

NAEGLERIA FOWLERI IS EATING BRAINS OF OUR PEOPLE: ARE WE AWARE OF THAT?

Shahid Mahmood Sethi,¹ Muhammad Arslan Tariq²

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Public health is an interesting field of science in which we face challenges every day. On one hand, we are concerned with common communicable diseases like influenza, measles, chicken pox, malaria, where we have been able to protect our people with reasonable success, however, number of emerging diseases like dengue, COVID-19 and now *Naegleria Fowleri* infection is diverting our attention and resources. These emerging infections not only indicate a change in disease agents and host immunity but also reflect the climate change, which in turn is transforming the ecological settings where disease agents live. Man has manipulated nature for his sustenance in the name of development and at the expense of habitat of other living organisms. In doing so, he has exposed himself to certain dangers to his health and well-being. Even behaviors that are adopted for recreation has put him at risk of contracting unusual infections such as *Naegleria Fowleri* (brain-eating amoeba).

Naegleria Fowleri is a free-living amoeba found in warm freshwater environments worldwide. It is a rare but highly lethal pathogen that can cause a devastating brain infection known as primary amoebic meningoencephalitis (PAM).¹ The amoeba enters the body through the nasal passages usually during activities such as swimming or diving in contaminated water. Once inside, it migrates to the brain, where it rapidly multiplies and causes severe inflammation, leading to neurological damage and death.² *Naegleria Fowleri* infections are exceedingly rare, with only a few cases sporadically reported worldwide each year. However, the infection carries an alarmingly high fatality rate and it is estimated to

be over 97%.³ Early symptoms, which could mimic bacterial meningitis, include headache, fever, nausea, and vomiting. As the disease progresses, patients may experience neurological symptoms like seizures, hallucinations, and altered mental status, often leading to a rapid deterioration within a few days.¹ There are almost 20 strains of *Naegleria* known but only *Naegleria Fowleri* is pathogenic in humans. Owing to the fact that it has unknown and possibly multi-factorial mechanisms of pathogenesis, a deep insight into its genetic background can reveal the reason for severe and rapidly fatal disease. Identification of unique genetic markers (e.g., singletons, novel genes), novel paralogues of known genes or protein families, and genes obtained via horizontal gene transfer will be crucial for understanding the mechanism of disease caused by this deadly pathogen. A genomic approach involving searching whole genome of *Naegleria Fowleri* could identify novel locations for its clinical manifestations.

Naegleria Fowleri is a rare infection and infection progresses quickly. The effective treatments pose challenge to the scientific community. Currently, PAM is treated with a combination of drugs including amphotericin B, azithromycin, fluconazole, rifampin, miltefosine, and dexamethasone. Miltefosine is the newest of these drugs. It has been shown to kill *Naegleria Fowleri* in the laboratory and has been used to treat three survivors.³

Developing countries do not invest much on recreational facilities such as swimming pool, playing grounds, gymnasiums for the public, therefore children and adults resort to use any water source, even rain water, for swimming and expose themselves to many disease such as gastrointestinal infections and brain eating amoeba. *Naegleria Fowleri* thrives in warm freshwater environments, such as lakes, rivers, hot springs, and poorly

1,2. Department of Community Medicine Allama Iqbal Medical College Lahore

Correspondence:

Dr. Shahid Mahmood, Associate Professor, Department of Community Medicine Allama Iqbal Medical College Lahore.
shahidsethi@hotmail.com

maintained swimming pools and spas. During periods of high water temperatures, particularly in the summer months, the amoeba's population can increase, posing a greater risk to individuals who come into contact with contaminated and non-chlorinated water sources. While the amoeba is most commonly found in freshwater environments, there have been rare instances of it being isolated from soil and poorly treated drinking water systems, that is raising concerns about potential additional routes of transmission.

Preventing *Naegleria Fowleri* infections primarily comprise of avoiding exposure to contaminated water. This could be achieved by avoiding water-related activities in warm freshwater bodies, using nose clips or holding the nose shut when engaging in water sports. Ensuring swimming pools and spas are adequately chlorinated will be protective. In some countries, another route of transmission is religious rituals, such as ablution by Muslims or taking bath (like Ganga Ashnan by Hindu pilgrims), in which water is pushed deeper to the upper nasal membrane, and amoeba may get entry through cribriform plate. Although said amoeba cannot infect individuals through ingestion or skin contact, inhaling contaminated water into the nasal passages provides the amoeba with direct access to the brain through the olfactory nerve.² Public health authorities may play a critical role in monitoring and preventing *Naegleria Fowleri* infection. Surveillance program should employ early notification and tracing of the cases. Water testing for adequate chlorination and public awareness regarding this potential hazard will ensure public protection.

Primary amoebic meningoencephalitis (PAM) due to *Naegleria Fowleri* is an emerging public health issue in Karachi, the major metropolitan city and coastal region of Pakistan. The first case of PAM was reported in 2008, and up until October 2019, about 146 cases had been reported from Karachi. As far as distribution of PAM cases in Pakistan, all cases were from Muslim community with no history of water related recreational activity, which may point towards religious rituals among these cases. It is interesting to observe this amoeba surviving in saline water sources of Karachi. This is possible that the type of strain prevalent in Pakistan might have developed resistance against saline environment.³

This needs to be explore further.

Comparing the incidence with other countries, the number of PAM cases in Pakistan exceeded those reported in the USA(141 cases reported from 1968 to 2019).² There is a difference in age as regards this infection; the highest number of PAM cases in the USA were reported in children younger than 14 years, but in Pakistan, most cases are reported in adults aged 26–45 years,² which may indicate a genetically different strain in Pakistan, which warrants further research in this regard.⁴ Climate change may have contributed in emergence of this infection in Pakistan.⁶ A surveillance and monitoring activity should be initiated in all parts of Pakistan.

In summary, *Naegleria Fowleri* is naturally occurring amoeba in fresh water. People should always assume that *Naegleria Fowleri* is present in warm freshwater lakes, rivers, and hot springs. However, infection is rare and there is no rapid test available to detect the amount of this amoeba in water. Therefore, Public awareness, adequate case reporting and reasonable environmental sanitation is the key to prevent this infection and to protect public from this amoeba for not eating their brains!

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