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Second hand smoke exposure associated with risk of invasive meningococcal disease: Commentary reviews based on epidemiological evidence

Dr. Shaik Kareemulla^{1*}, M. Pavan Kumar Reddy², Shaik Mohammed Ishak²,
G. Jyothsna², K. Sreeharinadh²

^{1*}Assistant professor, Department of Pharmacy Practice, P. Rami Reddy Memorial College of Pharmacy, Kadapa, Andhra Pradesh, India

²Doctor of pharmacy Intern, P. Rami Reddy Memorial College of Pharmacy, Kadapa, Andhra Pradesh.

*Corresponding author: Dr. Shaik Kareemulla

Email: tanveerkareems@gmail.com

ABSTRACT

Summary

Overview of systematic reviews of observational epidemiological evidence suggests that passive smoking is significantly associated with an increasing risk of many diseases or health problems, especially meningitis. Active smoking is a recognized risk factor of various infectious diseases. Passive smoking appears to increase the risk of meningococcal disease (MD) in adolescents. Although smoking and smoking-associated diseases are associated with a high risk of infection, most therapies aim to reduce inflammatory parameters, but do not necessarily take into account the presence of persistent colonisers. Further epidemiological, clinical and mechanistic research into this important area is warranted. The effect of cigarette smoke on host-pathogen interaction dynamics in the nervous system, together with current and novel therapies will have significant role in elimination of infectious diseases completely. Both exposure to 'smoke', or 'smokers' (who are highly susceptible to pharyngeal carriage of meningococcal) are postulated mechanisms, but unfortunately very few studies have examined the risk of exposure by considering these two variables separately, and this therefore remains a research priority.

Keywords: Active smoking, Second-hand smokers, Bacterial meningitis, Persistent colonisers, Host-Pathogen interaction, Pharyngeal carriage.

INTRODUCTION

Bacterial meningitis is the most serious type of meningitis. It can lead to death or permanent disability. It is a medical emergency. In this condition, bacteria mainly affect the meninges.

Meninges are the membranes that surround the brain, spinal cord and protect the central nervous system (CNS), together with the cerebrospinal fluid [1]. In 2006, the mortality rate for bacterial meningitis was 34 percent, while 50 percent of

patients experienced long-term effects after recovery. Due to this, treatment with antibiotics must be started as soon as possible. Several types of bacteria can cause bacterial meningitis, such as *Streptococcus pneumoniae* and Group B Streptococcus. Other types of meningitis include viral, parasitic, fungal, and non-infectious meningitis, but the bacterial type meningitis is the most severe.

Facts on bacterial meningitis

- ❖ In the United States (U.S.) from 2003 to 2007, there were around 4,100 cases of bacterial meningitis each annum, of which 500 cases were fatal.
- ❖ Bacterial type is the second most common type of occurring when compared to viral meningitis, and it is more serious.
- ❖ Infants are at high risk of bacterial meningitis.
- ❖ It spreads easily in places where many people gather, such as college campuses.
- ❖ Early signs include fever, stiff neck, headache, nausea, vomiting, confusion and increased sensitivity to light. Immediate medical attention is essential. [1, 2]
- ❖ Vaccination is important to prevent meningitis. Vaccines that protect against three types of bacterial meningitis are *Neisseria meningitidis* (*N. meningitidis*), *Streptococcus pneumoniae* (*S. pneumoniae*) and *Haemophilus influenzae* (*H. influenzae*) type B (*Hib*)

Types of Meningitis

Viral meningitis

It is more common than bacterial meningitis and is usually less severe. Most cases of viral meningitis are caused due to enteroviruses. Other common viruses causing measles, mumps and chicken pox also cause meningitis disease. Viral meningitis has similar symptoms as that of as bacterial meningitis. Symptoms include sudden fever, headache and neck stiffness. It often resolves on its own, without specific treatment, although it may be treated with antiviral medication. In some cases, it can be fatal. Death of meningitis patients depends on factors like type of virus causing the infection, patient's age, and calibre weakened immune system.

Parasitic Meningitis

A parasite called *Naegleria fowleri* is the source for Primary Amoebic meningoencephalitis (PAM)

infection which is a very rare type of parasitic meningitis. In PAM infection, brain infection progresses rapidly within 1 to 12 days. In fact, out of 31 confirmed cases of PAM in U.S. during 2003 and 2005, it is embracing that all the cases were fatal. Standard meningitis symptoms appear 1 to 7 days after infection, potentially followed by confusion, loss of balance, seizures, hallucinations and lack of attention towards surroundings. *Naegleria fowleri* has been detected world-wide in warm freshwater sources such as lakes, rivers, hot springs, soil and warm water discharged from industrial sources, poorly treated swimming pools, water heaters. The microscopic organism enters the body through nose, travels to brain and finally destroy brain tissue. Parasitic meningitis cannot be transferred by person-to-person contacts. [3]

Fungal Meningitis

It is also a rare form of meningitis. It occurs when a fungus enters the bloodstream through contaminated food items and other routes. It is affected by different age group people and the people with a weakened immune system are at increased risk. Fungal meningitis is most often caused by inhaling fungal spores from contaminated soil or from bird or bat droppings. Treatment consists of long durations of high-dose antifungal drugs, usually administered through intravenously. The type of fungus and state of the patient's immune system determine the length of treatment.

Non-Infectious Meningitis

Like parasitic and fungal meningitis, non-infectious meningitis is also non contagious. It typically occurs as the result of cancer, lupus, head injury, brain surgery and medications. Symptoms include sudden onset of fever, stiff neck, headache, nausea vomiting, light sensitivity, and altered mental state.

According to the Centre for Disease Control and Prevention (CDC), the symptoms of meningitis can appear either suddenly or over a few days. They normally emerge within 3 to 7 days after infection.

Early symptoms of meningitis include

- Nausea and vomiting
- Fever
- Headache and a stiff neck
- Muscle pain

- Sensitivity to light
- Confusion
- Cold hands or feet and mottled skin
- In some cases, a rash that does not fade under pressure
- Later symptoms include seizures and coma. [4]

Symptoms in Infants

- Breathe quickly
- Refuse feeds and be irritable
- Cry excessively, or give a high-pitched moan
- Be stiff, with jerky movements, or listless and floppy
- The fontanelle may be bulging.

Risk factors

Bacterial meningitis can happen at any age group, but infants are more susceptible. Other factors that increase the risk include:

- ❖ Anatomical defect or trauma, such as skull fracture, and undergone surgery, allowing a way for bacteria to enter the nervous system.
- ❖ Infection in the head or neck area. Spending time in communities such as schools or colleges.
- ❖ Living or traveling to certain locations like sub-Saharan African countries.
- ❖ Having a weakened immune system, due to medical condition or treatment.
- ❖ Working in laboratories and other settings where meningitis pathogens are present.
- ❖ Recurrent bacterial meningitis is possible but rare. Recent studies revealed that 59 percent of

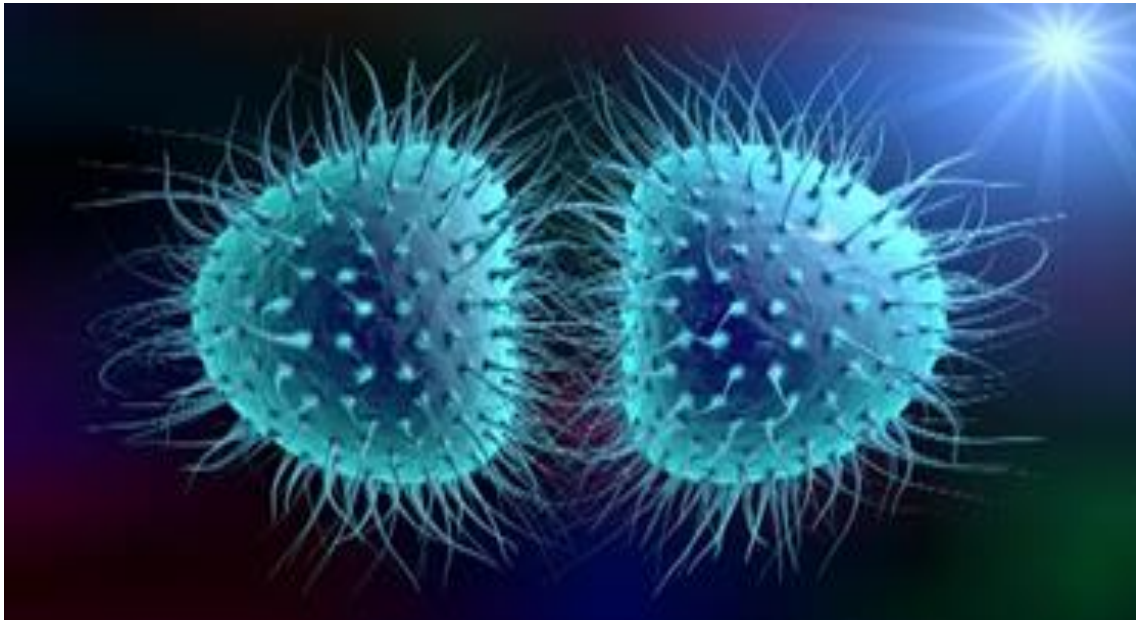
recurrent cases are due to anatomical defects and 36 percent occur in people with a weakened immune system. Some people are carriers. They have bacteria, but they do not develop symptoms. Living in a house with either a carrier or affected with meningitis increases the risk.

- ❖ It is important to follow the recommended vaccination schedule to prevent meningitis. *H. influenza* is the main cause of bacterial meningitis in children under age of 5, specifically to those countries who do not have Hib vaccine. [5]

Etiological agents

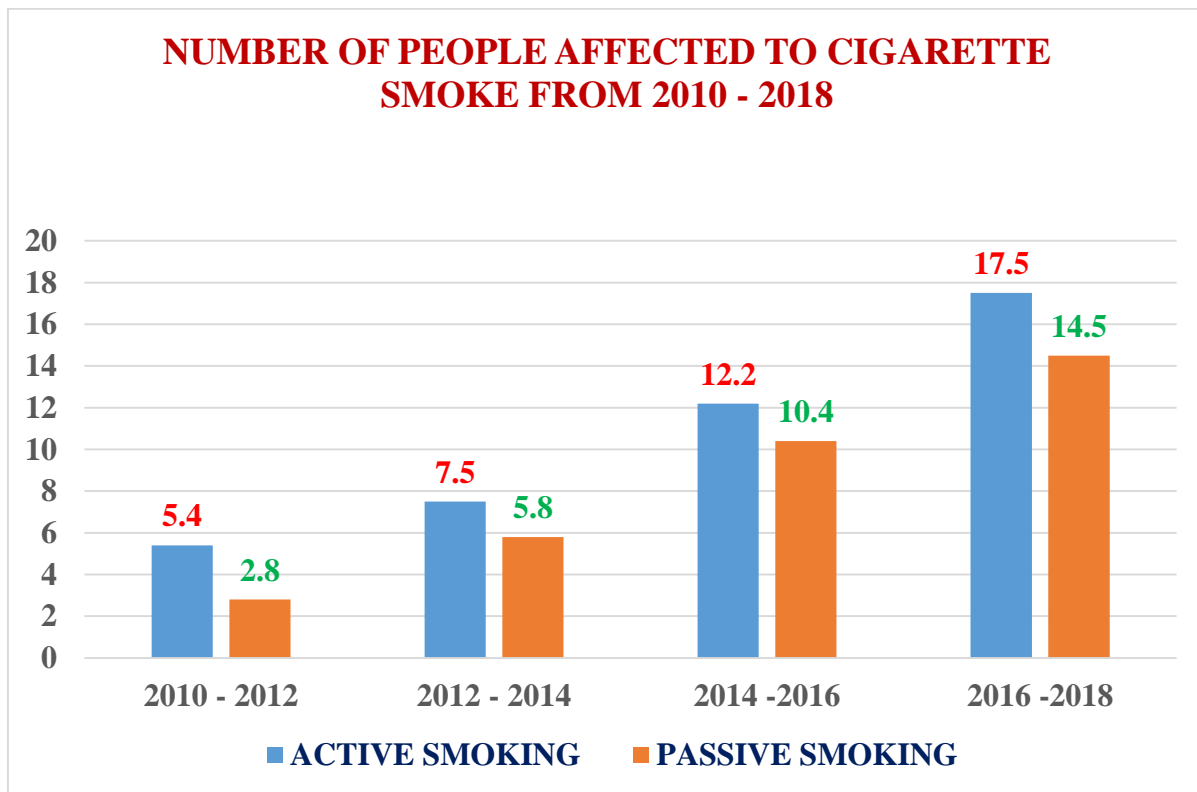
Bacterial meningitis can be caused by a range of bacteria, include the following:

- *Haemophilus influenzae* type B (Hib)
- *Neisseria meningitidis* (*N. meningitidis*)
- *Streptococcus pneumoniae* (*S. pneumonia*)
- *Listeria monocytogenes* (*L. monocytogenes*)
- Group B Streptococcus
- At different ages, people are more likely to be affected by different strains.
- The bacteria that cause meningitis usually become contagious from one person to another. **For example:** Through droplets during coughs, sneezing or through saliva. Some bacterial types may also spread through food.
- Group B streptococcus can make contagious from mothers to new-borns during delivery. [6]

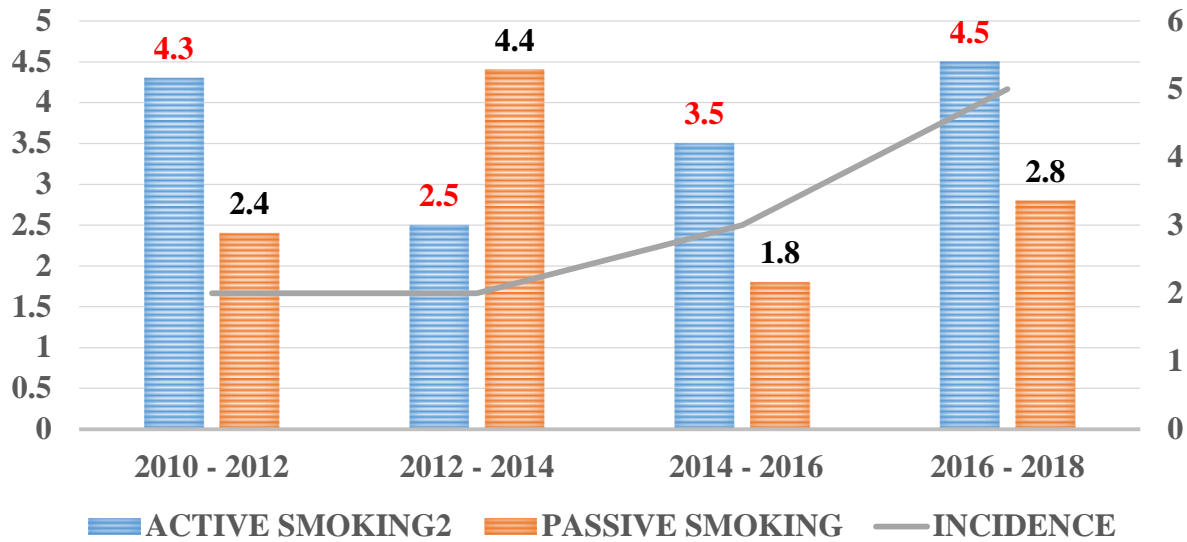


Meningococcal meningitis is caused by the meningococcal bacteria.

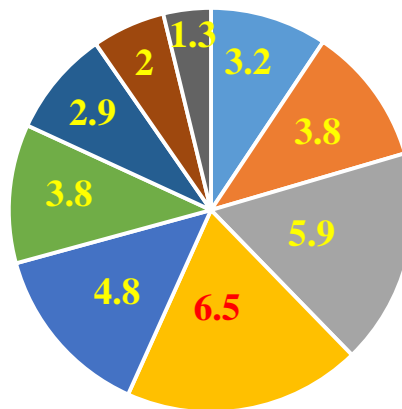
RESULT ANALYSIS



AVERAGE ANNUAL INCIDENCE AND PERCENTAGE OF ALL CASES OF BACTERIAL MENINGITIS IN PERSONS OF 20 TO 35 YEARS, INDIA 2010 - 2018



NUMBER OF AFFECTED CASES WITH PASSIVE SMOKING (In millions)



Upto 10yrs	11 - 10yrs	21 -30yrs
31 - 40yrs	41 - 50yrs	51 - 60yrs
61 - 70yrs	71 - 80yrs	More than 80yrs

DISCUSSION

Active Smokers

In a case-control study by Fischer et al, 36% of patients with bacterial meningitis were current smokers, while 14% were passive smokers. During an outbreak of sero-group C meningococcal disease among college students, 4 of 6 cases were current cigarette smokers and resulted increased prevalence than that of exposed controls. Cigarette smoking is associated with meningococcal colonization of the nasopharynx. Stuart et al found that 55% of active smokers were carriers compared with 36% of non-smokers and 76% of those exposed to second-hand tobacco smoke. The risk of carriage associated with active smoking increased with the daily number of cigarettes smoked [7]. The odd's ration for all smokers was 2.3, with a greater risk for smokers of more than 20 cigarettes per day. Caugant et al, performed a survey among Norwegian population and found that active smoking was independently associated with meningococcal carriage. There was no association between the number of cigarettes smoked daily and carriage. A similar pattern was found in a study conducted among recruits in Greece. [8]

Exposure to Second-hand Tobacco Smoke

Second-hand tobacco smoke exposure has also been associated with increased risk of meningococcal disease. In a case-control study, Fischer et al, established a strong epidemiologic link between smoking and meningococcal disease in children. For children < 18 years, having a mother who smoked was the strongest independent risk factor for invasive meningococcal infection compared with other risk factors such as maternal education, no primary physician, or humidifier use. 37% percent of infections could be attributed to maternal smoking. The number of smokers living in the home and the number of packs smoked per day had a significant linear relationship with the risk of meningococcal disease. No such association was observed for paternal smoking in this study. Among adult patients with meningococcal disease, 50% were passive smokers compared with 29% controls. In the Norwegian population survey, Caugant et al found a doubling of carriage rate for passive smokers. In a prospective study, Haneberg et al found that passive smoking in children < 12 years was significantly

more frequent in meningococcal patients than population controls. There are several potential mechanisms by which tobacco might increase the risk of meningococcal disease.

First possible mechanism

Tobacco smoke is a risk factor for meningococcal nasopharyngeal carriage that cause persons living with smoking habit have a greater chance to be exposed to meningococci.

Second possible mechanism

Presence of preceding viral infection, which is more frequent in smokers, can act as a co-factor for meningococcal disease. During an outbreak of meningococcal disease in Los Angeles & California, patients with meningococcal disease were more affected than matched neighbourhood controls in persons suffering from upper respiratory tract infections.

Third possible mechanism

Ineffective humoral immunity against the *Neisseria meningitidis* polysaccharide capsule is a well-recognized risk factor for invasive meningococcal disease. [8, 9]

PREVENTIVE MEASURES:

The incidence of meningitis in U.S. has dropped considerably since its vaccine was introduced. Treatment for bacterial meningitis normally involves admission to the hospital, and possibly intensive care units. Antibiotics are essential should be started empirically before getting the laboratory results, possibly before arrival at the hospital. Treatment includes, Antibiotic drugs are usually given through intravenously [10]. Corticosteroids drugs are given if the patient is suffering from inflammatory symptoms such as pressure in the brain. Acetaminophen or paracetamol to reduce fever. Cool sponge baths, cooling pads, fluids and room ventilation phenomenon also reduce fever. Anticonvulsant drugs such as phenobarbital or Dilantin may be used if the patient has seizures. Oxygen will be administered to assist with breathing. Intravenous fluids can prevent dehydration, especially if the patient is suffering from vomiting or if the patient is unable to take food substances through mouth. Sedative drugs will have a significant role to calm or to hypnotizes the patient if they are

irritable or restless. As several types of bacteria cause bacterial meningitis, range of vaccines is necessary to prevent infection. The first vaccine was created in 1981 to protect against 4 of the 13 subtypes of *N. meningitides*. In a survey of 17 million people belonging to united states, it was found that incidence of all types of meningitis was dropped by 31% from 1998 to 2007, after the introduction of routine vaccinations against meningitis-causing bacteria. The meningococcal vaccine is the primary vaccine in the U.S. All children should be administered during 11 years, 12 years and 16 years, when the risk of infection is higher. The Hib vaccine protects children against *H. Influenzae*. Before its introduction in U.S. in 1985, *H. Influenzae* infected over 20,000 children of 5 years' age annually, with a 3% to 6% mortality rate. Widespread vaccination has reduced the incidence of bacterial meningitis by 99%. The Hib vaccine is given in four doses at the ages of 2 months, 4 months, 6 months and 15 months [11]. Side effects of vaccines include redness, soreness at the site of injection and fever. Always check with a doctor to ensure that no allergies to any body parts of the vaccinations will be developed. To prevent the spread of bacterial meningitis and other diseases, it is

important to practice good hygiene such as frequent handwashing. Being aware of the signs and symptoms of bacterial meningitis will make it easier to take immediate action and to prevent further complications.

Availability of Data and Materials

This is a Review article

Competing Interests

We declare that we have no competing interests

Ethical Approval

Not Required

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