ISSN: 3048-6181 www.wjphr.org 2024, Volume 1, Issue 3. Page: 27-30.

WJPHR

World Journal of
Pharmaceutical and Healthcare Research

Review Article

EARTHQUAKE BEHAVIOR AND PREDICTION

Muhammad Akram[1*], David Pérez-Jorge[2], Momina Iftikhar[1], Sarvananda L[3], Francisco Garcia-Sierra[4], Riyadh S Al-Malki[5], Fethi Ahmet Ozdemir[6], Gaweł Sołowski[6], Najmiatul Fitria[7], Marcos Altable[8], Adonis Sfera[9], Simone Brogi[10], Ho Soonmin[11], Zaryab Fatima[12], El Hadji Seydou Mbaye[13], Isah Suleiman Yahaya[14], Md. Torequl Islam[15], Yahaya Usman[16]

[1]Department of Eastern Medicine, Government College University Faisalabad-Pakistan.
[2]DISAE Research Group. University of La Laguna Spain.
[3]Molecular Nutritional and Biochemistry Laboratory, University of Peradeniya, Sri Lanka.
[4]Department of Cell Biology, Center of Research and Advanced Studies of the National Polytechnical Institute, Mexico City, Mexico.
[5]Department of Pharmacology and Toxicology, Faculty of Pharmacy, Umm Al Qura University, Makkah, Saudi Arabia.
[6]Department of Molecular Biology and Genetics, Faculty of Science and Art, Bingol University, Bingol, 1200, Türkiye.
[7]Department of Pharmacology and Clinical Pharmacy, Universitas Andalas, Indonesia.
[8]Department of Neurology, Neuroceuta, (Virgen de Africa Clinic), Spain.
[9]Department of Psychiatry, Patton State Hospital, USA.
[10]Department of Pharmacy, University of Pisa, Via Bonanno, 6, I-56126 Pisa, Italy.
[11]Faculty of Health and Life Sciences, INTI International University, 71800, Putra Nilai, Negeri Sembilan, Malaysia.
[12]Department of Sociology & Criminology, University of Sargodha, Sargodha.
[13]7BCNet International Working Group, IARC/WHO, Dakar –Senegal.
[14]Department of Medical Laboratory Science, Faculty of Allied Health Sciences, Bayero University, Kano, Nigeria.
[15]Pharmacy, Bangabandhu Sheikh Mujibur Rahman Science and Technology University, Bangladesh.
[16]Federal College of Forest Resources Management Maiduguri Borno State Nigeria.

Article Info

Article Received: 21 August 2024,
Article Revised: 11 September 2024,
Published on: 02 October 2024.

***Corresponding author:**
Prof. Muhammad Akram
Associate Professor,
Department of Eastern Medicine,
Government College University
Faisalabad-Pakistan.
makram_0451@yahoo.com

ABSTRACT

Understanding seismic activity patterns is necessary for earthquake behavior and prediction in order to anticipate future earthquakes. Tectonic plate movement and stress buildup along fault lines define seismic behavior. An examination of geological features, historical earthquake data, and seismic activity monitoring are important forecast techniques. While making exact forecasts is still difficult, advances in early warning systems, machine learning, and real-time data analysis help us better assess the danger of earthquakes and lessen their effects. In order to better understand and anticipate seismic events, ongoing research combines theoretical frameworks with observational data to improve preparedness and refine prediction models. It is essential to comprehend earthquake behavior and forecast in order to reduce seismic hazards and enhance safety. As a result of tectonic plate movements, stress that has accumulated along geological faults is released during earthquakes. Analyzing past earthquake data, geological traits, and patterns of seismic activity are all part of predictive efforts. The methods used now include tracking seismic waves, putting early warning systems in place, and using machine learning algorithms to find probable antecedents. Because seismic processes are complicated, reliable earthquake prediction remains elusive despite major progress. The objectives of ongoing research are to increase prediction accuracy, incorporate real-time data, and create practical mitigation plans that safeguard communities.

KEYWORDS: Geological Structures, Earthquake Precursors, Historical Earthquake Data, Seismic Waves, Seismic Monitoring.

INTRODUCTION

They assert that their prediction was successful if an earthquake almost matches their forecast, even if one or more of the forecasted components diverge significantly from the actual event, indicating a failure prediction. (Olson et al., 2014). Social media is typically the first place where non-scientist predictions go viral when something that is thought to be an earthquake's precursor occurs soon. (Moelling et al., 2016). The so-called precursor frequently manifests as a cluster of minor earthquakes, rising radon levels in nearby water, peculiar animal behavior, intensifying magnitudes in moderate-sized occurrences, or an exceptionally rare moderate-magnitude event that raises the possibility that it is an omen. (Sims et al., 2015). Unfortunately, no actual prediction can be made as most of these precursors often occur without an earthquake following. Conversely, though, if there is a scientific foundation; a probabilistic prognosis is possible. (Reichenbach et al., 1971). Check out: What distinguishes earthquake forecasting, prediction, probabilities, and early warning systems from each other. Many years ago, tiny tremors and odd animal activity were used to foretell earthquakes in China. (Ikeya etal., 2004). Since many individuals opted to sleep outside of their houses, they were spared when the major earthquake struck and caused extensive damage. Nevertheless, big earthquakes seldom occur after this kind of seismic activity, and regrettably, most earthquakes have no prior occurrences. Thousands of people perished in China's next big earthquake, which was unprecedented. The USGS concentrates its efforts on enhancing building safety and reducing earthquake hazards over the long term, as opposed to attempting to fulfill immediate projections. (National Research Council et al., 200; Vere-Jones et al., 1995). Although the distinction between "prognosis" and "prediction" is useful, not all scientists make it citation needed. (Bzdok et al., 019). The difference between prediction and earthquake warning systems is that the former send out real-time, seconds-long alerts to nearby locations that may be impacted by an earthquake. Scientists believed that a workable technique for earthquake prediction would soon be discovered in the 1970s, but persistent failures in the 1990s made many doubt the feasibility of the endeavor. No clearly successful forecast of a major earthquake has been made, and the handful that have are debatable. The most well-known example of a successful forecast is the one allegedly made regarding the Haicheng earthquake of 1975. (Chen et al., 2008). If predictions can be demonstrated to be successful beyond chance, they are deemed significant. Consequently, the chance that an earthquake similar to the one anticipated will occur in any case (the null hypothesis) is ascertained using statistical hypothesis testing techniques. The next step in evaluating the predictions is to see if they correlate more strongly with real earthquakes than with the null hypothesis (Kagan et al., 1978; Pereira et al., 2015; Knopoff et al., 2000; Pwavodi et al.,2024; Bluestone et al.,2010; Arcuri et al.,2015; Stein et al.,2010; Rose et al.,2004)

GEOLOGICAL STRUCTURES

Geological features often extend in a single direction, which is known as the "strike" direction. If a reservoir is significantly elongated, it may be necessary to take into account its finite resistivity, which will eventually cause the potential to decline along the current flow. Furthermore, less leakage into a more resistive medium happens as a result of the conductor's elongation because the positive charges on its surface act to direct the flow primarily along the body. The current wants to travel in the path of least resistance. This suggests that in the charged body technique, the charge density is largely directed outside of the electric field perpendicular to the conductor and decreases very slowly along the conductor's elongation axis. The way that land and water are distributed, the form of The geological structure dictates the shoreline and the course of evolution. The survey region contains a short river, most of the sediments are coarse clastic deposits, and the most common rocky coast features are sporadic capes and bays. One of China's elevated regions is the depression belt. Long-term depression deposited these places on the silt-muddy coast that is growing and the huge plains; the current rates of coastal settlement are 2 to 5 mm/a and 1 to 2 mm/a, respectively. The well-known Pécs basin geological structure, which has been the focus of multiple studies, forms the geological setting of the tailings ponds. The basement of the mountain is composed of gneiss and granite, the oldest pre-Paleozoic metamorphic formations. The thickness of clayey and sandstone Pannonian and Pleistocene deposits varies, ranging from several hundred meters to several hundred meters. A cross section of the tailings pond area is shown in Figure 9.16.The basement relief varies under and around the tailings ponds, where the surface of a metamorphic rock basin basement is located a few hundred meters below the surface. As a result, the tailings ponds' Pannonian sediments are only partially thick. about 20 to 50 meters. Permeable sandy and impermeable clayey sands are the two main Pannonian sediment types found in the basin. The vast volumes of water reserves stored in the porous sandy formations of this basin make it an important water source for the city of Pécs. An significant structural feature of the basin's sediments is that most of the strata outcrop across a very narrow area. This is typical behavior found around tailings ponds. This makes it challenging to distinguish between aquifers and impermeable strata. More importantly, the area beneath the waste ponds is made up of alternating deposits of sand and mottled clay-containing soils rather of a continuous dividing layer. (McClay et al., 2013)

EARTHQUAKE PRECURSORS

The probability of powerful earthquakes happening in Greece and almost every other earthquake-prone area of the world in the upcoming years has been determined using this model. Recently, there has been a great deal of work on the concept of a crucial earthquake, and more specifically on the accelerated moment. Pre cesses mainly studies pre seismic alterations in the electric field. However, the results are fiercely disputed. Research into earthquake prediction saw a spike in attention in the 1960s and 1970s. A passionate search was underway at the time for any clues or anomalies that would point to the presence of a significant earthquake and enable the deployment of countermeasures with societal significance. There was a decline in interest in finding a solution to the problem of earthquake prediction after a magnitude 7.8 earthquake in 1976 completely destroyed the Chinese city of Tangshan. As a result, assessments of seismic hazards gradually replaced tasks associated with earthquake forecasting. However, major projects are still underway in Russia, and the field of earthquake prediction research is still ongoing likewise China. Except for the predominance of false or incorrect claims of accurate forecasts or precursory results, predictive research has not changed over time. Despite claims made in the 1970s, experts are still unable to predict earthquakes more than 10 years in advance (Press, 1975; Rikitake et al., 1975)

HISTORICAL EARTHQUAKE DATA

Historic earthquakes are defined as the significant earthquakes that are known to have occurred before the turn of the 20th century. The events in this list occurred before systematic instrumentation records were kept, hence innovations such as deep space satellite detections, artificial intelligence (AI) for earthquake early warning systems, and seism otomography imaging technology came after them. Based on these studies, religious and traditional beliefs about earthquakes as "God's punishment" or "the wrath of God" as well as observations of shaking items and/or animal behavior during earthquakes are the main sources of. An earthquake's precise location, magnitude, and sometimes even date are sometimes unknown. Moreover, the death toll is often extremely speculative, particularly in cases that are older and unidentified.

Historical earthquake data is crucial for improving prediction algorithms and understanding seismic activity. This data contains records of past earthquakes, including their magnitudes, locations, depths, and effects. By searching these historical records for patterns and trends in seismic activity, scientists can get more insight into the behavior of fault lines and tectonic plates throughout time. This data aids in the estimation of potential seismic events in the future by assessing the earthquake recurrence intervals in certain places. Moreover, historical documents offer valuable information about the consequences of past earthquakes, which can guide the development of better building regulations and readiness plans. Scientists aim to increase risk mitigation strategies and seismic prediction accuracy by combining historical earthquake data with advanced analytical tools and modern seismic monitoring. The four main layers that comprise the Earth are the crust, inner core, outer core, and mantle. Moreover, these jigsaw pieces keep moving slowly, bumping with and falling upon one another. Tectonic plates are the names given to these puzzle pieces, while plate boundaries indicate the distances between the plates. Plate borders are formed by numerous faults, and the majority of earthquakes occur worldwide on these shortcomings. Scientists are unable to declare a lesser earthquake to be an earthquake before a larger one occurs omen. One of these is said to be the largest main shock. Large earthquakes typically have aftershocks. Aftershocks from a main shock might linger for weeks, months, or even years, depending on how big it was. (Stucchi et al., 2004)

SEISMIC WAVES

Velocity tends to rise as one descends into the Earth's crust. A mechanical sound wave that travels through a seismic wave travels through the Earth or another planetary body. Large-scale man-made explosions that generate low-frequency acoustic energy, volcanic eruptions, lava flows, large-scale landslides, and earthquakes in general can all be the source of it. Seismologists utilize accelerometers, hydrophones (used in water), or seismometers to monitor seismic waves. Seismic noise, sometimes referred to as ambient vibration, is a continuous, low-amplitude vibration that comes from both natural and artificial sources. Seismic waves are not the same as this. The density and elasticity of the medium, in addition to the wave type, influence how quickly a seismic wave propagates. Velocity tends to rise as one descends into the Earth's crust. and mantle, but quickly drops to Earth's outer core from Every now and again, scientists produce and monitor vibrations to investigate the surface structure below the surface. Primary waves are longitudinal compression waves, sometimes referred to as P waves (Honda et al., 1962)

SEISMIC MONITORING

Seismic monitoring is the systematic observation and study of seismic activity to understand and predict earthquakes. This approach uses a network of seismic wave sensors to detect ground motion caused by seizures and accelerometers positioned in various locations. These sensors measure the amplitude, frequency, and duration of seismic waves to offer real-time data on Earth's motions. Data from seismic monitoring is crucial for several reasons. Above all, technology makes it easier to quickly identify earthquakes, which makes it possible to offer early warnings that could prevent damage and save lives. Thanks to the efforts of seismic monitoring networks, scientists are able to map faults and tectonic boundaries in great detail, which helps them better understand regional seismic risks and the behavior of different seismic sources. The analysis of patterns and patterns of seismic activity—which are essential for identifying potential threats—is made possible by extended seismic surveillance. By routinely observing ground movements, researchers can identify differences in stress building along faults; these data may indicate a higher probability of earthquakes in the future. Furthermore, these data contribute to the enhancement of techniques for predicting earthquakes and the development of more accurate models for seismic hazards. The study of aftershock sequences after large earthquakes, which aids in identifying current threats and guiding emergency response efforts, is facilitated by seismic monitoring. By combining seismic data with other geophysical and geological information, we may advance earthquake preparedness and resilience strategies and gain a better understanding of seismic dynamics. (Urbancic et al., 2000)

CONCLUSION

In conclusion, even though understanding earthquake behavior and prediction has advanced significantly, producing reliable forecasts still presents difficulties. To evaluate risk and enhance readiness, current approaches make use of seismic monitoring, historical data, and sophisticated analytical algorithms. Our capacity for prediction is nevertheless constrained by the intrinsic complexity of seismic events and the unpredictability of fault movements. Sustained research that incorporates data analytics and technological advancements is essential for refining prediction models and creating efficient early warning systems. To lessen the effects of earthquakes and protect communities through enhanced preparedness and mitigation techniques, ongoing efforts in these areas are crucial.

REFERENCES

1. Arcuri A, Simoncini M. Scientists and legal accountability: lessons from the L'Aquila case. EUI Department of Law Research Paper. 2015(2015/17).
2. Bluestone JR. Why the earth shakes: Pre-modern understandings and modern earthquake science. University of Minnesota; 2010.
3. Bzdok D, Ioannidis JP. Exploration, inference, and prediction in neuroscience and biomedicine. Trends in neurosciences. 2019 Apr 1; 42(4): 251-62.
4. Chen QF, Wang K. The 2008 Wenchuan earthquake and earthquake prediction in China. Bulletin of the Seismological Society of America. 2010 Nov 1; 100(5B): 2840-57.
5. Honda H. Earthquake mechanism and seismic waves. Journal of Physics of the Earth. 1962; 10(2): 1-97.
6. Ikeya M. Earthquakes and animals: From folk legends to science. World Scientific; 2004 Jun 25.
7. Knopoff L. The magnitude distribution of declustered earthquakes in Southern California. Proceedings of the National Academy of Sciences. 2000 Oct 24; 97(22): 11880-4.
8. Kagan Y, Knopoff L. Statistical study of the occurrence of shallow earthquakes. Geophysical Journal International. 1978 Oct 1; 55(1): 67-86.
9. Moelling K. Viruses: More friends than foes. World Scientific; 2016 Oct 14.
10. McClay KR. The mapping of geological structures. John Wiley & Sons; 2013 Jun 17.
11. National Research Council, Division on Earth, Life Studies, Board on Earth Sciences, Committee on Seismology, Committee on the Economic Benefits of Improved Seismic Monitoring. Improved Seismic Monitoring-Improved Decision-Making: Assessing the Value of Reduced Uncertainty. National Academies Press; 2006 Feb 4.
12. Olson RS, Podesta B, Nigg JM. The politics of earthquake prediction. Princeton University Press; 2014 Jul 14.
13. Pwavodi J, Ibrahim AU, Pwavodi PC, Al-Turjman F, Mohand-Said A. The role of artificial intelligence and IoT in prediction of earthquakes. Artificial Intelligence in Geosciences. 2024 Feb 27:100075.
14. Pereira CM, de Mello RF. Persistent homology for time series and spatial data clustering. Expert Systems with Applications. 2015 Sep 1; 42(15-16): 6026-38.
15. Rose A. Defining and measuring economic resilience to disasters. Disaster Prevention and Management: An International Journal. 2004 Sep 1; 13(4): 307-14.
16. Rikitake T. Earthquake precursors. Bulletin of the Seismological Society of America. 1975 Oct 1; 65(5):1133-62.
17. Reichenbach H. The theory of probability. Univ of California Press; 1971.
18. Stein S. Disaster deferred: how new science is changing our view of earthquake hazards in the Midwest. Columbia University Press; 2010.
19. Sims J. The no-nonsense guide to earthquake safety (Enhanced Edition). Lulu. com; 2015.
20. Stucchi M, Albini P, Mirto M, Rebez A. Assessing the completeness of Italian historical earthquake data. Annals of Geophysics. 2004.
21. Urbancic TI, Trifu CI. Recent advances in seismic monitoring technology at Canadian mines. Journal of Applied Geophysics. 2000 Dec 1; 45(4): 225-37.
22. Vere-Jones D. Forecasting earthquakes and earthquake risk. International Journal of Forecasting. 1995 Dec 1; 11(4): 503-38.