

EDITORIAL

NAEGLERIA FOWLERI: RISING CASES DUE TO A UNIQUE STRAIN IN PAKISTAN**Syed Shabbir Afzal, Aabiya Arif, Priyanka Mohan Lal**

Ziauddin Medical University, Karachi-Pakistan

Naegleria fowleri is a pathogenic flagellate amoeba that can cause primary amoebic meningoencephalitis, a potentially fatal brain infection (PAM). Primary amoebic meningoencephalitis symptoms are similar to those of bacterial and viral meningitis, including fever, headache, stiff neck, nausea, vomiting, anorexia, and, in rare cases, seizures. Although this amoeba cannot live in saline water, the majority of cases recorded indicate that it thrives in saline residential water supplies, which is both surprising and concerning. In 2021 alone, Pakistan recorded six deaths due to *Naegleria fowleri* in a span of just two-month, five from Karachi and one from Balochistan. The number of deaths caused by *Naegleria fowleri* is steadily rising in Pakistan. There is currently no treatment for *Naegleria fowleri*, which is extremely concerning given that it has a death rate of 95–99 percent. As a result, preventative measures such as chlorinating water tanks, performing correct diagnostic tests, and utilizing distilled water for ablution procedures, among other things, play an important part in combating this disease.

Keywords: *Naegleria fowleri*, primary amoebic meningoencephalitis (PAM)

Citation: Afzal SS, Arif A, Lal PM. *Naegleria fowleri*: rising cases due to a unique strain in Pakistan. J Ayub Med Coll Abbottabad 2021;33(4):547–8.

Naegleria fowleri is a pathogenic flagellate amoeba that can cause a life-threatening brain infection known as primary amoebic meningoencephalitis (PAM). Being free-living it is commonly found in freshwater habitats and soil feeding off bacteria, but in rare circumstances, it can infect humans. It is commonly known as “Brain-eating Amoeba” as it can destroy neurons. Primary amoebic meningoencephalitis has a similar presentation to bacterial and viral meningitis including fever, headache, stiff neck, nausea, vomiting, anorexia, and occasionally seizures as well. Death commonly ensues after 3–7 days of the appearance of signs and symptoms as a result of increased intracranial pressure and edema with cerebral herniation.¹ The parasite is commonly found in immunologically strong individuals as well as in healthy children and young adults, having had recent exposure to recreational freshwater. The infection begins as it attaches to the nasal mucosa to travel along the olfactory nerve and reach the olfactory bulbs via the cribriform plate inside the CNS.¹

This amoeba is becoming a concern in Karachi, Pakistan's largest city and a major coastal port. PAM was initially reported in 2008,² and within a decade the number of cases documented in Pakistan surpassed those reported in the United States for the previous half-century (i.e., 142 cases between 1968 and 2019)³. This year, within 2 months, Pakistan has reported 6 deaths due to *Naegleria fowleri*, of which five are from Karachi and one from Baluchistan.⁴ First being around mid-May 2021, next on the second week of June followed by another on the 28th of June and the rest of the 3 deaths took place within the first two weeks of July 2021.^{5,6}

The number of deaths caused by *Naegleria fowleri* is showing an increasing trend; in 2017 there were a total of six deaths followed by seven in 2018 and by October of 2019, Karachi had witnessed 15 deaths.^{7,8} This year Pakistan has witnessed 6 deaths in just under 2 months, moreover, PMA representatives expressed that they feared that unreported deaths would be higher than the reported ones.⁴ Considering that this amoeba has a mortality rate of 98% with no proper treatment known to the medical world, this increasing trend is of concern.

The majority of PAM cases in the United States were recorded in children under the age of 14, but the majority of cases in Pakistan were documented in adults aged 26–45 years. In addition, most of the reported cases of PAM, in Pakistan, are not related to recreational water activity, which suggests that the saline domestic water supply is the most common vector for transmission. Amoebas cannot thrive in saline water; thus, this is surprising. These findings indicate that the *Naegleria fowleri* strain found in Pakistan has gained tolerance to saline settings, implying the existence of a genetically distinct strain in Pakistan.⁹

From April through October, the average temperature in Karachi remains above 30 °C which leads to most cases being reported during this period.² Annual mean surface temperatures in Pakistan have progressively increased over the last century as a result of global warming. The summer of 2010 brought temperatures of more than 50 °C to twelve Pakistani cities.¹⁰ This tendency of rising temperatures in Pakistan as a result of global warming provides the optimum temperature range (35–46 °C.) for the growth of *Naegleria fowleri* reproductively active and infectious stages.¹ Water delivery in Karachi can be inconsistent,

because of which underground and overhead storage tanks are required. During the summer, ambient temperatures can exceed 44 °C, causing water temperatures in overhead tanks to rise. Water temperatures of up to 34°C were discovered, which may promote the excystation of *Naegleria fowleri* amoebae to infective forms.¹¹ Although *Naegleria fowleri* infections are most commonly connected with recent exposure to freshwater during recreational activities, they have also been linked to insufficiently chlorinated household water supplies or swimming pools.² On 12 July 2021, 95% of the water samples taken from the city's 50 union councils revealed that they were unfit for human consumption, and water is also becoming polluted with sewage as a result of line leaks¹² and because chlorine concentrations have been variable throughout the water distribution system, *Naegleria fowleri* has been able to persist and grow as a biofilm in supply lines, residential plumbing, and overhead water storage tanks¹³.

Primary amoebic meningoencephalitis instances have recently been diagnosed in association with nasal irrigation utilizing neti pots and ablution practices (religious nasal washing).² On June 28, 2021, a man in Karachi died as a result of *Naegleria fowleri*. When the Sindh Health Department and the Karachi Water and Sewerage Board investigated the source of the bacteria, they discovered that the victim and his family used groundwater at home and that he performed ablution at home as he was a religious person.¹⁴ These instances have been reported previously and have been increasing and raise a question of concern. Currently, there is no treatment for this which is quite alarming due to high mortality.¹ Hence the best way to tackle this disease is through prevention. The government should make distilled or purified bottled water accessible for ablution at mosques and urge that ablution water used at home be boiled or filtered with pores of 1 µm or smaller instead of untreated water. Swimming and other water recreational activities in unchlorinated water bodies should be avoided from March to October, and if they cannot be avoided, persons should use nose clips to prevent water from entering the nose. Because chlorination is the only known way for eliminating germs, the government should encourage regular and quality-regulated chlorine pumping from April to October at water filtration and distribution plants. Since deteriorating water line conditions of Karachi hinders the chlorination of water. Hence the government should encourage the public to chlorinate their water tanks annually. Research into this potentially unique strain of amoeba in Pakistan holds much importance as this

might improve our prevention, diagnosis, management, or treatment strategies. Hence, the government should encourage or allot grants for such researches. Because the symptoms of viral meningitis are similar to those of *Naegleria fowleri*, the government should encourage hospitals to test for it even in patients with a classical presentation of viral meningitis, which occurs most frequently between March and October.

REFERENCES

1. Jahangeer M, Mahmood Z, Munir N, Waraich UE, Tahir IM, Akram M, *et al.* *Naegleria fowleri*: Sources of infection, pathophysiology, diagnosis, and management; a review. *Clin Exp Pharmacol Physiol* 2020;47(2):199–212.
2. Ghanchi NK, Jamil B, Khan E, Ansar Z, Samreen A, Zafar A, *et al.* Case Series of *Naegleria fowleri* Primary Amoebic Meningoencephalitis from Karachi, Pakistan. *Am J Trop Med Hyg* 2017;97(5):1600.
3. Pakistan: Is the *Naegleria fowleri* strain seen in Karachi different? [Internet]. *Outbreak News Today* [cited 2021 Aug 16]. Available from: <http://outbreaknewstoday.com/pakistan-is-the-naegleria-fowleri-strain-seen-in-karachi-different-15208/>
4. PMA urges people to take precautions to avoid 'brain-eating' amoeba - Pakistan [Internet]. DAWN.COM [cited 2021 Aug 16]. Available from: <https://www.dawn.com/news/1635136>
5. Karachi reports fourth death of 2021 from *Naegleria* [Internet]. [cited 2021 Aug 16]. Available from: <https://www.geo.tv/latest/359614-karachi-reports-fourth-death-of-2021-from-naegleria>
6. Another *Naegleria* death reported in Karachi - Pakistan - [Internet]. DAWN.COM [cited 2021 Aug 16]. Available from: <https://www.dawn.com/news/1634761>
7. Karachi: 11 *Naegleria fowleri* deaths in 2019 through July according to Pakistan media. [Internet]. *Outbreak News Today* [cited 2021 Aug 16]. Available from: <http://outbreaknewstoday.com/karachi-11-naegleria-fowleri-deaths-in-2019-through-july-according-to-pakistan-media-15269/>
8. Pakistan: 15th *Naegleria fowleri* death reported in Karachi - [Internet]. *Outbreak News Today* [cited 2021 Aug 16]. Available from: <http://outbreaknewstoday.com/pakistan-15th-naegleria-fowleri-death-reported-in-karachi-97298/>
9. Ali M, Jamal SB, Farhat SM. *Naegleria fowleri* in Pakistan. *Lancet Infect Dis* 2020;20(1):27–8.
10. GLOBAL WARMING AND ITS IMPACTS IN PAKISTAN. [Internet]. [cited 2021 Aug 16]. Available from: https://www.climateemergencyinstitute.com/uploads/global_warming_and_its_impacts_on_Pakistan.pdf
11. Ghanchi NK, Khan E, Khan A, Muhammad W, Malik FR, Zafar A. *Naegleria fowleri* Meningoencephalitis Associated with Public Water Supply, Pakistan, 2014. *Emerg Infect Dis* 2016;22(10):1835–7.
12. Doctor, boy fall victim to 'brain-eating' amoeba in Karachi - Pakistan. [Internet]. DAWN.COM [cited 2021 Aug 16]. Available from: <https://www.dawn.com/news/1634585>
13. Karim AM, Yasir M, Ullah I, Lee JH, Lee SH. Important factors causing high fatal cases of *Naegleria fowleri* primary amoebic meningoencephalitis in Pakistan. *Int J Infect Dis* 2020;97:230–2.
14. *Naegleria* death in Karachi: How was the patient infected? [Internet]. SAMAA [cited 2021 Aug 16]. Available from: <https://www.samaa.tv/news/2021/07/naegleria-fowleri-karachi/>

Address for Correspondence:

Syed Shabbir Afzal, Ziauddin Medical University, Karachi-Pakistan

Email: syedshabbirafzal6@gmail.com