



# The main types of bacteria causing meningitis in children, infants and the role of the breast feeding to reduce meningitis in Tripoli-Libya

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## Abstract

Meningitis is an infection of the fluid of spinal cord and the fluid that surrounds the brain, it is a life-threatening illness beyond the neonatal period, childhood, or at any time of age, the most cases are due to infection with viruses, bacteria, fungus, and the parasites being the next most common causes, it may also result from various non-infectious causes. The study was carried out over a 12-months period, and there were 360 children with a presumptive diagnosis of acute bacterial meningitis. The study shows that the incidence of acute bacterial meningitis was 3.6%, Children of one year of age were more affected by the infection 3.05%, the rest of infected children is above one year age, the total of child male to child female ratio was 1.2:1.

From the total studied cases 96 % shows no infection with meningitis, the incidence of Streptococcus pneumonia is (29%) which make it the predominant organism identified, followed by Neisseria meningitidis (22%), followed by Haemophilus influenza and Enterobacter sakazakii (14%) respectively, and followed by Pseudomonas aeruginosa (7%).

**Keywords:** Meningitis. infection. Infants. Breast feeding. Bacteria. Virus. fungus.

## Introduction

Meningitis is an infection of the fluid in the spinal cord and the fluid that surrounds the brain [Tunkel, A.R and Hartman, B.J. 2004]. Meningitis is a life-threatening illness which is caused by a virus or a bacteria beyond the neonatal period, childhood, or at any time of age [Larry, E. Davis,Faan,. 2018].

It appears that epidemic meningitis is a relatively recent phenomenon, since the first recorded major outbreak occurred in Geneva in 1805, several other epidemics in Europe and the United States were described shortly afterwards, in Africa the first report of an epidemic appeared in 1840. Meningitis is usually caused by infection from viruses or other micro-organisms [Attia ,J and Hatala ,R; et al., 1999] such as bacteria, fungus, and the

parasites being the next most common causes, and it may also result from various non-infectious causes.[Tunkel, A.R. and Hartman, B.J., et al., 2004]

Viral meningitis, which is called aseptic meningitis, is generally less severe and often disappears without specific treatment, it is typically occurs in the summer and early fall, and is seen primarily in children and young adults, the most common viruses that can cause meningitis includes herpes simplex virus type 2 (and less commonly type 1), varicella zoster virus (known for causing chickenpox and shingles), measles, influenza, west Nile, mumps virus, HIV, LCMV and enteroviruses, these viruses are found in the throat and feces of infected people. [Logan SA, and MacMahon E ., 2008].

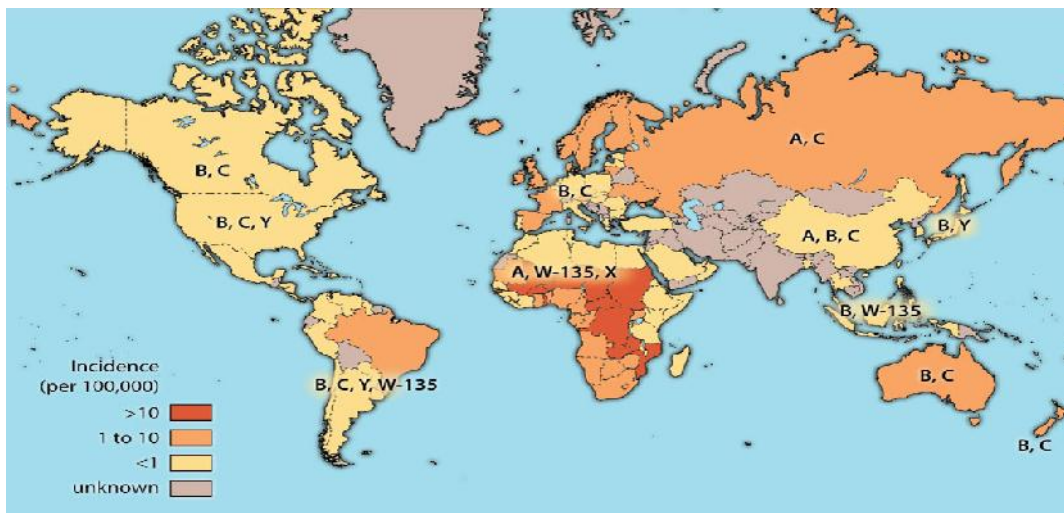
Fungal meningitis is relatively uncommon but causes chronic meningitis, occasionally it can cause mimic acute bacterial meningitis, Cryptococcal meningitis is a common fungal infection leading to the disease that affects people with immune deficiencies, such as in patients with AIDS,[ Panackel, C. ; Vishad; Cherian, G. et al 2006][Weller, P.F and Liu, L.X., 1993].

The parasitic infection is assumed to cause meningitis when there is a predominance of eosinophils in the CSF, the most common parasite implicated are *Angiostrongylus cantonensis*, and *Gnathostoma spinigerum*[ Panackel, C. ; et al., 2006][Weller, P.F and Liu, L.X., 1993].

Bacterial meningitis can be a serious and may lead to brain damage, hearing loss, or learning disabilities in children; the infection may even cause death, since it is characterized by inflammation of the meninges [Raymund, R.and Razonable.2009].

A minimum of 50 kinds of bacteria can cause Bacterial meningitis, according to the Center of Disease Control [CDC] . Acute bacterial meningitis usually occurs when bacteria enter the bloodstream and migrate to the brain and spinal cord, but it can also occur when bacteria directly invade the meninges, as a result of an ear or sinus infection or a skull fracture [Raymund, R.and Razonable.,2009].

The most common organisms that cause bacterial meningitis are *Streptococcus pneumoniae*, , *Neisseria meningitidis*, *Streptococcus group B*, *Escherichia coli*, *Haemophilus influenzae type b*, *Mycobacterium tuberculosis*, *Enterobacter sakazakii* [Jackson,L.A., et al,1995], [Daniel B.Jernigan, at al 2002].Meningitis due to the infection by *Mycobacterium tuberculosis*, is more common in those from countries where tuberculosis is common [Lawn, SD; Zumla, AI . 2011], but it is also encountered in those with immunodeficiency diseases such as AIDS [Opara, Ambrose. et al (2011)], *Enterobacter sakazakii* (*Cronobacter* spp.) defined as a new species of *Cronobacter* in 1980 and recognized as causative agents of neonatal meningitis, which have been linked to the consumption of contaminated reconstituted infant formula [Lai, K.K., 2001]. Some neonatal *Cronobacter* (*E. sakazakii*) infections have been associated with the use of powdered infant formula[CDC 2002][ Bowen AB and Braden CR 2006] with some strains able to survive in a desiccated state for more than two years [ Caubilla-Barron J and Forsythe S 2007].Although meningitis is a notifiable disease in many countries, the exact incidence rate is unknown [Logan, S.A.and MacMahon, E., 2008 ] Bacterial meningitis occurs in about 3 people per 100,000 annually in Western countries, population-wide studies have shown that viral meningitis is more common, at 10.9 per 100,000, and occurs more often in the summer [ Attia, J. ;Hatala, R, et al, 1999]. Epidemics typically occur in the dry season (December to June); [Greenwood, B., 1999] .

**Figure (1) incidence of meningitis.**

There are significant differences in the local distribution of causes for bacterial meningitis, the *Neisseria meningitidis* groups B and C cause most disease episodes in Europe, and group A is found in Asia and continues to predominate in Africa, where it causes most of the major epidemics in the meningitis belt, accounting for about 80% to 85% of documented meningococcal meningitis cases [W H O., 1998].

The incidence of meningitis is presumed to be higher in developing countries because of less access to preventative services such as vaccination, among the common causes of acute bacterial meningitis, the highest mortality rate is observed with pneumococcus [Raymund R., et al 2009]. The Incidence of neonatal bacterial meningitis is 0.25-1 case per 1000 live births; In addition, the incidence is 0.15 case per 1000 full-term births and 2.5 cases per 1000 premature births [Scheld, W.M., et al 2002], [Schuchat., et al 1997]. Approximately 30% of newborns with clinical sepsis have associated with bacterial meningitis [Scheld, W.M., et al 2002].

## Material and Methods

Since the study designed to detect the main types of bacteria that cause meningitis in children, and infants, as long as to detect the role of breast feeding and the correlation between the bottle feeding babies and infection by meningitis, also, to indicate the percentage of infected people by meningitis in Tripoli city Libya, the investigations carried on based on a medical history, a physical exam and certain diagnostic tests.

In this study 360 specimens of cerebrospinal fluid from infants and children, who have the symptoms and expected to have meningitis infection were examined, all the specimens were investigated by using routine microbiological techniques, which are the most common for the diagnosis of meningitis, these techniques used for isolation, identification and characterization of bacterial meningitis which includes *Neisseria meningitidis*, *Streptococcus pneumoniae*, *Haemophilus influenzae* and *Cronobacter sakazakii* from the cerebrospinal fluid [Tunkel AR., et al 2004]. The diagnosis of meningitis depends on lumbar puncture techniques to obtain cerebrospinal fluid samples from the patients. Spinal fluids are obtained by lumbar puncture used for Cell counting, Gram stain, culture and sensitivity test, glucose levels, protein concentration. The investigation starts by inoculating the obtained CSF samples on Cooked meat broth, Glucose broth, Chocolate agar media, MacConky agar media and Blood agar media which incubated at 37°C aerobically and anaerobically with 5% CO<sub>2</sub>, those used for cultivation of aerobes and anaerobes microorganisms, especially pathogenic

microorganisms, then cerebrospinal fluid samples screened to measure sugar, and protein concentration, and to differentiate and count cells in samples.

CSF fluid often shows a low sugar (glucose) level along with an increased white blood cell count and increased protein concentrations in patients with meningitis. Staining the smear of CSF deposit, which obtained by centrifugation, with Leishman's stain and Gram stain, to classify bacteria and to differentiate between white blood cells; finally the isolated bacteria were identified by using API system.

## Results

A study to the patients, who have come with the symptoms of meningitis infection in the city of Tripoli-Libya, has been made, the number of patients in the study were 360 cases. After the investigations made, the results show that 7 out of 220 child female, and 6 out of 140 child male infected by meningitis infection. The percentage of infected people is 3.6% and the percentage of (female and male) who infected are (3.18% and 4.28%) respectively, by looking at the results the majority of meningitis infections in the city of Tripoli, and one case is out of the city, two cases are non-Libyan as in table (1).

There are 12 cases who bottle feeding and only one case who breast fed and bottle feeding, in cases with meningitis infections, this result approves the fact that the breast feeding baby is more resistible to the infection by the bacterium causes meningitis, and the bottle feeding could be contaminated and source of infections, furthermore, we could isolate the *Enterobacter sakazakii* for the first time in Tripoli city, which not isolated in the previous study in Benghazi city.

Table (1) distribution of the patients according to their age, sex, nationality.			
Clinical parameter		Number of patients	Number of patients with meningitis
Sex	Male	140	6
	Female	220	7
Age	Less than 2 months	64	3
	From 2 months	221	8
	More than 1 year	75	2
Address	Tripoli	233	12
	Outside Tripoli city	27	1
Nationality	Libyan	153	11
	non Libyan	7	2
Breastfeeding	breast-feed for only	7	-
	the breast feed and bottle feeding		1
	bottle feeding only.		12

## Discussion and Conclusion

The study was carried out over a 12-month period, and there were 360 children with a presumptive diagnosis of acute bacterial meningitis, the incidence of acute bacterial meningitis infections was 3.6%, and about 96% showed no infection with meningitis, children of one year of age were more affected by the infection which 3.05%, the rest of infected children is above one year age, the total of child male to child female ratio was 1.2:1. The incidence of *Streptococcus pneumoniae* is (29%) which make it the predominant organism identified, followed by *Neisseria meningitidis* (22%), followed by *Haemophilus influenzae* and *Enterobacter sakazakii* (14%) respectively, and followed by *Pseudomonas aeruginosa* (7%) as it shown in tables (2,3).

Table (2) CSF culture results		
No of pts	CSF growth	Percentage
4 Patients	Streptococcus pneumonia	40%
2Patients	Neisseria meningitides	20%
1 Patients	staphylococcal meningitis	10%
2 Patients	Enterobacter sakazakii (Cronobacter spp.)	20%
1 Patients	Pseudomonas	10%

Before performance of a diagnostic lumbar puncture, many children with meningitis receive antibiotics (49%), Many of the bacterial isolates were sensitive to ampicillin, cefotaxime and ceftriaxone and least sensitive to chloramphenicol.

Invasive infection is slightly more common in males than in females, the ratio is highest in infancy and gradually decreases with age [Saul, N and Faust; M.A., 2009]. The percentage of child male who infected with meningitis is 4.28% which is more than child females percentage which is 3.18%, this result compatible with most previous studies in Benghazi city in Libya in 1998 , Egypt and USA, but different in Saudi Arabia .

We come out with the study to diffuse awareness about the causes of meningitis and encourage providing children vaccines against all types of bacteria that cause meningitis, to diffuse awareness about the importance of mother's breastfeeding, to raise awareness of the risk of giving antibiotics and their direct impact in the outcome analysis of meningitis, to increase control over the dry baby milk formula and provide the necessary tests to detect the bacterium Enterobacter sakazakii (Cronobacter spp.).

Table (3) CSF samples Infected by meningitis		
No of pts	Bacterial meningitis	Percentage
4 Patients	Streptococcus pneumonia	29%
2Patients	Haemophilus influenzae type b	14%
3Patients	Neisseria meningitides	22%
1 Patients	Staphylococcal meningitis	7%
2 Patients	Enterobacter sakazakii (Cronobacter spp.)	14%
1 Patients	Pseudomonas	7%
1 Patients	GBS	7%

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