

## Is Turkey an Earthquake Country?

### Türkiye Bir Deprem Ülkesi midir?

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#### Abstract

It is important that the fact that Turkey is an earthquake country should be corroborated by scientific data. Researches show that major Turkish cities such as İstanbul, İzmir, Malatya, Erzincan, Hatay and Van have been struck by devastating earthquakes several times in the past. According to the earthquake catalogue for Turkey drawn up by the researchers Ambraseys and Finkel, 12 earthquakes causing very severe damage have taken place in İstanbul over the last 1500 years. The Marmara earthquake of 17 August, 1999, resulted in 17.479 deaths and 43.953 injuries. One hundred and twenty-four earthquakes causing more than 1.000 deaths, have taken place across the world since 1900. Seventeen of these were in Turkey. In 2000, Parsons et al. calculated a  $62\pm 15\%$  probability of a powerful earthquake in the vicinity of İstanbul within the following 30 years. These findings clearly reveal that Turkey is one of the world's major earthquake countries. Turkey and Turkish emergency medicine must bear this reality in mind in all present and future planning. (JAEM 2013; 12: 33-7)

**Key words:** Earthquake, earthquake country, İstanbul, emergency medicine, Turkey

#### Özet

Türkiye'nin bir deprem ülkesi olduğunun bilimsel verilerle desteklenmesi önemlidir. Yapılan çalışmalar ülkemizin İstanbul, İzmir, Malatya, Erzincan, Hatay ve Van gibi önemli şehirlerinin geçmişte bir çok kez yıkıcı depremlerle karşılaştığını göstermektedir. Araştırmacılar Ambraseys ve Finkel'in yapmış oldukları Türkiye deprem kataloglarına göre son 1500 yılda İstanbul'da büyük hasar oluşturan 12 deprem olmuştur. 17 Ağustos 1999 tarihinde meydana gelen Marmara depreminde 17.479 ölüm ve 43.953 yaralanma meydana gelmiştir. 1900'lü yıllar içinde dünyada 1000'den fazla ölüme neden olan 124 deprem meydana gelmiştir. Bu depremlerden 17 tanesi Türkiye topraklarında olmuştur. Barka ve arkadaşlarının 2000 yılında yaptıkları hesaplamalarda önümüzdeki 30 yıl içinde İstanbul'a yakın bir alanda kuvvetli bir deprem olma olasılığı  $62\pm 15$  olarak bulunmuştur. Bu bulgular Türkiye'nin dünyadaki bir kaç önemli deprem ülkesinden biri olduğu gerçeğini açıkça ortaya koymaktadır. Türkiye ve Türkiye'deki Acil Tıp günümüz ve gelecek ile ilgili yapmış olduğu tüm planlamalarını bu gerçeği göz önüne alarak yapmalıdır. (JAEM 2013; 12: 33-7)

**Anahtar kelimeler:** Deprem, depremler ülkesi, İstanbul, acil tıp, Türkiye

#### Introduction

"Turkey is an earthquake country." It is important to clarify the scientific foundations of these words which are frequently heard in Turkey. There have been several studies concerning Turkey's seismicity, particularly the research by Ambraseys and Finkel (1). These studies show that such major Turkish cities as İstanbul, İzmir, Malatya, Erzincan, Hatay and Van have been struck by several devastating earthquakes in the past (Figure 1) (1). Examination of some of these earthquake disasters in these cities provides important clues regarding Turkey's seismicity.

#### İstanbul

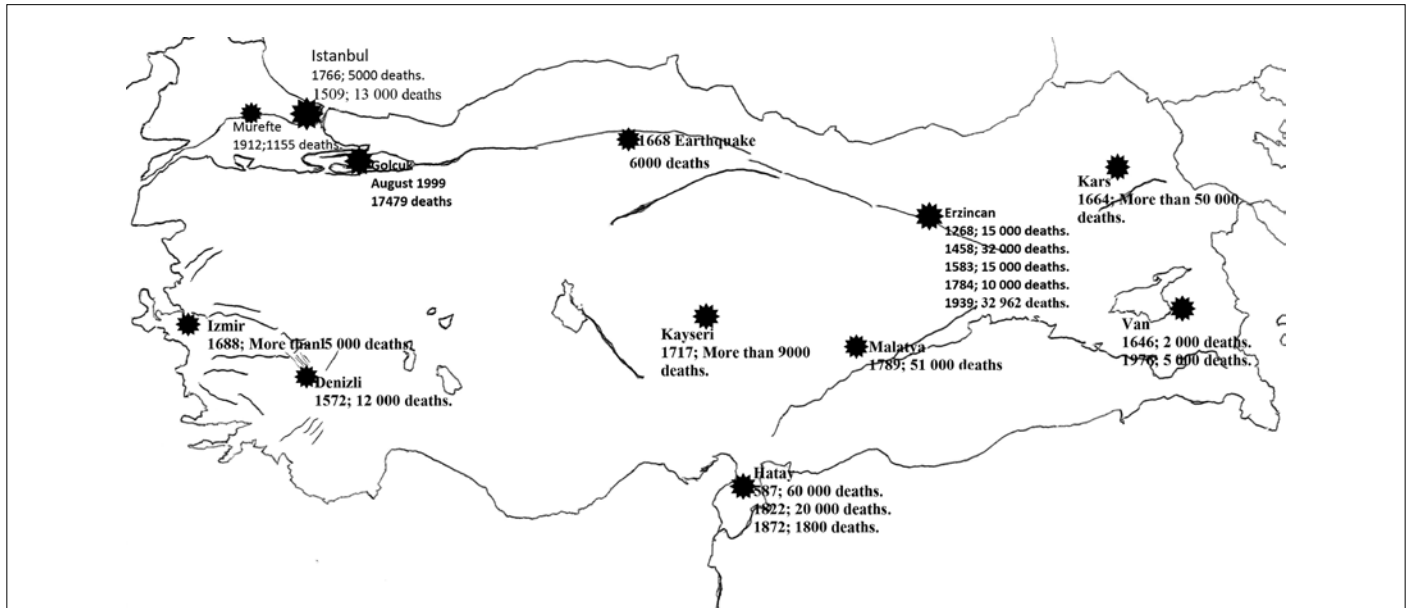
Researches show that İstanbul and its surrounding area have been exposed to destructive earthquakes ever since the first century AD (2). According to these studies, there is a strong likelihood that the earthquakes that struck in the years 32, 121, 128, 155, 181, 269, 358, 362, 447, 460, 478, 484, 557, 740, 861, 869, 967, 989, 1011, 1063, 1296, 1323, 1343, 1345 and 1419 AD all measured 7 or above. The earthquake of 9 November, 447 AD, has been described as "catastrophic." Houses and official buildings in İstanbul collapsed in the 447 earthquake, 57 of the 96 rampart towers fell down, the

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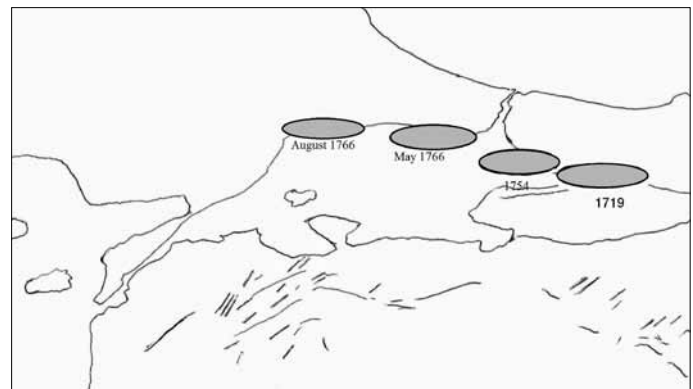


**Figure 1.** Some of devastating and deadly earthquakes in major cities in Turkey in the past

quake was followed by a tsunami, landslides occurred and large fissures opened up in the ground (2).

Nicholas Ambraseys and Caroline Finkel's book "The Seismicity of Turkey and Adjacent Areas" provides data regarding historic earthquakes in Turkey between 1500 and 1800. According to these data, the 1509 Istanbul earthquake was given the name of "Lesser Judgment Day." This devastating earthquake occurred around 22:00 hours on 10 September, 1509, and was felt across a wide region. People were left out in the open for many days. The Sultan initially stayed in a tent in the palace garden, and then moved to Edirne. The death toll in that quake has been put at about 13,000. The loss of life in İstanbul was put at about 2% of the city's population. These percentages would equate to 300,000 on the basis of the present-day population of around 15 million. More than 10,000 people were injured and houses collapsed on top of another 10,000 (1).

One of the great waves of earthquakes affecting İstanbul and its vicinity came in the 18<sup>th</sup> century. In that century the North Anatolian Fault, which covers the whole north of Turkey and is highly active, caused four major earthquakes affecting İstanbul and its vicinity. These highly destructive quakes took place in 1719, 1754, May 1766 and August 1766. The closest to İstanbul were the 1766 quakes (Figure 2). The May 1766 earthquake was the most powerful of the 18<sup>th</sup> century Marmara earthquakes. It struck on the morning of the third day of the Muslim Feast of the Sacrifice, 22 May, 1766. Numerous homes and public buildings in İstanbul collapsed during the quake and some 5000 people died. The destructive effects spread as far as the central parts of Thrace and the southern Marmara regions; the tsunami that followed struck the shores of the Bosphorus and the Gulf of Mudanya. Seventy-four days after the May 1766 earthquake, a second quake on 5 August caused extensive damage to the western part of Tekirdağ, which had been spared during the previous quake. That second quake struck at around 12:30 in the afternoon and lasted for less than 1



**Figure 2.** Destructive earthquakes affecting İstanbul and its vicinity in the 18<sup>th</sup> century

min. According to the European press, the quake caused no major destruction in İstanbul, although 20 people were killed and more than 100 injured in Samatya (1, 2).

One of the worst earthquakes affecting the Marmara region in the last century occurred in Mürefte on 9 August 1912, and covered an area comprising Mürefte, Şarköy, Gelibolu and Çanakkale, lasting 25-30 seconds. Some 9000 houses collapsed in the entire region affected by the quake. The death toll in Mürefte and the surrounding area was put at 1155 (3).

One of the strongest earthquakes in the Marmara region and surrounding area took place at 03:02 local time on 17 August, 1999, and was centered in Gölcük. According to data from the Prime Ministry Crisis Center, 66,441 homes and 10,901 workplaces suffered severe damage, 67,242 homes and 9,927 workplaces suffered moderate damage and 80,160 homes and 9,712 workplaces suffered mild damage. There were 17,479 deaths and 43,953 injuries (4). According to Ambraseys and Finkel's earthquake catalogue for Turkey, 12 destructive earthquakes have taken place in İstanbul in the last 1500 years (1, 5).

**Table 1.** Earthquakes with 1,000 or More Deaths since 1900 (U.S. Geological Survey)

Date	Location	Deaths	Date	Location	Deaths	Date	Location	Deaths
2010	Haiti	316000	1974	Pakistan	5300	1945	Japan	1961
1976	China	242769	1972	Iran	5054	1917	China	1800
2004	Sumatra	227898	1949	Ecuador	5050	1960	Chile	1655
1920	China	200000	1980	Algeria	5000	1990	Philippines	1621
1923	Japan	142800	1976	Muradiye*	5000	1997	Iran	1567
1948	Turkmenistan	110000	1972	Nicaragua	5000	1950	China	1526
2008	China	88000	1902	Russia	4700	1981	Iran	1500
2005	Pakistan	86000	1945	Pakistan	4000	1977	Romania	1500
1908	Italy	72000	1943	Ladik	4000	1917	Indonesia	1500
1990	Peru	70000	1914	Burdur	4000	1930	Italy	1404
1990	Iran	50000	1998	Afghanistan	4000	1946	Peru	1400
1927	China	40900	1906	Chile	3882	1946	Japan	1362
1939	Erzincan	32700	1929	Iran	3800	1983	Erzurum	1342
1915	Italy	32610	1948	Japan	3769	2005	Indonesia	1313
2003	Iran, Bam	31000	1923	China	3500	1946	Muş	1300
1935	Pakistan	30000	1903	Malazgirt	3500	1906	Taiwan	1250
1939	Chile	28000	1935	Taiwan	3270	1954	Algeria	1250
1988	Armenia	25000	1927	Japan	3020	1957	Iran	1200
1976	Guatemala	23000	1933	Japan	3000	1943	Japan	1190
2011	Japan	20352	1906	California	3000	1999	Colombia	1185
2001	India	20085	1981	Iran	3000	1957	Iran	1130
1974	China	20000	1969	China	3000	2009	Indonesia	1117
1905	India	19000	1912	Mürefte	2800	1942	Erbaa	1100
1999	Kocaeli	17118	1982	Yemen	2800	1963	Yugoslavya	1100
1978	Iran	15000	1931	Armenia	2800	1970	Gediz	1086
1960	Morocco	15000	1944	Gerede	2790	1953	Yenice Gönen	1070
1962	Iran	12225	1935	Taiwan	2740	1903	Göle	1000
1907	Russia	12000	1980	Italy	2735	1906	Colombia	1000
1949	Tajikistan	12000	1966	Varto	2529	1907	Jamaica	1000
1968	Iran	12000	1992	Indonesia	2500	1918	China	1000
1934	India	10700	1930	Iran	2500	1940	Romania	1000
1931	China	10000	1931	Nicaragua	2500	1951	Nicaragua	1000
1970	China	10000	1999	Taiwan	2400	1966	China	1000
1993	India	9748	1998	Afghanistan	2323	1966	China	1000
1985	Mexico	9500	1975	Diyarbakir	2300	1971	Bingöl	1000
1933	China	9300	2003	Algeria	2266	1976	Italy	1000
1976	Philippines	8000	1923	Iran	2200	1986	Salvador	1000
1944	Argentina	8000	1998	New Guinea	2183	1987	Colombia	1000
1909	Iran	6000	1902	Guatemala	2000	1988	Nepal	1000
1925	China	5800	1975	China	2000	2002	Afghanistan	1000
2006	Indonesia	5749	1991	India	2000			
1905	Japan	5502	1995	Sakhalin	1989			

\*The earthquake was located along the Turkish-Iranian border region  
(Note: Bold Italics are earthquakes which occurred in Turkey)

Using the Coulomb model, Parsons et al. (5) calculated a  $62\pm 15\%$  probability of a powerful earthquake near Istanbul within the next 30 years, and of  $32\pm 12\%$  of one within the next 10 years.

### Erzincan

In the 27 June, 1583 earthquake in Erzincan in eastern Anatolia, Erzincan was almost completely destroyed and 15,000 lives were lost (6). The earthquake on 18 July, 1784, affected a wide area extending from Erzincan to Muş. Reference sources state that only 500-600 of the 8000 houses in Erzincan were left standing, the rest having collapsed. The death toll varies according to the reference source, with some putting it at more than 10,000 (7). The 7.9 earthquake in Erzincan on 26 December, 1939, resulted in the loss of 32,962 lives, with some 100,000 people injured and 116,720 buildings destroyed. A 350-km fault line extending from Erzincan to Niksar developed, and deaths were reported from the provinces and regions of Tokat and Sivas (8). According to data from the Kandilli Observatory, 15,000 people died in the 1268 earthquake in the Erzincan region, and 32,000 in the 1458 quake (9).

### The 1668 Earthquake

The records show that a major destructive earthquake took place on the North Anatolia Fault from Bolu to Erzincan on 17 August, 1668. They also state that this was one of the largest and most devastating earthquakes on the North Anatolia Fault line and affected a very large area. Six thousand people are reported to have died in the destruction around Merzifon-Osmancık-Niksar. Records also state that the city of Bolu collapsed entirely, with 1800 people losing their lives (1, 2).

### Malatya

The records state that a major earthquake in the Malatya provincial borders, in the area of the present-day Keban Dam, in May 1789 also affected the regions of Elazığ and Tunceli. The total death toll is put at 51,000 (1, 10).

### Van

The earthquake in the area to the southeast of Lake on 7 April, 1646, caused severe damage in the city of Van, with many mosques collapsing. Records from the time to not give exact figures, but refer to "countless deaths" in order to give an idea of the magnitude of the death toll (1, 11). Five thousand people died in an earthquake measuring 7.3 in Muradiye, Van, in 1976 (12).

### Kars

A lengthy earthquake is reported to have occurred in Kars and Iğdır on 29 May, 1664, in which 50,000 are said to have lost their lives. Mosques, markets and tradesmen's shops were all destroyed. Records of the time show that two towers in the neighborhood of Ağrı were buried by landslides (13).

### İzmir

Records show that the 10 July, 1688, İzmir earthquake struck at 11:45 local time and lasted some 20-30 s. Only three of the city's large mosques were left standing (1). More than 15000 people in

İzmir lost their lives (9). Most of the loss of life is said to have come from a fire that broke out after the earthquake (1).

### Denizli

Twelve thousand people died in an earthquake in Denizli and the surrounding area at 08:30 on 25 February, 1572. Records show that the Gümüşçayı stream close to Eskihisar changed course (14).

### Kayseri

Records state that more than 9000 people died in an earthquake in Kayseri and the surrounding area on 9 May, 1717 (15). Considering that the total population of the city was just 25,000, the death toll gives an idea of the scale of the quake.

### Hatay- İskenderun

Twenty thousand lives were lost in an earthquake in the İskenderun region of Antakya and subsequent tsunami in 1822. A death toll of 8000 was reported in another earthquake in the Samandağ region of Antakya in 1872 (9). Records state that 60,000 people lost their lives in a devastating earthquake in Antakya in 587 AD (9).

According to U.S. Geological Survey data, the 20<sup>th</sup> century saw 124 earthquakes involving a death toll greater than 1000 across the world (Table 1) (12). Seventeen of these took place in present-day Turkey. The same source reports that, during the same time frame, there were 17 earthquakes with a death toll greater than 1000 in China, 16 in Iran, and 9 in Japan.

These findings show that Turkey is one of the countries worst affected by earthquakes and at greatest risk of being affected by them in the future. Turkey and Turkish emergency medicine must bear this reality in mind in all present and future planning.

### Conflict of Interest

No conflict of interest was declared by the authors.

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