earthquake	56,5	10,1	**0,004**
	43	Post-Earthquake	49,9	11,8	
	103	Total	53,8	11,3	
Metastatic Stage	4	Pre-Earthquake	70,0	9,8	**0,040****
	11	Post-Earthquake	51,1	16,7	
	15	Total	56,1	17,2	

*Student's T-Test, **Mann-Whitney U Test

Discussion

In this study, we found an increase in tumor size, lymph node metastasis, distant organ metastasis, and stage in breast cancer patients treated after the earthquake compared to before. We also determined that the average age of patients who presented before the earthquake was higher than that of those who presented after the earthquake. When we analyzed the impact of age on stage progression before and after the earthquake, similar to the entire sample, the average age before the earthquake was higher than after the earthquake in each cancer stage. In the province where we conducted the study, due to the significant damage to healthcare facilities after the earthquake, the increase in stages post-earthquake was linked to the inability to conduct screening tests for approximately six months in most parts of the province. Another possible reason could be the lack of healthcare facilities where symptomatic patients could seek care, apart from screening tests.

Approximately one in every eight women will develop breast cancer in their lifetime. The risk of developing breast cancer increases with age, and the most common age for diagnosis is between 70 and 74 years. It is the second most common cause of cancer-related deaths in women. The mortality rate is higher in those diagnosed at later stages due to socioeconomic factors [13,14]. It has been suggested that more than half of breast cancer patients can be prevented through certain tests and interventions. These primarily include lifestyle changes, risk-reducing medications, and surgical interventions. Chemoprophylaxis and prophylactic surgeries in high-risk individuals identified through genetic testing are primary preventive methods for breast cancer. Secondary preventive methods include mammography screening programs, patient education, and physical examination, which are the main tools for early detection of breast cancer. It is recommended to create an individual screening program based on each patient's risk status. Mortality rates are lower in patients diagnosed at an early stage [7,15-17].

A significant portion of breast cancer patients seek medical care when they notice symptoms related to cancer. Among these patients, delayed presentation is defined as not seeking medical attention for three months or longer after the onset of symptoms. This delay leads to an increase in the stage of the disease and worsens the prognosis [18-20]. Major disasters expose victims to high levels of stress, cause changes in social relationships and living situations, and contribute to patient delays. Additionally, they may render healthcare facilities dysfunctional. A detailed study investigating the effects of the 2011 Fukushima disaster on breast cancer found a significant delay in patient presentation after the disaster [9]. After natural disasters, healthcare services generally focus on treating the injured and responding to emergencies to save lives. Vulnerable groups, such as those with chronic conditions like diabetes, respiratory, and heart diseases, as well as cancer patients, face various challenges. Inadequate management of these conditions can lead to an increase in mortality [20,21]. Furthermore, such disasters disrupt cancer screening programs, and it has been found that these disruptions lead to an increase in the stage of newly diagnosed cancer cases after disasters [22,23].

Immediately after the February 6, 2023, Kahramanmaraş earthquakes, only three hospitals in Hatay province remained operational. One of these, our university hospital, began providing emergency healthcare services to the injured from the first moments of the earthquake. With the participation of volunteers coming from various parts of the country, this service continued intensively for about 10 days. Later, after the occurrence of an aftershock with a magnitude of 6.4, the hospital was evacuated and began operating as a field hospital. During this period, medical devices such as computed tomography, magnetic resonance imaging machines, and mammography, which were used for diagnosis and treatment, could not be used. After necessary reinforcement and improvements, our hospital reopened in August 2023. The first mammogram after the disaster was performed on August 12, 2023. While 2,100 mammograms had been performed at our hospital 15 months before the disaster, only 1,268 mammograms were performed in the 15 months following the disaster. Prior to the disaster, an average of 140 mammograms were performed monthly, but approximately half of the 1,268 mammograms performed post-disaster were done in the first three months. This was considered one of the significant reasons for the delay in seeking care, as access to suitable healthcare facilities was limited. In this study, since traumatic factors such as injury, being trapped under rubble, or the loss of loved ones were not evaluated in relation to the patients, the impact of these factors on the delay could not be determined.

There was also an increase in tumor size, number of lymph nodes, and metastatic disease status. One significant reason for this was the patients' inability to access adequate healthcare services for about six months, and the inability to conduct cancer screening tests. Interestingly, the average age of patients diagnosed with breast cancer after the disaster was found to be lower. This supports the idea that these patients were unable to seek care at a suitable healthcare facility when they first noticed symptoms. Another reason considered was that elderly patients were unable to access healthcare facilities.

CONCLUSİON

After major natural disasters such as earthquakes, it must be considered that healthcare facilities may be damaged, routine healthcare services may be disrupted, and as a result, the stage of diseases included in screening programs, such as breast cancer, may increase. In situations where healthcare facilities are expected to be unable to return to normal routine operations within three months, additional measures should be taken for the early diagnosis and treatment of these diseases. For disaster preparedness, trained teams providing mobile services and vehicles with adequate equipment should be prepared and deployed in disaster areas. By providing on-site healthcare services, delays in patient presentations can be prevented. We believe that such an approach would help ensure early diagnosis and treatment of breast cancer.

Competing Interests: The authors declare no conflict of interest regarding this study and its publication.

Data Availability Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Ethical Approval: The current study was approved by Ethical Committee, Hatay Mustafa Kemal University of

Medical Sciences, with reference numbered 36 and dated November 20, 2024.

REFERENCESS

1. Balikuddembe, J. K., Reinhardt, J. D., Vahid, G., & Di, B. (2024). A scoping review of post-earthquake healthcare for vulnerable groups of the 2023 Turkey-Syria earthquakes. *BMC Public Health*, *24*(1), 945. doi: 10.1186/s12889-024-18395-z. PMID: 38566072; PMCID: PMC10985979.

2. Okuyama, J., Seto, S., Fukuda, Y., Suzukamo, Y., Okazaki, T., Furusawa, Y., ... & Imamura, F. (2024). Establishment of a post-disaster healthcare information booklet for the Turkey–Syrian earthquake, based on past disasters. *Scientific reports*, *14*(1), 1558. doi: 10.1038/s41598-024-52121-4. PMID: 38238418; PMCID: PMC10796905.

3. *British Red Cross. The latest news on the earthquakes in Turkey (Turkey) and Syria. Turkey (Turkey) and Syria earthquake: three months on 2023* Accessed Oct 2024 from: https://www.redcross.org.uk/stories/disasters-and-emergencies/world/turkey-syria-earthquake

4. Center for Disaster Philanthropy (CDP), Turkey-Syria E. April 24, 2023. Accessed Nov 2024 from: 2023 Turkey-Syria Earthquake - Center for Disaster Philanthropy

5. Türkiye Cumhuriyeti Cumhurbaşkanlığı Strateji ve Bütçe Başkanığı 2023 Kahramanmaraş and Hatay Earthquakes Report. Accessed Nov 2024 from: https://www.sbb.gov.tr/wp-content/uploads/2023/03/2023-Kahramanmaras-and-Hatay-Earthquakes-Report.pdf

6. da Costa Vieira, R. A., Biller, G., Uemura, G., Ruiz, C. A., & Curado, M. P. (2017). Breast cancer screening in developing countries. *Clinics*, *72*(4), 244-253. doi: 10.6061/clinics/2017(04)09. PMID: 28492725; PMCID: PMC5401614.

7. Coleman, C. (2017, May). Early detection and screening for breast cancer. In *Seminars in oncology nursing* (Vol. 33, No. 2, pp. 141-155). WB Saunders. doi: 10.1016/j.soncn.2017.02.009. Epub 2017 Mar 29. PMID: 28365057.

8. McDonald, E. S., Clark, A. S., Tchou, J., Zhang, P., & Freedman, G. M. (2016). Clinical diagnosis and management of breast cancer. *Journal of Nuclear Medicine*, *57*(Supplement 1), 9S-16S. doi: 10.2967/jnumed.115.157834. PMID: 26834110.

9. Ozaki, A., Nomura, S., Leppold, C., Tsubokura, M., Tanimoto, T., Yokota, T., ... & Ohira, H. (2017). Breast cancer patient delay in Fukushima, Japan following the 2011 triple disaster: a long-term retrospective study. *BMC cancer*, *17*, 1-13. doi: 10.1186/s12885-017-3412-4. PMID: 28629330; PMCID: PMC5477136.

10. Colón-López, V., Contreras-Mora, H. M., Pérez, C. M., Berríos-Ortiz, H., Sánchez-Díaz, C. T., Disdier, O. M., ... & Suárez-Pérez, E. L. (2023). Breast and Colorectal Cancer Screening Utilization after Hurricane María and the COVID-19 Pandemic in Puerto Rico. *International Journal of Environmental Research and Public Health*, *20*(19), 6870. doi: 10.3390/ijerph20196870. PMID: 37835140; PMCID: PMC10572647.

11. Miki, Y., Tase, T., Tokunaga, H., Yaegashi, N., & Ito, K. (2020). Cervical cancer screening rates before and after the Great East Japan Earthquake in the Miyagi Prefecture, Japan. *PLoS One*, *15*(3), e0229924. doi: 10.1371/journal.pone.0229924. PMID: 32160221; PMCID: PMC7065810.

12. Giuliano, A. E., Edge, S. B., & Hortobagyi, G. N. (2018). of the AJCC cancer staging manual: breast cancer. *Annals of surgical oncology*, *25*, 1783-1785. doi: 10.1245/s10434-018-6486-6. Epub 2018 Apr 18. PMID: 29671136.

13. Michaels, E., Worthington, R. O., & Rusiecki, J. (2023). Risk Assessment, Screening, and Primary Prevention. *Women's Health, An Issue of Medical Clinics of North America, E-Book: Women's Health, An Issue of Medical Clinics of North America, E-Book*, *107*(2), 271-283. doi: 10.1016/j.mcna.2022.10.007. PMID: 36759097.

14. Siegel, R., Ward, E., Brawley, O., & Jemal, A. (2011). Cancer statistics, 2011: the impact of eliminating socioeconomic and racial disparities on premature cancer deaths. *CA: a cancer journal for clinicians*, *61*(4), 212-236. doi: 10.3322/caac.20121. Epub 2011 Jun 17. PMID: 21685461.

15. Colditz, G. A., & Bohlke, K. (2014). Priorities for the primary prevention of breast cancer. *CA: a cancer journal for clinicians*, *64*(3), 186-194. doi: 10.3322/caac.21225. Epub 2014 Mar 19. PMID: 24647877.

16. Nelson, H. D., Smith, M. B., Griffin, J. C., & Fu, R. (2013). Use of medications to reduce risk for primary breast cancer: a systematic review for the US Preventive Services Task Force. *Annals of internal medicine*, *158*(8), 604-614. doi: 10.7326/0003-4819-158-8-201304160-00005. PMID: 23588749.

17. Birnbaum, J. K., Duggan, C., Anderson, B. O., & Etzioni, R. (2018). Early detection and treatment strategies for breast cancer in low-income and upper middle-income countries: a modelling study. *The Lancet Global Health*, *6*(8), e885-e893. doi: 10.1016/S2214-109X(18)30257-2. PMID: 30012269; PMCID: PMC6214657.

18. Khakbazan, Z., Taghipour, A., Latifnejad Roudsari, R., & Mohammadi, E. (2014). Help seeking behavior of women with self-discovered breast cancer symptoms: a meta-ethnographic synthesis of patient delay. *PloS one*, *9*(12), e110262. doi:

10.1371/journal.pone.0110262. PMID: 25470732; PMCID: PMC4254513.

19. Unger-Saldaña, K., & Infante-Castañeda, C. B. (2011). Breast cancer delay: a grounded model of help-seeking behaviour. *Social science & medicine*, *72*(7), 1096-1104. doi: 10.1016/j.socscimed.2011.01.022. Epub 2011 Feb 18. PMID: 21388729.

20. Arndt, V., Stürmer, T., Stegmaier, C., Ziegler, H., Dhom, G., & Brenner, H. (2002). Patient delay and stage of diagnosis among breast cancer patients in Germany–a population based study. *British journal of cancer*, *86*(7), 1034-1040. doi: 10.1038/sj.bjc.6600209. PMID: 11953844; PMCID: PMC2364177.

21. Gorji, H. A., Jafari, H., Heidari, M., & Seifi, B. (2018). Cancer patients during and after natural and man-made disasters: a systematic review. *Asian Pacific Journal of Cancer Prevention: APJCP*, *19*(10), 2695. doi:

10.22034/APJCP.2018.19.10.2695. PMID: 30360593; PMCID: PMC6291047.

22. Ozaki, A., Tsukada, M., Shimada, Y., Kawamoto, A., Wang, J. W., Bhandari, D., ... & Ohira, H. (2021). Potential association of prolonged patient interval and advanced anatomic stage in breast cancer patients in the area affected by the 2011 triple disaster in Fukushima, Japan: Retrospective observational study. *Medicine*, *100*(32), e26830. doi: 10.1097/MD.0000000000026830. PMID: 34397887; PMCID: PMC8360466.

23. Maringe, C., Spicer, J., Morris, M., Purushotham, A., Nolte, E., Sullivan, R., ... & Aggarwal, A. (2020). The impact of the COVID-19 pandemic on cancer deaths due to delays in diagnosis in England, UK: a national, population-based, modelling study. *The lancet oncology*, *21*(8), 1023-1034. doi: 10.1016/S1470-2045(20)30752-X. PMID: 32702310; PMCID: PMC7417808.