**ABSTRACT**

Measurement of background radiation is of great interest for it provides useful information in monitoring environmental radioactivity. The aim of the present study is to provide information and generate database on the natural background radiation dose levels of densely populated Queen Amina Hall, Ahmadu Bello University, Zaria. The radiation dose (outdoor and indoor dose rate) were measured at 29 rooms (Block 1-4) and their compounds using RADOS survey meter held at 1m above the ground. The measured radiation dose range from 0.01 mGy h⁻¹ to 1.72 mGy h⁻¹ and 0.54 mGy h⁻¹ to 4.3 mGy h⁻¹ for indoor and outdoor respectively. Some of the high values recorded could be attributed due to the contribution of cosmic radiation emanating from the atmosphere as well as the geological settings of the location as there is no any artificial contributing factor within the area. The annual effective doses within the study area was found to be 0.01 mSv y⁻¹ throughout which is quit below the world average value of 0.87 mSv y⁻¹ for natural sources.

Keywords: Radiation dose, Annual effective dose, RADOS meter, Queen Amina Hall.

**INTRODUCTION**

Human Ear is a sense organ concerned with hearing and stability. Ear is made up of three parts, which include the outer, middle and inner ear (Hoberman et al., 2011). Otitis media (OM) is defined as the infection of the middle ear cavity. Pathogenic microorganism (e.g. bacteria, viruses and fungi), allergy, and anatomic/functional deviations of the middle ear or Eustachian tube can cause otitis media (Jawetz et al., 2007). Ear infection can be acute (acute otitis media) or chronic (chronic or suppurative otitis media). Otitis media is one of the most common childhood illnesses, particularly in children under the age of six (Marom et al., 2014). A worldwide survey of 21 WHO regional areas from 2005 to present, estimated that there are 709 million new cases of OM annually (Monasta et al., 2012). In 2005, global incidence was highest among children under five (61%) (Monasta et al 2012). In a recent study of children under 6 years of age in Germany, Italy, Spain, Sweden, and the United Kingdom (UK), the incidence of Acute OM was 268 per 1000 people in 2007 to 2008 and 256 between 2008 and 2010 (Liese et al. 2014). The rates of recurrent OM decreased by 28% from 2001 to 2011 (Marom et al. 2014). The number of surgical procedures for OM doubled between 1978 to 1979 and 1994 to 1995, and then increased by 1.5-fold from 1987 to 2002 in Finland (Haapkyla et al. 2008). The recent decline in Acute OM may be due to the introduction of the pneumococcal conjugate vaccine, which appears to have decreased the number of individuals suffering from OM as supported by many studies (Marom et al. 2014). The prevalence of otitis media in Nigerian children was estimated to be 87.8% (overall), though it was found to be 83.3% in the dry season. Additionally, some of the common microorganisms associated with the infection are *Pseudomonas aeruginosa* as the most common bacteria and subsequently *Staphylococcus aureus*, *Escherichia coli*, *Streptococcus pneumoniae*, *Serratia marcescens*, *Proteus mirabilis* and *Klebsiella*. Fungal agents such as *Candida* spp. are among the common cause of otitis media in children (Amah et al., 2015). There is increase occurrence of *M. catarrhalis* especially in the United States and in the Nordic countries, while in some countries, like Spain, *M. catarrhalis* is a rare finding. The most alarming feature in the bacteriological reports has been increasing proportion of pathogens resistant to antimicrobial agents (C. Timia 2009). The proportion of beta lactamase producing strains of *H. influenza* has increased from 25 to 30% (Barkai et al., 2009). The aim of this write-up is to present a review in the diagnosis and treatment of otitis media in children.

**Anatomical and Physiological Risk Factors**

The middle ear is a cavity that contains the ear ossicles with the Eustachian tube placed anteriorly; the mastoid air cells posteriorly; Tympanic membrane laterally; that is between the middle and external ear, and the inner ear medially (Figure 1). Other important nearby structures are the base of the skull/brain and meninges superiorly, and the sigmoid sinus posteriorly; the nasopharynx lies behind the nasal cavities and above the soft palate. The nasopharynx is connected to the middle ear cavity by the Eustachian tubes. The nose, nasopharynx, Eustachian tubes, middle ear cavities and mastoid air cells are a continuum and covered by respiratory mucosa. The Eustachian tube regulate air and sound pressure by actively opening when swallowing, yawning or sneezing, and then by passively closing. Changes in body position affect the degree of opening and closing of the Eustachian tube. The best opening of the Eustachian tube is achieved by swallowing when in a sitting position while the worst is when in a head-down position.
The Eustachian tube also allows the secretions of the middle ear to drain into the nasopharynx with the assistance of secretory cells and the mucociliary defence system and prevents the secretions of the nasopharynx from entering the middle ear. Young children are susceptible to Acute OM because of the immaturity of the Eustachian tube (Bluestone 2008). Eustachian tube matures by the age of seven years. Thus, their eEustachian tube is shorter, more flexible and horizontal. Also craniofacial anomalies, Down syndrome and cleft palate are associated with eEustachian tube dysfunction. The nasopharyngeal dimensions have been shown to be smaller in children with OM than in healthy children (Renko et al. 2007).

Breastfeeding for at least three months is protective; this effect may be associated with position maintained during breastfeeding, suckling movements, and protective factors in breast milk (Hatakka et al., 2010). Children raised in low socioeconomic conditions are more likely to have otitis media. A higher incidence of otitis media was reported during the winter months (Hoffman et al., 2013). Otitis media in children was realized to be associated with downs syndrome and other conditions causing craniofacial distortions. Children deficient in certain nutrients are at risk for developing otitis media. The nutrients most frequently implicated are vitamin A, zinc, and essential fatty acids (Hoffman et al., 2013).

Aetiopathogenesis
The microorganisms associated with otitis media in children include bacteria, viruses and fungi. The most common bacterial pathogens isolated from middle ear discharge in children with Acute otitis media are *Streptococcus pneumonia*, *Pseudomonas aeruginosa*, and *E. coli* in 26 to 39% of cases (Rutt et al., 2008). Other bacteria, such as Gram-negative rods and *Staphylococcus aureus* are occasionally isolated from the middle ear discharge during the infection (Casey et al. 2010). *Streptococcus pneumonia* (S. pneumoniae), *Haemophilus influenzae* (H. influenzae), and *Moraxella catarrhalis* (M. catarrhalis) colonize the nasopharynx from early infancy and are considered part of the normal flora. An increased rate of colonization at three (3) months of age may identify a subpopulation of children that are at increased risk of OM. The prevalence of colonization with these pathogens differs by age and is highest during early childhood when over 60% of children are colonized at some point (Casey et al. 2010).

The most commonly verified virus in Acute OM is respiratory syncytial virus. Other important agents are rhinovirus, influenza virus and adenoviruses, along with enterovirus and parainfluenza virus (Coker et al. 1983). Otitis media caused by viral agents occurs most frequently following viral upper respiratory tract infection, leading to nasopharyngeal and Eustachian tube inflammation, negative middle ear pressure and the movement of secretions from the nasopharynx into the middle ear (Chonnmaitree et al. 2008). Viral infection of the nasopharynx creates an environment that promotes bacterial attachment and colonization, adhesion to cells, and invasion of the middle ear (Murphy et al. 2013). Human rhinovirus, parainfluenza viruses, adenovirus and respiratory syncytial virus were detected significantly more often in the nasopharynx of children with a history of recurrent Acute OM compared to healthy children (Wiertsema et al. 2011). Some of the fungi associated with otitis media in children are *Aspergillus niger*, *A. flavus*, *A. fumigates*, *Candida albicans*, *Penicillium spp*, *Cephalosporium spp*, Alternaria alternate (Rutt et al., 2008).

Clinical Features
The incubation period of bacterial otitis media can be short from five to seven (5-7) days or long for up to 21 days. Signs & symptoms may develop within two days (Hoberman et al. 2011). The clinical features are irritability, difficulty in sleeping, tugging or pulling at one or both ears, fever, Otalgia, Otorrhea (ear discharge) and Headache (Laine et al., 2010).

Complications
The complication of acute or chronic otitis media is of two types:

i. The intracranial complication and,

ii. The extracranial complication.

Intracranial complications include the following:
Brain abscess: characterised by fever, headache and convulsions.
Meningitis: fever, Meningismus.
Sigmoid sinus thrombosis: spiking fever, otitis media, oedema and tenderness over mastoid bone, headache.

Extracranial complications include the following:
- Labyrinthitis: inflammation of the kinetic labyrinth characterized by fever, nystagmus, and vertigo, which may occur secondary to suppurative otitis media.
- Mastoiditis: the inflammation of mastoid bone with subperiosteal abscesses, fever, fluctuate overlying the mastoid area, lateral displacement of pinna (Lieberthal et al. 2013).
- Petrositis: retro-orbital pain, Otorrhea and fever (Dubey et al. 2007).

**Diagnosis of Otitis Media**

Otitis media is diagnosed by clinical and laboratory approaches.

**Clinical Diagnosis**

Clinical diagnosis involves the use of clinical features discussed earlier and Otoscopy, which is the examination of the infected ear using an instrument known as otoscope.

An auroscope/otoscope is an instrument that is used for examination of tympanic membrane that is not obstructed by cerumen (Figure 2). It is used in cases of suspected acute otitis media to avoid over diagnosing “red ears”. The appearance of the eardrum in acute otitis media is hyperaemic (reddish), bulging and finally perforation and discharge from the ear. The discharge may be serous, serosanguineous or mucopurulent (Figures 3a and 3b). Crying or attempts to remove cerumen can cause erythema of the eardrum; therefore erythema of the tympanic membrane alone should not be the sole basis for the diagnosis of acute otitis media. In otitis media with effusion, Otoscopic findings include visualization of air-fluid levels and clear or amber middle ear fluid (Lieberthal et al. 2013). In cases of chronic suppurative otitis media, visualization of the tympanic membrane will reveal a perforation. In addition, polyps and discharge crusts may also be evident. It may be necessary in some children to examine the ears under general anaesthesia to make a proper assessment.

![Figure 2: The instrument for ear examination (otoscope). Source: Lieberthal et al. (2013).](image)

**Laboratory Diagnosis**

The laboratory diagnosis of otitis media is carried out after immediate collection of ear discharge from the infected ear using swab sticks (a stick with a cotton wool at its summit) at the microbiology laboratory. Isolation of bacteria associated with otitis media is done by culture method, using media such as MacConkey agar, blood agar and mannitol salt agar. The isolates are incubated aerobically at 37°C for 24 hours. Bacterial species are identified according to standard microbiological methods such as biochemical tests (catalase, oxidase, urease and motility). The presence of colonies in the isolated media indicate the presence of bacteria. Gram staining is performed to know whether the bacteria is Gram positive or Negative. Additionally, Biochemical tests and sensitivity testing are carried out to characterize the bacteria and identify the better antibiotics for the effective treatment of otitis media (Cheesborough, 2006).

**Treatment of Otitis Media**

The increased patterns of bacterial resistance mandate an evidence-based approach to pharmacotherapy of otitis media. The recommended treatment duration for uncomplicated Acute OM is 5 - 7 days.
Amoxicillin has been the first line antibiotic for treating otitis media even though, there may be a high prevalence of drug-resistant Streptococcus pneumoniae, because of resistance to β-lactam antibiotics, such as amoxicillin, which develops as a stepwise process. Amoxicillin-clavulanic acid combination is an appropriate choice as a second-line antibiotic if a child is not responding to treatment with amoxicillin after 72 hours. Similarly, Quinolones such as ciprofloxacin or ofloxacin among others were found to be effective in the treatment of Otitis media (Bailey and Parvataneni, 2000). If the patient is allergic to the penicillins, other antibiotics (e.g. ciprofloxacin otic drop and cefturoxime oral) are useful alternatives. A child that remains symptomatic for more than three days while on a second-line agent may require tympanocentesis to identify the causative pathogen. In case resistant pneumococcus spp is found or if sample of ear discharge is not obtainable, clindamycin or intramuscular ceftriaxone appears to be best third-line drug. Recent studies have shown that short courses (2-3 days of antibiotic) at high doses are equally effective in terms of resolution of clinical features (Tähtinen et al. 2011). The side effects of antibiotics such as penicillins that may compay a treatment option should be considered before giving any prescription.

Prevention and Control

i. Exclusive Breastfeeding for the first six months is associated with great protection against otitis media in children.

ii. Pneumococcal conjugate vaccines (PCV) in early infancy, decreases the risk of acute otitis media in healthy infants (Lieberthal et al. 2013).

REFERENCES


