RISK FACTORS FOR OTITIS MEDIA IN RURAL, PRESCHOOL SOUTH INDIAN CHILDREN

DISSERTATION SUBMITTED IN PART FULFILLMENT OF THE RULES AND REGULATIONS FOR THE M.S (BRANCH - IV) (OTORHINOLARYNGOLOGY) EXAMINATION OF THE TAMILNADU Dr.M.G.R MEDICAL UNIVERSITY TO BE HELD IN MARCH - 2008

CERTIFICATE

This is to certify that the dissertation "**RISK FACTORS FOR OTITIS MEDIA IN RURAL, PRESCHOOL SOUTH INDIAN CHILDREN"**is a bonafide work of **Dr. Sophia.A** that was carried out under my guidance, for the **M.S.Branch IV(Otorhinolaryngology)** examination of **The Tamil Nadu Dr.M.G.R. Medical University** , to be held in **March 2008**.

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CONTENTS

INTRODUCTION:

Otitis media (OM) is one of the most common diseases of childhood. It is also the most frequent diagnosis recorded for infants and children who visit physicians because of illness. It is a disease that not only has a substantial impact on patients and their families, but also is a burden on health care systems in both well developed industrialized nations and developing countries. Otitis media begins in early childhood, in some countries it is seen as early as within the first few weeks of life. Acute otitis media (AOM) precedes chronic suppurative otitis media (CSOM). Estimates of direct and indirect costs attributed to the medical and surgical treatment of children with OM in five years old and younger exceed 5 billion dollars per year (Gates GA,1996).

Otitis media in developing countries poses a special problem particularly in the preschool age group. A number of risk factors are associated with otitis media in the children. Host factors that lead to increased risk include male sex, age less than 3 years and a member of the family with acute otitis media. Environmental factors include day care attendance, parental smoking, poor ventilation, low socioeconomic status, and lack of adequate breast feeding (Uhari et al,1996).Other risk factors include race, altered host defenses, and seasonal variation.

The present study is aimed at studying the prevalence of Otitis media and determining the risk factors for otitis media in children aged 1-6 years in a rural South Indian population using a case control study design.

REVIEW OF LITERATURE

EPIDEMIOLOGY OF OTITIS MEDIA:

Epidemiology is the study of distribution and determination of health related states and events in a specified population and the application of this study to the control of health problems. The goal of all epidemiological studies is to uncover relationships or associations between the exposure to a risk factor and change in the health status.

There are two major types of epidemiological studies, descriptive and analytical. Descriptive studies look at the existing distribution of a particular disease or other variable. Analytical studies are designed to examine associations or risk factors for a particular health problem .They include cross sectional studies, prospective cohort studies, retrospective studies, case control studies and meta- analysis.

In the study of otitis media a number of study designs have been recorded in the literature. The majority of studies have been analytical .Cross sectional studies are a type of analytical study in which individuals are observed at only one point in time. These studies are also known as surveys. A number of cross sectional studies have been performed on otitis media. These include those of Jacob et al,(1997) and Rupa et al, (1999) where the prevalence of OM and CSOM were studied in rural South Indian children of two different age groups. Similarly studies from Nepal (Little et al,1993), West Africa (McPherson and Holborrow,1985) and Denmark (Parving,1985) provide information on prevalence of OM in different age groups.

Some authors have performed prospective cohort studies to examine the effect of a risk factor on the incidence and prevalence of OM over a period of years. These include the Greater Boston cohort study where 877 children where enrolled from birth and followed up till 7 years of age. This was a prospective cohort study which showed that the peak incidence of otits media was in the second half of the first year of life (Teele et al,1992).

Another cohort study on 3-4 year old children by Castagno in Southern Brazil showed that seasonal variation affected the incidence of OM in this age group (Castagno and Lavinsky, 2002). A large cohort of 2253 infants studied in Pittsburgh,USA by Paradise et al ,(1997) similarly followed up infants for the first 2 years of life and looked at various risk factors.

The major advantages of these studies is that the incidence of OM and absolute and relative risks of OM can be measured directly. A temporal relationship between the risk factors like age, gender, socioeconomic status, breast feeding, passive smoking, seasonal variation, day care attendance and OM can be established.

Retrospective case control study designs also have been used for OM. These Studies cannot measure absolute risk for OM as the incidence of the disease is not known. However, the relative risk or odds ratio may be calculated. The study by Kraemer et al (1983) on the risk factors for persistent middle ear effusions was a hospital based

study on children undergoing myringotomy and grommet insertion for OME. The study showed that nasal catarrh, household cigarette smoke exposure and atopy were important risk factors for OME. Lassisi et al(2007) studied clinical and demographic risk factors associated with CSOM by a case control study design that low socioeconomic status, malnutrition, overcrowding and bottle feeding were significant risk factors for CSOM. Sternstorm and Ingvarsson (1997) performed a case control study on otitis prone children in Sweden and found that the male gender and heredity were important risk factors for developing OM.

A useful meta – analyses of epidemiology and pathogenesis of CSOM by Blue stone (1998) is yet another study design where the results of several studies have been pooled together. The countries with the highest prevalence of otitis media were easily distinguished from the others in this study.

TERMINOLOGY AND DEFINITIONS:

The terms most commonly used in relation to Otitis media are defined as follows (Paparella MM,1976).

Otitis media (OM) is an inflammation of the middle ear without reference to cause or pathogenesis.

Acute Otitis media(AOM): is defined by the presence of fluid in the middle ear, a bulging tympanic membrane, plus a sign of acute local or systemic illness. The patient with AOM may have symptoms and signs specific to ear disease, including pain, otorrhea, and hearing loss, as well as systemic symptoms and signs of fever, irritability, headache, lethargy, anorexia, or vomiting.

Middle ear effusion (MEE): designates the presence of liquid in the middle ear but not cause, pathogenesis, pathologic appearance or duration. An effusion may be

1) Serous : a thin watery liquid
2) Mucoid: a thick, viscid, mucus- like liquid
3) Purulent
4) Hemorrhagic – blood stained effusion

An effusion can be the result of either acute otitis media or otitis media with effusion. The effusion can be of recent onset, acute or more long lasting , sub acute or chronic.

Persistent middle ear effusion: is a term that is used to describe asymptomatic middle ear effusion persisting for weeks to months following the onset of acute otitis media**.** The term Otitis media with effusion is also synonymous with secretory otitis media (SOM), Mucoid otitis media (MOM), serous OM, and "glue ear".

Chronic Suppurative Otitis Media (CSOM): is the most advanced disease state in the spectrum of OM, and by definition, it is associated with some form of irreversibly pathologic condition of the middle ear. Patients with CSOM exhibit perforations of the tympanic membrane or ossicular destruction with resultant hearing loss and both are often seen when cholesteatoma or granulation tissue is present.

RISK FACTORS:

Prolonged duration of middle ear effusion in children has been associated with age less than 3 years, male gender, low socio economic status, not being breast fed, smoking in the household, attendance in day care and seasonal changes**.**

Age:

Otitis media is a disease of infancy and early childhood. The peak age specific attack rate occurs between 6 and 18 months of age. The incidence of otitis media declines with age after first year of life, except for a limited reversal of downward trend between 5 and 6 years of age ,the time of entrance into school (Teele et al,1989).Children who have had little or no experience with OM by 3 years of age are unlikely to have subsequent severe or recurrent disease.

Race:

Selected racial groups, most in developing countries have an extraordinary incidence of severe episodes of acute otitis media. Several studies have suggested a lower incidence of otitis media in American black children compared with American white children (Kessner et al, 1974; Marchant et al, 1984; Schappert, 1992) .Marchant and colleagues (1984) reported a significantly lower incidence of OM diagnosed by otoscopy in 26 black children than in 44 white children followed from birth to 12 months of age. In another prospective study, 2,253 children were followed from approximately 2 months to 2 years of age, with otoscopic examinations every 6 weeks. The mean cumulative

percentage of days with MEE during the first year was higher in the black infants than in the white infants, but by the second year, the rates were equal (Paradise et al, 1997).

Social and economic conditions:

Poverty has been considered an important risk factor for the rate and severity of otitis media. The factors suggested include crowded living conditions, poor sanitation and inadequate medical care. Children living in households with many members are more likely to have otitis media than are children living in smaller households (Castagno and Lavinsky, 2002). A study of Pittsburgh children found an inverse relationship during first 2 years of life between the total number of days with MEE and socioeconomic index based on type of health insurance and level of maternal education (Paradise et al, 1997).

Day care centers:

The setting for child day care in the preschool years (child's home, other home, family based care, or large center facility) is an important factor in the incidence of otitis media. The more children in day care, the greater the exposure to respiratory pathogens, the higher the rate of respiratory tract infections, including otitis media.

Day care centers vary in size from small groups in the responsibility of one or two adults to large, organized group centers. Similarly some facilities have adequate room and ventilation, whereas others are crowded and poorly ventilated. In the day care setting ,coughing and sneezing at close range are common .Epidemics of disease due to respiratory viruses are common .Thus there is ample opportunity for spread of respiratory

infections among children in day care and for higher incidence of infection in children attending day care than in children who receive care at home.

Alho and colleagues (1993) examined responses to questionnaires sent to parents of 2,512 Finnish children as well as the children's medical records and found an odds ratio of 2.06 for the development of AOM in children attending day-care centers compared with children cared for at home. This increased incidence of AOM in children in day-care centers was also found in a case-control study in Finland (Pukander et al, 1982).

Season:

The seasonal incidence of infections of the middle ear parallels the seasonal variations of upper respiratory tract infections. Acute episodes peak during the winter, but are also frequent in the fall and spring and they are least frequent in summer. The incidence of episodes of otitis media also increases during outbreaks of viral infections of the respiratory tract in children. These are most likely to occur in the winter and spring seasons (Henderson et al,1982).

Smoking and ambient air pollution:

An association between OM and passive exposure to smoking has been reported by many investigators (Etzel et al, 1992; Kraemer et al, 1983). Passive smoking and environmental pollutants have come under increased scrutiny as agents responsible for structural and physiological changes in the respiratory tree. Smoke exposure can result in

goblet cell hyperplasia and mucus hypersecretion in the respiratory tract and ciliostasis and decreased mucociliary transport it may play a role in altering immune defenses of the respiratory tract (Wanner , 1997).

Etzel et al demonstrated that high concentrations of serum cotinine were associated with increased incidence of acute otitis media and increased duration of MEE after an acute episode. Heavy maternal smoking (>20 cigarettes per day) was a significant risk factor for three or more episodes of acute otitis media in the first year of life. The rate of recurrent infections (32%) was higher in those infants whose mothers were heavy smokers during pregnancy and after delivery (19%).

Breast feeding:

Breast feeding has been identified as an important factor in the prevention of respiratory and gastrointestinal infection in infancy. In the Boston study (Teele et al, 1989) children were observed from birth with frequent examinations and assessments of the mode of feeding. Breast feeding was strongly associated with a decreased risk for acute otitis media during the first year of life. Analysis of duration of feeding indicated that breast feeding for 3 months in the first year of life was useful in prevention.

Various hypotheses suggested for the beneficial effect of breast feeding are

1. Immunologic factors are provided in breast milk and these prevent various bacterial and viral infections.

2. Nonimmune protective factors include interferon, glycoproteins, lactadherin, glycolipids, glycosaminoglycans and unsaturated fatty acids.

3. Anti-inflammatory factors in breast milk that may limit the infection include antioxidants, lactoferrin, tumour necrosis factor alpha and interleukin 1 and 10.

The role of allergy in otitis media:

The role of allergy in the etiology of otitis media continues to be hypothetical and controversial (Bernstein ,1993). Four possible mechanisms have been postulated :

1. middle ear mucosa functioning as shock organ.
2. inflammatory swelling of the mucosa of the Eustachian tube.
3. inflammatory obstruction of the nose.
4. aspiration of bacteria laden allergic nasopharyngeal secretions into the middle ear cavity (Bluestone , 1978).

The allergic reaction might be a predisposing factor producing congestion of the mucosa of the nose and Eustachian tube, leading to obstruction of the tube with retention of fluid in the middle ear.

TYPES OF OTITIS MEDIA:

Acute otitis media:

Acute OM is an acute bacterial infection of the middle ear cleft characterized by rapid onset of otalgia, fever and ear tugging, sleeplessness, and irritability. As the infection progresses, purulent exudates accumulates in the middle ear, and the tympanic membrane visually appears opaque, full, or bulging. The membrane may rupture, allowing the purulent effusion to drain. AOM is usually followed by a middle ear effusion (MEE) as part of the natural history of the disease.

Specifically, at 2 weeks postinfection, even with appropriate therapy, 60% of patients will have a MEE; at 30 days, 50%; at 60 days, 20%; and at 90 days,15% (Marchant et al., 1984) . By 3 years of age, nearly 50% of all children will have experienced three or more episodes of AOM and about 40% of children experience six or more episodes of AOM by age 7 years (Teele et al,1992).

Recurrent otitis media:

Klein(1984) defined three bouts of AOM in 6 months or four episodes in 12 months as having recurrent AOM. A recent report found an increasing incidence of recurrent AOM in the United States that seem closely related to an increase in the use of child care centres and a higher prevalence of allergic conditions in children . Predisposing factors such as positive family history, submucous cleft palate, child care in a large group setting, allergy, ciliary dyskinesia, chronic sinusitis or immunologic deficiencies should be identified.

Serous otitis media:

A serous effusion in the middle ear is a clear, watery, transudate that occupies the middle ear cleft. It may be present in the continuum of types of fluid associated with OME regardless of their cause. Otoscopy reveals an amber or straw colored tympanic membrane with normal contour. Air bubbles or an air- fluid level may be seen through the tympanic membrane. Otoscopy or tympanometry reveals impaired mobility of the tympanic membrane and audiometry may demonstrate a mild conductive hearing loss.

Mucoid otitis

Mucoid OM implies both an intact tympanic membrane and the presence of any chronic MEE more tenacious than the thin, watery fluid of serous OM. The effusion is often cloudy and thick or semisolid in character. Most children with a persistent effusion or after treatment for AOM develop MOM.

Otitis media with effusion:

Otitis media with effusion (OME) is an inflammation of the middle ear with fluid collected in the middle ear space. The signs and symptoms of an acute infectious process are not present. It is often asymptomatic but hearing loss may be manifested in children as inattentive behaviour, delayed speech, or a failed hearing screening at school. Impaired tympanic membrane mobility, detected by otoscopy or tympaometry ,and conductive hearing loss are valuable diagnostic signs of OME. Predisposing factors, such as palatal cleft, ciliary dyskinesia, chronic sinusitis, or a nasopharyngeal mass, may be considered before treatment is begun.

Chronic suppurative otitis media:

Chronic suppurative OM is the most advanced disease state in the spectrum of OM, and by definition it is a chronic inflammation of the middle ear and mastoid cavity, which presents with recurrent ear discharges through a tympanic perforation and is associated with some form of irreversibly pathologic condition in the middle ear. The diagnosis of CSOM is usually be made by history, otoscopy, microscopic ear examination and appropriate audiometric assessment.

The disease usually begins in childhood as a spontaneous tympanic perforation due to an acute infection of the middle ear, known as acute otitis media (AOM), or as a sequel of less severe forms of otitis media e.g.secretory OM . The infection may occur during the first 6 years of a child's life, with a peak around 2 years. The point in time when AOM becomes CSOM is still controversial. Generally, patients with tympanic perforations which continue to discharge mucoid material for periods of from 6 weeks to 3 months, despite medical treatment, are recognized as CSOM cases. The WHO definition requires only 2 weeks of otorrhoea, but otolaryngologists tend to adopt a longer duration, e.g. more than 3 months of active disease (Acuin,2004).

AETIO PATHOGENESIS OF OTITIS MEDIA:

Bacteriemia with Otitis Media:

Streptococcus pneumoniae is the most frequent bacterial agent associated with acute otitis media and the most frequent cause of severe disease and suppurative complications. There are 90 antigenically distinct serotypes of *S.pneumoniae* (Heinrichsen and Sorenson, 1995) .The most common types responsible for acute otitis media in order of deceasing frequency are 19, 23, 6,14,3, and18. Of interest is the relative constancy of the most frequently isolated types 19, 23, 6 and14. Pneumococci are frequent colonizers of infants and children and the organisms present in the nasopharynx are frequently the types that result in acute otitis media. Microbial adherence identifies the binding of bacteria to components of the mucosal cell surface. Selective adherence to receptors on the mucosa of the nasopharynx and middle ear may contribute to the pathogenesis of acute otitis media(Swanborg et al., 1991).

Haemophilus influenzae was considered to be restricted in importance to otitis media occurring in preschool children ; however the organism is a significant cause of otitis media in older children ,adolescents ,and adults.

Nasopharyngeal colonization with *Moraxella catarrhalis* is common throughout infancy .By 2 years of age, three quarters of children have been colonized (Faden et al, 1994).

Other bacteriae incriminated in causing otitis media are GroupA and B Streptococci, Staphylococcus aureus, Staphylococcus epidermidis , Diphtheroids,gram negative bacilli. Recent improvements in the techniques for isolation and identification of anaerobic bacteria have provided a better understanding of the anaerobic flora of humans and the role of these organisms in disease. Peptostreptococcus species were the most frequent pathogen. Fusobacterium species and Bacteroides species in addition to Peptostreptococcus species have been implicated in chronic otitis media(Brook ,1979).

Sterile cultures:

In all studies of acute otitis media a significant proportion (approximately one third) of middle ear fluids are sterile after appropriate and usual cultures for bacteria have been made. The cause of these cases of otitis media may be one or more of the following:

1. A non bacterial organism , such as virus ,Chlamydia , or mycoplasma.
2. A fastidious batcerial organism such as an anaerobic bacterium,that is not isolated by usual laboratory techniques.
3. The presence of bacterial antigens in the absence of viable organisms indicating past or present bacterial infection and suppression of growth of the organism.
4. An immune response to an antimicrobial agent that would suppress growth of bacteria.
5. Prior administration of an antimicrobial agent that would suppress growth of bacteria.

Viruses:

Epidemiologic data support the concept that viral infection is frequently an antecedent of acute otitis media. In a longitudinal study of respiratory illnesses and complications in children aged between 6 weeks to 6 years attending a day care and school program, Henderson et al (1982) demonstrated a correlation between isolation of viruses from the upper respiratory tract and clinical diagnosis of otitis media. Otitis media was increased in the 14 days after isolation from the upper respirtory tract of respiratory syncytial viruses(RSV), adenoviruses(usually types 1,2,and 5), influenza virus types A and B, parainfluenza and mumps viruses ,and enteroviruses.

Mycoplasma:

These organisms have a role in otitis media. Myringitis, associated with hemorrhage and bleb formation in the more severe cases, was observed in non immune volunteers inoculated with Mycoplasma pneumoniae (Rifkind etal, 1962).

PATHOGENESIS OF OTITS MEDIA:

OM is a generic term for a continuum of disease and is often used to describe the presence of middle ear effusion (MEE). The continuum includes AOM, MEE with characteristic signs and symptoms of infection; OM with effusion (OME); asymptomatic MEE (this term has also been used by researchers to describe the presence of MEE with or without symptoms); chronic OME, an effusion that persists for 2 to 3 months; chronic OM, a perforated tympanic membrane with a draining ear; and recurrent OM, more than one episode or a specified number of episodes in a given time period.

Otitis Media with Effusion:

Otitis media with effusion (OME) is an inflammation of the middle ear with fluid collected in the middle ear space. The signs and symptoms of an acute infectious process are not present. OME detected in surveillance studies also had high rates of spontaneous resolution. Fifty-one percent of children clear the fluid by 1 month, 74% by 6 months, and 95% by 1 year (Buckley G and Hinton A , 1991). These data demonstrated that OME is a common sequela of AOM and that the majority of children with fluid after an episode of AOM, or fluid found on routine examination, clear the fluid without intervention by 3 months.

OME is most certainly associated with hearing loss. The mean three-frequency pure-tone average hearing level associated with OME is 27 dB in infants and 25 dB in older children (Fria et al, 1985). However, the range is 0 to 60 dB. Although, on average, this is only a “mild” loss, hearing function is tested in a soundproof booth and may not truly reflect real-life listening situations. Thus, OME is associated with hearing loss and difficulty hearing in normal listening environments.

Acute Otitis Media:

The pathogenesis of acute otitis media usually occurs with the following pattern in most children:

The patient has an antecedent event usually an upper respiratory viral infection that results in congestion of respiratory mucosa of the upper respiratory tract, including nasopharynx and eustachian tube .Congestion of the mucosa in the eustachian tube obstructs the tube, negative middle ear pressure develops and if prolonged potential pathogens are aspirated from the nasopharynx into the middle ear. Thus by promoting adherence of bacteria in the inflamed nasopharynx, and by destroying the normal mucociliary defense mechanisms of the ET and middle ear, a viral URI facilitates extension of pathogenic bacteria into the ET and middle ear cleft. Microbial pathogens proliferate in the secretions resulting in a suppurative and symptomatic otitis media. For Children with recurrent acute otitis media anatomic or physiologic abnormality of the eustachian tube appears to be an important factor.

The bacteriology of AOM is well established and varies little throughout the world. Data from the Pittsburgh Otitis Media Research Centre revealed that in 2807 ears with AOM , the predominant bacteria cultured from the MEEs were *Streptococcus pneumoniae*(35%),*Haemophilus influenzae*(23%),and *Moraxella catarrhalis*(14%).Group A streptococci and Alpha Hemolytic streptococci were each present in 3% of AOM effusions ,and *Staphylococcus aureus* and *Pseudomonas aueoginosa* were each present in 1%.Other bacteria present in 39% of patients with AOM included oral flora ,enteric bacteria ,yeast and fungi.The incidence of beta lactamase producing strains of

H.influenzae and *M.catarrhalis* increased from 1981 to 1989 when 37% of *H.influenzae* and 88% of *M.catarrhalis* produced betalactamase (Bluestone et al,1992).

Recurrent Otitis media :

Although many different parameters exist in the literature for defining recurrent AOM, one of the more established ones is the occurrence of three episodes in a 6-month period or four episodes in a 12-month period (Bluestone and Klein,2001). The exceptions to these criteria are very young children, in whom even a single episode in the first 6 months of life or two episodes in the first 12 months of life may qualify them for consideration as "otitis prone" if these episodes are accompanied by a strong family history of middle ear disease (Bluestone and Klein, 2001).

The etiology and pathogenesis of otitis media is multifactorial but abnormalities of the structure and function of eustachian tube appears to be the most important. Eustachian tube dysfunction can cause otitis media and related conditions because of ,

1. Impairment of pressure regulation as a result of anatomic obstruction of the tube (the tube is "too closed")or failure of the tubal opening mechanism(the tube "won't open"),i,e functional obstruction.
2. Loss of protective function due to abnormal patency of the tube (the tube is "too open")a tube that is "too short"abnormal gas pressures within the middle ear or nasopharynx or a nonintact middle ear and mastoid.
3. Impairment of clearance function. (Bluestone CD 1978).

Chronic SOM:

Chronic suppurative otitis media is the stage of ear disease in which there is chronic inflammation of the middle ear and mastoid and a nonintact tympanic membrane. There is no consensus regarding the duration of otitis media to be designated chronic suppurative otitis media. Even though 3 or more months appears to be appropriate, some clinicians consider a shorter duration of otitis media, such as 3 weeks, as being chronic, especially when the causative organism is Pseudomona***s***. When acute otorrhea fails to improve after initial, appropriate, and adequate ototopical therapy (and systemic antibiotic treatment), the disease can progress to the chronic stage if not effectively managed. Thus, the distinction between acute and chronic otorrhea is based not only on duration but also on response to management, the causative bacterial pathogens, and the underlying pathology.

When a cholesteatoma is also present, the term cholesteatoma with chronic suppurative otitis media is appropriately used .The otomicroscope should be used to completely evaluate the external ear canal and tympanic membrane. This will help assess the defect in the tympanic membrane and rule out the possible presence of a cholesteatoma .

Several classifications of CSOM exist .A useful working classification is as follows:

1. Tubotympanic disease
2. Attico-antral disease

Some authors distinguish ears with dry central perforations (Permanent perforation syndrome) from ears with actively discharging central perforations (tympano mastoid disease).

Chronic Suppurative Otitis Media-Attico antral type:

Cholesteatoma has been defined by Abramson and colleagues (1977) as "…a three dimensional epidermal and connective tissue structure, usually in the form of a sac and frequently conforming to the architecture of the various spaces of the middle ear, attic and mastoid. This structure has the capacity for progressive and independent growth at the expense of underlying bone and has a tendency to recur after removal."

Cholesteatoma is classified as congenital and acquired. Acquired cholesteatoma occurs in the presence of chronic suppurative otitis media (CSOM) and when keratinizing stratified squamous epithelium accumulates in the middle ear or other pneumatized portions of the temporal bone. An aural acquired cholesteatoma develops from a retraction pocket in the pars tensa or pars flaccida or migration of epithelium through preexisting defect of the tympanic membrane. A cholesteatoma may involve only the middle ear ,only the mastoid or both.

DIAGNOSIS:

For the clinician the diagnosis of otitis media usually depends on a high index of suspicion and the presence of symptoms, but primarily on the otoscopy finding.

Otoscopy: is the recommended subjective method of diagnosis.

Otoscopy enables assessment of the size, site and shape of the perforation, the presence of discharge, inflammation of the external canal and the state of the middle ear mucosa (dry/ moist), presence of granulations, edema, cholesteatoma and the presence of tympanosclerosis.

Otoscopic findings in different types of OM:

ASOM: Changes in the mucosa may be envisaged as occupying four stages inferred from findings at otoscopy:

1. Stage of Tubal occlusion: Retraction of tympanic membrane .
2. Stage of Presuppuration: Hyperemia of tympanic vessels also described as cartwheel appearance of TM.
3. Stage of Suppuration: Convex bulging of the membrane into the meatus(Fig 1). Purulent discharge seen in the external auditory meatus if there occurs a perforation.
4. Stage of Resolution: Gradual return of tympanic membrane to normal.

Fig1: Stage of suppuration.

Fig2:OME showing air fluid level.

OME: Blue or amber coloured tympanic membrane with air fluid level or air bubbles seen with decreased mobility of the tympanic membrane(Fig 2).

CSOM –Tubotympanic disease: Central perforation which could be small, moderate, large and subtotal with or without active discharge(Fig 3).

CSOM – Atticoantral disease**:** This could be marginal perforation, posterior superior retraction pocket with or without cholesteatoma flakes ,attic retraction pocket,attic perforation with or without cholesteatoma(Fig 4).

Fig 3:CSOM-Tubotympanic Disease **Fig 4:CSOM-Atticoantral disease**

Tympanometry: is an important adjunct to otoscopy in diagnosing OM.

It is defined as measuring acoustic immitance of the ear as a function of ear canal air pressure. Tympanometry results have been described as curve patterns (A,B,C)This system uses the following definitions:

Type A, peak pressure at 0 dapa.

Type B flat curve .

Type C negative pressure peak(-100 to -199 dapa).

Pure tone Audiometry can determine the hearing levels in the different types of OM all of which could produce mild to moderate degrees of conductive hearing loss.

Acute otitis media:

Examination with a otoscope reveals a hyperemic opaque, bulging tympanic membrane that has poor mobility. Purulent otorrhoea is also a reliable sign. Hearing loss may not be a complaint by the child or may not be noted by the parents. Tympanometry reveals an effusion pattern (flat) or a high positive pressure pattern.

Tympanocentesis is usually productive of a purulent middle ear aspirate but a serous or mucoid effusion is present in 20 %. Because of variability of symptoms,infants and young children with diminished or absent mobility and opacification of tympanic membrane should be suspected of having acute otitis media.

Otitis media with effusion:

Most children are asymptomatic with chronic middle ear effusion, some may complain of hearing and very rarely tinnitus and vertigo. The symptoms are usually bilateral. Otoscopy reveals a retracted or full tympanic membrane that is opaque sometimes airfluid level or air bubbles may be visualized and a blue or amber colour is noted. Tympanometry shows a type B curve.

CSOM-Tubotympanic type:

When a chronic aural discharge is present, it is desirable to culture the drainage. The antimicrobial regimen can then be adjusted according to the results of the Gram stain and culture, and susceptibility testing. The most effective method to obtain a sample of the discharge is to remove as much of the purulent material as possible from the external canal by suction or cotton-tipped applicator and then aspirate the pus directly at or through the perforation or tympanostomy tube using a blunt-nosed needle attached to a tuberculin syringe or an Alden-Senturia trap and suction. This procedure is most effectively accomplished employing the otomicroscope .

IMAGING:

X-Ray of the mastoids are helpful in conditions such as mastoiditis where it shows “clouding” of cells” and also delineates the normal mastoid anatomy. X rays also show the presence of cholesteatomas ,bone erosion which produces a “lucency” or “cavity” in the mastoid.

CT scanning of the middle ear in otits media is helpful in determining the course of the facial nerve and demonstration of labyrinthine fistula. Erosion into the intracranial compartments may also be seen. CT scan of the brain with contrast is required to exclude intracranial complications.

SEQUELAE OF OTITIS MEDIA:

Hearing loss :

Hearing loss is the most common complication and sequelae of otitis media and can be conductive, sensoineural or both. When conductive the loss may be either transient or permanent.

Conductive hearing loss:

The hearing loss can be either mild or moderate with the maximum loss being no greater than 60db.However the loss is usually between 15 and 40 db. When due to otitis media with effusion there is average loss of 27 db. The hearing usually returns to normal thresholds when the middle ear effusion resolves. Permanent conductive hearing loss can occur however as a result of recurrent acute or chronic inflammation, adhesive otitis media , ossicular discontinuity or fixation.

Sensorineural Hearing Loss:

The hearing loss can be mild, moderate, severe or profound. Reversible sensorineural hearing impairment is generally attributed to the effect of increased tension and stiffness of the round window membrane. Permanent sensorineural hearing loss is most likely due to spread of infection or products of inflammation through the round window membrane into the labyrinth development of perilymphatic fistula in the oval or round window or labyrinthitis (Stephenson et al,1992).

Perforation of Tympanic membrane :

A perforation may be acute or chronic and otorrhea may or may not be present. Spontaneous perforation of the tympanic membrane during an episode of acute otitis media (AOM) is a relatively common occurrence.

As in any case of AOM, it is felt that the most common scenario is the an antecedent event (usually a viral upper respiratory tract infection) results in congestion of the respiratory mucosa of the nasopharynx, leading to obstruction of the eustachian tube. Subsequent development of negative middle ear pressure may lead to aspiration of potential pathogens from the nasopharynx into the middle ear. Owing to eustachian tube obstruction, adequate middle ear clearance is prevented, allowing microbial pathogens to proliferate and cause suppurative OM . It has been theorized that pus accumulation in the middle ear cavity may exert pressure against blood vessels in the TM, leading to ischemic necrosis with eventual perforation and drainage of pus.

Studies using fluorescein angiography have demonstrated that the anterior half of the human TM is consistently less well perfused than the posterior half of the TM which may account for the high percentage of spontaneous perforations that occur in the anterior-inferior quadrant (Bluestone,1998;Applebaum and Deutsch 1986). Development of spontaneous perforation during an attack of AOM typically results in improvement in the clinical condition of the patient, with decreased fever and otalgia.

3. Tympanosclerosis:

This refers to hyaline degeneration within the tympanic membrane or middle ear mucosa .It appears as white plaques. These plaques may hinder ossicular mobility and produce conductive hearing loss.

4.Ossicular Necrosis:

This may follow chronic otitis media .The long process of Incus is the most frequently involved ossicle**.**

COMPLICATIONS OF OTITIS MEDIA:

These may be subdivided into extracranial and intracranial complications

Extra cranial complications include:

Mastoiditis, petrositis , facial nerve paralysis, labyrinthitis and mastoid abscess.

Intracranial complications include Meningitis, extradural abscess, subdural abscess, brain abscess, dural sinus thrombosis and otitic hydrocephalus.

Knowledge of these complications is important to recognize the presence of impending complications in children with OM.

MANAGEMENT:

Acute otitis media:

Infants and children who have signs and symptoms of acute otitis media should receive an antimicrobial agent effective against S.pneumoniae, H.influenzae and M.catarrhalis. Most clinical trials and standard practice include a 10 day course of an oral antibiotic agent.

Symptomatic therapy includes analgesics, antipyretics, antihistaminics and oral decongestant. Follow up visits are necessary after 10-14 days to evaluate if the child has persistent effusion.

Following antibiotic treatment for an episode of acute otitis media 30% to 70% of infants and children will have a persistent middle ear effusion without further treatment only 6% to 26%will have an effusion remaining in the middle ear 3 months after the onset of acute episode.The mean duration of persistent middle ear effusion being 23 days. Most effusions resolve without further treatment not requiring another course of antibiotic treatment.

Otitis media with effusion:

OME in most children will resolve without active treatment**.** It is evident that most effusions that develop after an episode of AOM and effusions found on routine examination in an otherwise healthy child will resolve spontaneously. Watchful waiting for these children is indicated. In addition, a single course of oral antibiotics may be given in an attempt to clear the effusion, In an otherwise healthy child with unilateral OME for 6 months without hearing loss, developmental delays, or middle ear/tympanic membrane abnormalities, it would be appropriate to continue watchful waiting. However, if there is any significant hearing loss, aural fullness, school performance problems, or tympanic membrane/middle ear abnormalities, tube placement is more appropriate.

Chronic suppurative otitis media:

Chronic suppurative otitis media, which is uncomplicated, is initially treated medically. Because the bacteria most frequently cultured are gram negative, antimicrobial agents should be selected to be effective against these organisms, but the antibiotic treatment should be culture directed. Medical treatment consists of aural toilet, ototopical medication, and possible administration of systemic antimicrobial agents, first orally and, if this fails, intravenously. Surgery is required to close a perforation as in those patients

with permanent perforations or tympanomastoid disease .Simple closure of perforation (Myringoplasty) or reconstruction of ossicles (Ossiculoplasty) or surgery of the mastoid (Cortical mastoidectomy/Modified radical mastoidectomy) are some of the surgical procedures done in CSOM.

IMMUNOPROPHYLAXIS:

S. pneumoniae and H. influenzae are the predominant pathogens recovered from the middle ear of children with AOM. Vaccines for preventing disease caused by *S. pneumoniae* have focused on the capsule as a critical virulence feature, even though each of the described 90 serotypes has a unique polysaccharide composition with limited cross-reaction among serotypes. One reason for targeting the capsule is its capacity to protect *S. pneumoniae* from host defenses and the low pathogenicity of unencapsulated isolates (at least for invasive disease).

A 23-type vaccine composed of capsular polysaccharide antigens was licensed in the United States in 1983, replacing a 14-type vaccine licensed in 1977. Each polysaccharide antigen is prepared separately and stimulates a type specific immune response. Currently, there are two licensed pneumococcal polysaccharide vaccines available in the United States. The first pneumococcal vaccine capable of eliciting protective antibodies in infants, a heptavalent pneumococcal conjugate polysaccharide vaccine (PCV-7), was approved by the FDA in February 2000. The vaccine contains the polysaccharides of *Streptococcus pneumoniae* conjugated to a nontoxic diphtheria protein CRM 197. The vaccine elicits an antibody response to all serotypes after primary immunization and produces an amnestic response following a booster dose. Protective

titers were achieved after doses administered at ages 2, 4, and 6 months, but concentrations of antibody waned during the following 6 months, requiring a booster dose between ages 12 and 15 months. The vaccine was effective in preventing vaccine-type invasive disease (97.4% in fully immunized infants) and pneumonia (35% decrease for radiographically identifiable disease) (Black et al, 2000).

Vaccination against viral (influenza) and bacterial (*Streptococcus pneumoniae*) pathogens is an established general preventive strategy for acute otitis media (AOM), but preventing respiratory infection caused by a single virus or subpopulation of the major bacterial AOM pathogens is unlikely to have a substantial impact on a specific child.

1. High serum antibody concentrations for specific bacterial pathogens are achievable with conjugate vaccine technologies. Local antibody may be more efficacious in preventing colonization with viral or bacterial respiratory pathogens.
2. Heptavalent pneumococcal conjugate vaccine (PCV7) reduces pneumococcal otitis media, but replacement disease is observed and long-term effects remain uncertain.

PREVENTION OF OTITIS MEDIA:

Although OM is a common condition in developing countries, the value of targeting limited health care resources to the diagnosis and management of otitis media is controversial. The cost of treatment of children with OM comprise a substantial part of total health care expenditure. Prevention of otitis media and its sequelae should be part of both primary care giver and national health schemes. Strategies should be devised to prevent development of OM and its sequelae in the children community. The strategy

should include parent education, chemoprophylaxis, immunoprophylaxis and a consideration for surgery.

Parents should be educated about the risk factors for OM by active health education .They may be empowered to change environmental risk factors such as eliminating cigarette smoking from the household and encouraging home or small group out of home care .Health education should also include provisions for better hygiene and sanitation and promotion of breast feeding for at least 3 months duration.

Chemoprophylaxis should be reserved for patients who have had 3 or more episodes of AOM in 6 months or 4 or more episodes in 12 months .This is done to prevent development of multidrug resistant strains. Immunoprophylaxis with seven-valent conjugate pneumococcal vaccine has been documented to benefit children with severe and recurrent OM .

If the child continues to suffer from recurrent OM after the prior steps have been taken then myringotomy and grommet insertion is valuable in prevention of further episodes (Casselbrant et al,1992). Adenoidectomy, irrespective of size of the adenoids, has been demonstrated to reduce the rate of recurrent episodes of OM. (Paradise et al.,1990) .

AIMS AND OBJECTIVES

I. To study the prevalence of otitis media and its sequelae in children aged 1-6 years in rural Tamil Nadu.

II.To identify the risk factors for otitis media in children aged 1-6 years using a case –control study design.

MATERIALS AND METHODS

RESEARCH DESIGN AND METHODS

STUDY DESIGN

1. To measure the prevalence of Otitis media, a cross sectional survey design was used.
2. To determine the risk factors for Otitis media in children aged 1-6 years, a case control study was designed

DESCRIPTION OF THE STUDY AREA

This study was done in K.V Kuppam rural development block, the service area of RUHSA (Rural Unit for Health and Social Affairs) Department, one of the units of Community Health Department, Christian Medical College, Vellore, Tamilnadu. RUHSA is located 25 kms North West of Vellore town. The block is divided in to 18 peripheral service units (PSU) for service purpose with an average population of 5000 to 7000 in each of the units, covering 90 villages. There is a health sub-center located in each of the PSUs. RUHSA program is an integrated health and development program providing primary health care services for an estimated population of 120,000. The geographic area for this project is 100% rural and the majority of the people residing in this area are subsistent agricultural farmers and agricultural laborers; the other occupations include weaving, tailoring, poultry farming, beedi (local cigarettes) making. Two of the PSUs were selected for the study (Fig 1). One PSU was located closer to the RUHSA community health center and the other was located about 20 km away.

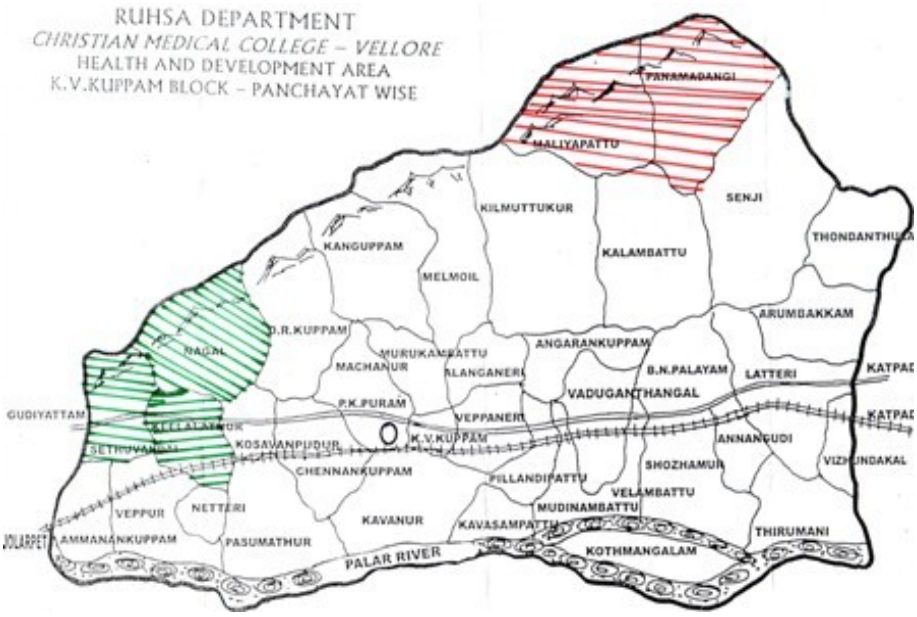


Fig 1.Map of K.V.Kuppam Block-Panchayat wise showing the study areas.

SAMPLE SIZE:

Based on a study done in the neighboring rural development block (Kaniyambadi block), we know that about 22% of the children in the age group of 1-6 years (children in day care center) would give history of persistent rhinorrhoea (Cherian et al,2000).We anticipated that the odds for history of persistent rhinorrhoea among those who are diagnosed to have otitis media to be three times of that of controls. The estimated sample size of 70 cases and 70 controls will have 80% power to detect a difference between two proportions using a two group continuity corrected chi-square or Fisher's Exact test, with

a 0.05 two-sided significance level. Sample size calculations were done using PS-Power and sample size calculation software.

Previous studies have shown that the prevalence of chronic suppurative otitis media in children is about 6-7% (Jacob et al,1997).A sample size of 1000 children for prevalence study was calculated based on the estimates that 6-7 % of the children will have otitis media and therefore we will be able to diagnose about 70 children with otitis media for the case control study**.**

SELECTION OF STUDY PARTICIPANTS:

Prevalence study:

A list of cohort born between 1st of June 2000 to 31st of may 2005 as documented by RUHSA's computerized demographic surveillance system was taken by the Rural Community Officers and Health aides (the members of peripheral health service team of RUHSA) to motivate the parents to bring the children to the screening camps.

Case control study:

Selection of cases:

Children in the age group of 1 to 6 years who presented with acute suppurative otitis media or sequelae of acute otitis media including Otitis media with effusion and chronic otitis media which would include CSOM tubotympanic type and CSOM attico-antral type were taken as cases .

Case definitions:

1. Acute Suppurative otitis media: Diagnosed by the presence of ear ache and fever with or without ear discharge and a congested or bulging ear drum.

2. Otitis media with effusion: Diagnosed by the presence of a dull tympanic membrane with or without a fluid level and a type B curve on tympanometry. Hearing loss and ear ache may be present.

3.Chronic suppurative otitis media without cholesteatoma : Diagnosed by the presence of a perforation of tympanic membrane and decreased hearing with or without active ear discharge .A history of ear discharge more than 6 weeks prior to examination should be present.

4.Chronic suppurative otitis media with cholesteatoma: Diagnosed by the presence of an attic perforation or retraction or postero-superior retraction pocket with or without cholesteatoma.

Exclusion criteria :

1. Down's syndrome
2. Cleft palate.
3. Systemic diseases like juvenile diabetes, Nephrotic syndrome etc
4. Immuno-deficiency.

Children with the above mentioned conditions were excluded from the case control study since they are at greater risk for developing otitis media .

Selection of controls:

When a child was diagnosed as a case, the following child screened negative for otitis media was selected as a control.

COMMUNITY EDUCATION:

In order to create awareness regarding otitis media and its consequences in children in the community and to motivate the parents to bring their children to screening camps, an education program was designed and implemented. The target audiences were Rural Community Officers, Family Care Volunteers and members of Self-Help Women Groups and men in the community. The principal investigator was the educator in all the education sessions. Education material included colored charts displaying the anatomy of the ear, signs and symptoms and consequences of otitis media(Fig 2). We used interactive sessions to educate the community.

Fig 2:Health Education to the Community

DEVELOPMENT OF STUDY QUESTIONNAIRE:

A survey questionnaire was developed with three parts. Part I had socio-demographic information of all the participants, Part II had all the risk factors for both cases and controls. The risk factors studied were persistent rhinorrhoea, attendance in balwaadi (day care nursery), poor ventilation, low socioeconomic status, malnutrition, exposure to smoke, bathing in ponds, and lack of adequate breast feeding. Part III included the details of clinical examination of each child, pure tone audiometric thresholds and middle ear compliance measurements (See APPENDIX 1).

STATISTICAL ANALYSIS:

Sample size calculation:

Based on a study done in the neighboring rural development block (Kaniyambadi block), we know that about 22% of the children in the age group of 1-6 years (children in day care center) would give history of persistent rhinorrhoea (Cherian et al,2000).We anticipated that the odds for history of persistent rhinorrhea among those who are diagnosed to have otitis media to be three times of that of controls. The estimated sample size of 70 cases and 70 controls will have 80% power to detect a difference between two proportions using a two group continuity corrected chi-square or Fisher's Exact test, with a 0.05 two-sided significance level. Sample size calculations were done using PS-Power and sample size calculation software.

Previous studies have shown that the prevalence of chronic suppurative otitis media in children is about 6-7%(Jacob et al,1997). A sample size of 1000 children for prevalence study was calculated based on the estimates that 6-7 % of the children will have otitis media and therefore we will be able to diagnose about 70 children with otitis media for the case control study**.**

Operational definitions of risk factors for analysis:

Age category: We categorized age as 2 groups .Group 1 included all those children below the age of 3 years and group 2 included children who were above 3 years of age as the children below 3 years are more prone to get ear infections

Education: We categorized the study population into 2 groups. Group I included all those whose parents had studied upto 10^{th} grade and group 2 included all those whose parents who had studied further

Type of house: The type of house was categorized into 2 groups (Table I) .Group 1 included those with katcha , mixed and hut .Group 2 included those with tiled, pucca and mansion

TableI: Definition of type of house

Hut	1 room constructed with mud wall and thatched roof
Katcha	Constructed with more than 1 room with mud wall Thatched roof
Mixed	1.Cement or Mortar used for constructing the wall 2.Thatched roof
Tiled	A house with tiled roof
Pucca	Foundation laid with bricks or stones with mortar, Stone laid walls or cement walls with Tiled or concrete roof
Mansion	Large house with more than 5 rooms excluding kitchen and toilet

Assessment of malnutrition of children:

In this study, we considered weight for age as a measure for malnutrition. The nutritional status was analyzed using Nutrition Anthropometry Programme of CDC/EPIINFO statistical package (2000).

Malnutrition was defined in our study as all those children who weighed less than 2 standard deviation below the reference median.

Persistent Rhinorrhoea:

Upper respiratory tract infection lasting more than 2 weeks.

The data were analyzed using SPSS (Statistical Package for Social Sciences) version 12, Chicago IL

Bivariate association:

We used chi-square statistics to determine the association between risk factors and otitis media

Multivariate analysis:

We used logistic regression (unconditional) multivariate model including the following potential risk factors: age , type of house, attendance in day care centres ,breast feeding less than 6 months and persistent rhinorrhoea for otitis media:

Community education program

The members of the SHG were informed earlier about the health education camps by the RCOs, Health aides and family care volunteers. About 30- 50 women were gathered at every session (Fig3). The education camps were in the evening between 5pm to 7.30pm and about 2-3 selected areas were covered in a day.

Fig 3:Health Education to the Community

Table II: **Description of community education program**:

Target audience	Number of sessions	Number of participants	Method used
Rural Community Officers	1	8	Coloured charts Interactive sessions
Members of SHG, FCV, and other interested men and women in the village	12 in each PSU totaling to about 24	30-40	Coloured charts Interactive sessions

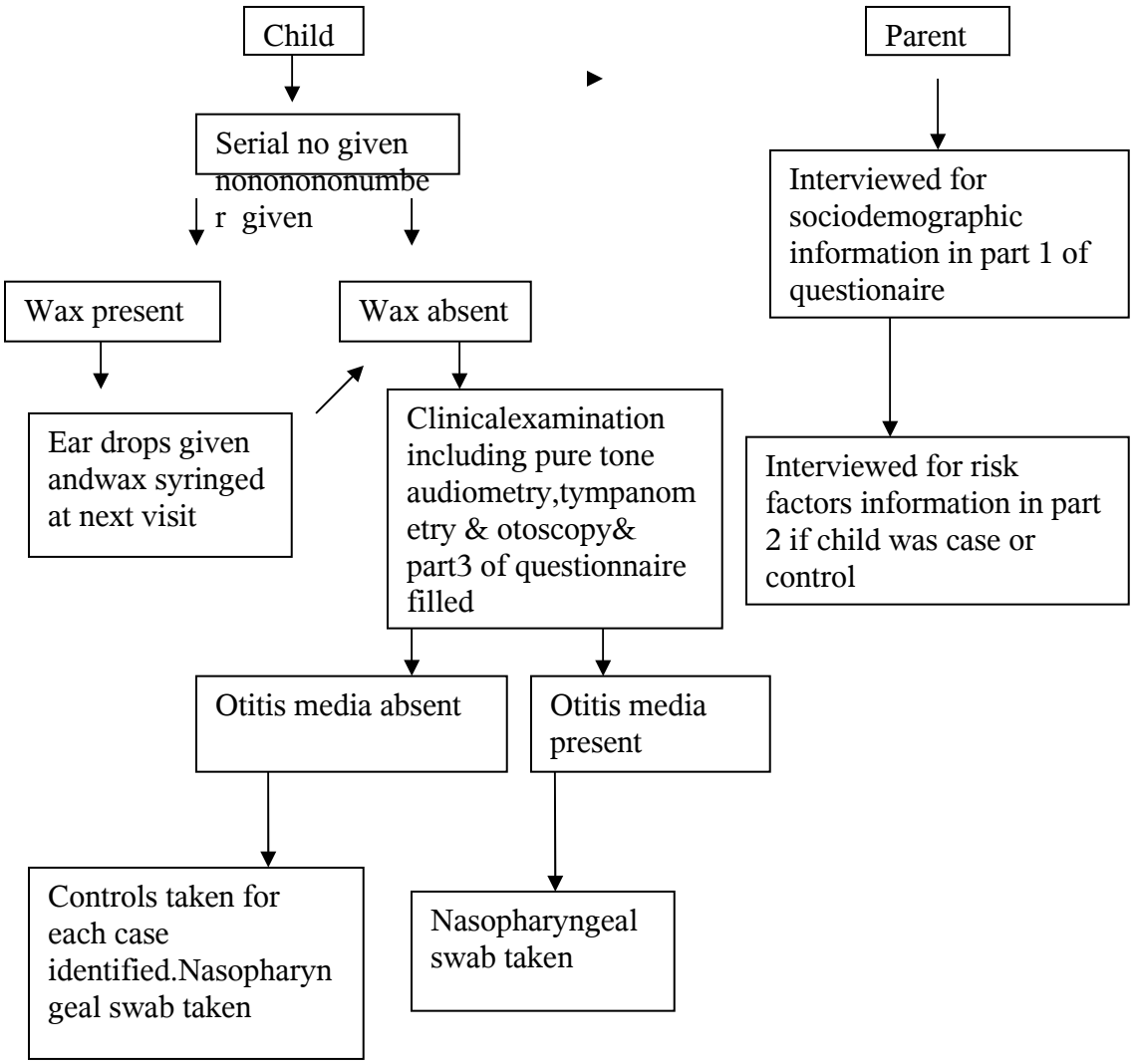
The screening camps were started in July 2006. Approximately 6-7 camps per month were conducted. During the government holidays & local festivals, camps were avoided. A total of 36 camps were conducted in 2 study areas. On an average 35 children were screened at every camp. The Children were first seen by one of the RCOs (rural community officer) who checked the name in the list, if not found in the checklist, verified the eligibility age and area of residence and recruited the participants for the study. After registration,(Fig4) they were seen by the other RCO who completed the part

I of the proforma containing socio-demographic characteristics of the study participants by interviewing the accompanying parent and were given a study identification number. Following this, the child was examined by the principal investigator who identified the children with otitis media. If a child was identified as a case, then the very next child who had no evidence of otitis media was taken as control. Part III of the questionnaire was filled up after complete clinical examination to pick up cases of otitis media and normal controls. All cases and their controls underwent nasopharyngeal swabbing. The cases and controls thus identified were again interviewed by the RCO to collect the information on risk factors for otitis media in the part II of the questionnaire. Children who presented with ear wax were given ear drops and was asked to come after the wax syringed by ENT specialist in RUHSA hospital .Those who were treated for wax and returned back to screening camp was again examined to include them in the study if eligible. An informed consent was taken from all parents/ informants who attended the camps with the children before they underwent examination

Screening of Children:

Figure 4:

Step1


Child
Parent
Serial no given
nononononumbe
r given
Interviewed for sociodemographic information in part 1 of questionaire
Wax present
Wax absent
Ear drops given andwax syringed at next visit
Clinicalexamination including pure tone audiometry,tympanom etry & otoscopy& part3 of questionnaire filled
Interviewed for risk factors information in part 2 if child was case or control
Otitis media absent
Otitis media present
Controls taken for each case identified.Nasopharyn geal swab taken
Nasopharyngeal swab taken

All children above 2 years without ear wax underwent audiometric evaluation with a portable audiometer and were marked as normal or abnormal. Those children who were less than 2 years of age underwent free field testing with un-calibrated noise makers and were marked as normal or abnormal.

Tympanometric evaluation (Fig 5) was done at the same time with portable tympanometer (Welch-Allyn Diagnostics ltd) and were categorized as type A referred to as normal middle ear. Type B was diagnostic of fluid in the middle ear , and type C of Eustachian tube block .

Fig 5: Tympanometric evaluation of a Child during Health camps

The children who were identified as cases and controls underwent nasopharyngeal swabs testing and they were transported within 6 hours to the microbiology department for plating and processing.

RESULTS

Results :

Sociodemographic characteristics of the study population:

We screened a total of 800 children in the age group of 1-6 years, residing in 2 peripheral service units in K.V Kuppam block, to study the prevalence of otitis media, from July 2006 to April 2007. There were about 1000 children in the study age group in the area as per the computerized demographic data list of RUHSA department and we were able to motivate 800 children to participate in the study.

Description of study population

As displayed in the bar graph (Fig1), the study population had a reasonable representation from all the ages included in the study. The mean age was 47 month(range between 11 months to 84 months).Less than 1/3rd of children (31.4%) were less than 3 years of age .It is noteworthy that about 50% of the households in this rural community had a member who was educated above high school and about 60% of them lived in either tiled or pucca houses (Table: I).

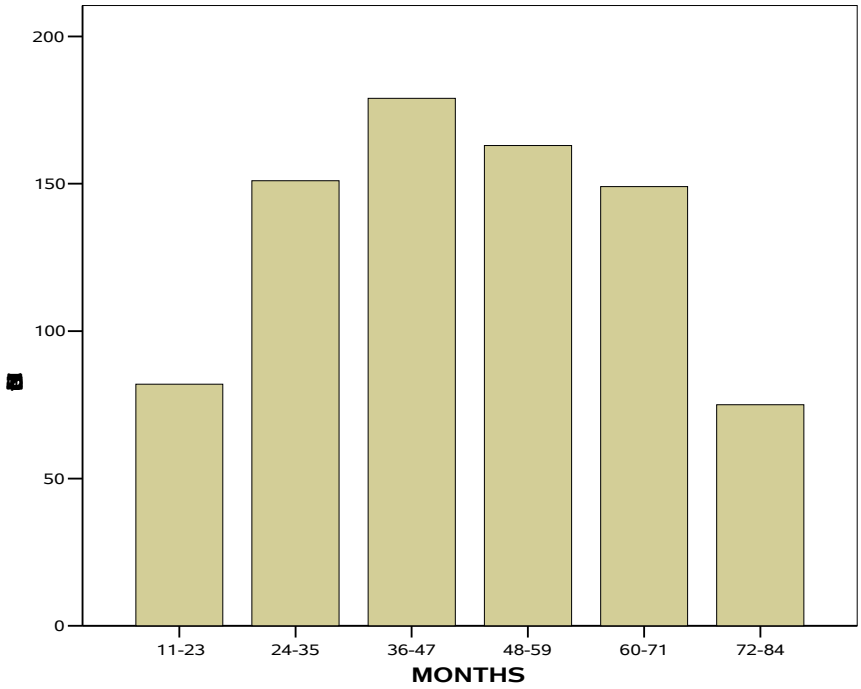


Fig1: Age distribution of study participant

Table I: **Sociodemographic Charateristics of the study population.**

Characteristics	**Frequency**
Age [Mean in months(S.D)**]**	47.10(17.68)
Sex[Female Number(%)**]**	389 (48.6)]
Occupation [Number(%)]	
Unemployed	3(0.4)
Unskilled	65(8.1)
Semiskilled	523(65.4)
Skilled	155(19.4)
Clerical	34(4.3)
Semiprofessionals	6(0.8)
Professionals	14(1.8)
Highest Education in the Family[Number(%)]	
Nil education	26(3.3)

Primary school	111(23.9)
Middle school	234(29.3)
Intermediate	63(7.9)
High school	332(41.5)
Degree	34(4.3)
Type of House[Number(%)]	
Hut + katcha + Mixed	290(36.3)
Tiled + Pucca+ Mansion	510(63.9)

Clinical Examination Findings

All 800 children underwent a systemic ear, nose, throat examination during their visit in the screening camps and the results are as follows.

Table II : Description of the ear examination findings:

Finding Observed	**[Number(%)]**
Ear	
Normal	**457(57.1)**
Wax	**213(26.6)**
Discharge	**15(1.9)**
Tympanic membrane	
Retraction	**81(10)**
Perforation	**14(1.8)**
Tympanometry	
TypeA	**493(61.6)**
TypeB	**47(5.9)**
TypeC	**44(5.5)**
Audiometry	
Hearing Loss	**18(2.3)**

Otitis Externa	**1**

Hearing loss among the study population by Audiometry:

Audiometry was done on all children without wax and we found that 18 children (2.3%) (Table:II)had abnormal hearing which includes both conductive and sensorineural hearing loss.

Prevalence of Otitis Media:

There were 41 children diagnosed to have otitis media out of 800 children screened. The over all prevalence rate of otitis media was found to be 5%.

Table III: Distribution of types of otitis media :

Diagnosis	Number (%)
Otitis Media with Effusion (OME)	**26(3.5)**
Eustachian Tube Catarrh	**24(3.0)**
Chronic supurative otitis meda- Tubotympanic Disease (CSOM-TTD)	**11(1.4)**
Acute suppurative otitis media(ASOM)	**7(0.9)**

CASE CONTROL STUDY:

Risk factors for Otitis media

A number of risk factors are known to predispose a child to otitis media .These include persistent rhinorrhoea, attendance in balwaadi (day care nursery), poor ventilation, low socioeconomic status, malnutrition, exposure to smoke, bathing in ponds, and lack of adequate breast feeding . We designed a case-control study to identify the significant risk factors for otitis media in this rural population in order to recommend appropriate intervention to prevent otitis media in children. A sample size of 70 cases and 70 controls was required for the study to have 80% power to detect a difference between the prevalence of persistent rhinorrhoea among those who have otitis media and those who do not have otitis media at 5% two-sided significance level, provided the prevalence of history of persistent rhinorrhoea among the normal controls is 22%. However, we were able to recruit only 41 cases and 41 controls as the prevalence of otitis media in this study population was lower than expected (only 5%) and also due to time constraints only 800

children could be screened as against the proposed 1000 children. Following are the results:

We analyzed the results of 41 cases and controls for the risk factors which are age, persistent rhinorrhoea, attendance in balwaadi (day care nursery), poor ventilation, low socioeconomic status, malnutrition, exposure to smoke, bathing in ponds, and lack of adequate breast feeding and the results are as follow**s:**

Socio-demographic characteristics of the study population:

The mean age of cases was 43.8 months and that of controls was 45.76 months. The age distribution was not skewed to any side (Fig 2)

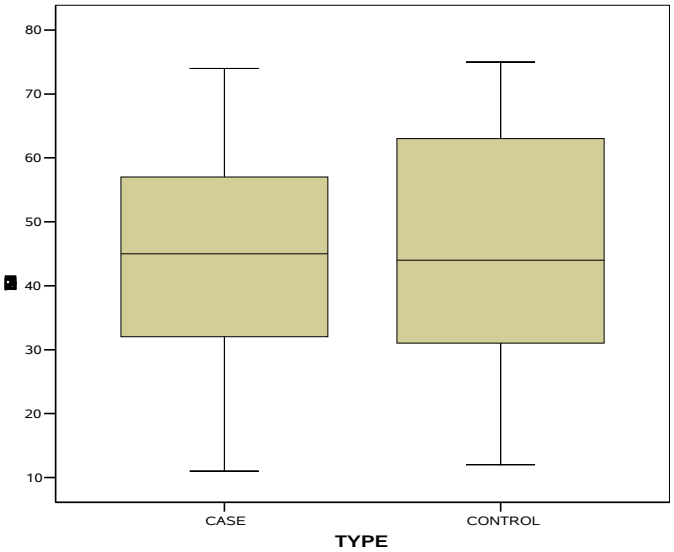


Fig 2: Age distribution of the case- control population

Description of case-control study population:

Table IV: Sociodemographic characteristics of the case- control population

Variable	Cases(n= 41)	Control (n=41)
1.Age in months [Mean(C.I)]	43.8(38.44-49.17)	45.76(39.86-51.65)
2.Sex (Number) Female	17 (41.46)	21(51.21)
3.Highest Highest level of education in the family(Number)		
10^{th} grade	16	18
$>10^{th}$ grade	25	23
4. Socioeconomic status based on Type of house(No)		
1- katcha , mixed and hut	7	11
2-Tiled, pucca and mansion	34	30

Prevalence of risk factors among cases and controls

Table V: **Prevalence of and association between risk factors and otitis media among those with otitis media as compared to those without otitis media**

Risk factors	Cases n = 41 [Number(%)]	Control n=41 [Number (%)]	Odds Ratio	p-value
Age less than 36 months	13(31)	14(34.1)	1.007	.62
Sex (Male)	24(58.5)	20(48)	0.674	.376
Poor education (less than 10^{th} grade)	16 (39)	18(43)	1.103	0.411
Poor housing (Hut+ katcha+mixed)	7(17.02)	11(26.8)	1.836	0.212
Malnutrition (weight for age >-2SD from reference median)	19(46.3)	17(41.46)	0.910	0.412
Attended Day care center(Balwadi)	17(41.46)	12(29.26)	1.711	0.178
Breast feeding less than 6 months	3(7.31)	8(19.51)	0.325	0.097
Persistent Rhinorrhoea	22(53.65)	9(21.95)	3.950	.003*

* - Significant

Age:

Bivariate analysis was performed to study the age as a risk factor for otitis media.There was no significant association between age (categorized <3 years, ≥3 years) and otitis media (p = 0.622)

Education:

We categorized the study population into 2 groups. Group I included all those whose parents had studied upto 10^{th} grade and group II included all those whose parents who had studied more than high school level education. .We then looked for association with the disease .Education levels were roughly the same in both cases and controls. Children whose parents were less educated were in no way more predisposed to otitis media than those whose education was greater(p= 0.411)

Sex :

There was an almost equal distribution of females and males among both cases and controls .There was no sex predilection for otitis media (p = 0.376) .

Socioeconomic status based on type of House:

We did not use the Kuppuswamy scale in evaluating socioeconomic status because the scale is not updated and the highest income (Rs.2000) as one of the items in the scale which will give the participant a high socio-economic status is not relevant now. In this study, we used type of house, education as surrogate markers of socio-economic status. The studies done at our institution have shown that the type of house is

a good indicator of socioeconomic status. The type of house was categorized into 2 groups for analysis (TableV).Group 1 included hut, katcha and mixed and group 2 included those with tiled, pucca and mansion. We found that there was no significant association between the type of housing and prevalence of otitis media (p=0.212)

Malnutrition :

In this study we followed the Indian Association of Pediatrics (IAP) classification and used weight for age as a measure of malnutrition. Nutritional status was analyzed using nutrition anthropometry programme of the CDC/EPI-INFO statistical package (2000). Malnutrition was defined in our study as all those children who weighed less than 2 standard deviation below the reference median. We clubbed all grade1,2 and 3 as there were less than 5 children with grade 3 malnutrition and when the number in a cell is less than 5 it is difficult to do statistical analysis

We found that more than 40 % of both the cases and controls were malnourished and therefore there was no significant association between otitis media and malnutrition (Fig 3) (p=0.412)

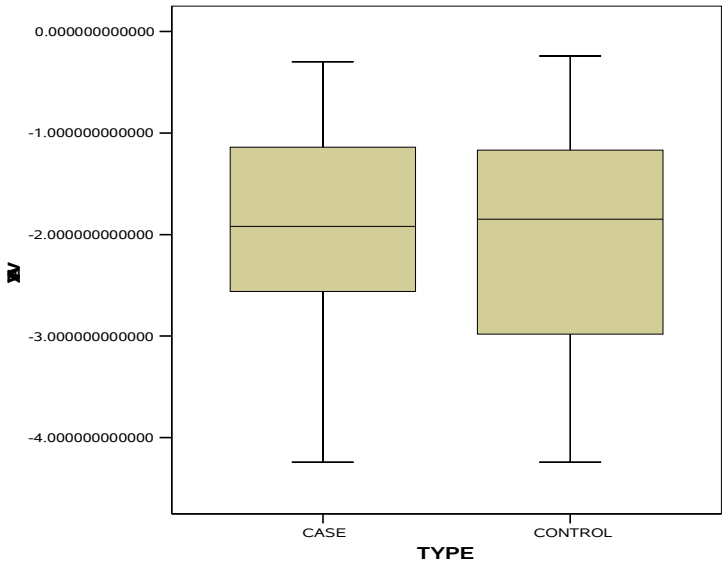


Figure3: Prevalence of malnutrition among cases and controls

Day care center attendance (Balwaadi):

It is shown that children attending balwaadi(day care center attendance) may have a predisposition for the disease because of close interaction between children with respiratory infection and others in an enclosed space. However, in this study we found no association between attendance at a balwaadi and otitis media(p= 0.178)

Breast feeding:

It is recommended that children should be breast fed more than 6 months for better nutritional status and immunity in children. We categorized the breast feeding based on the duration in to 2 groups. Group 1 included all children who were breast fed for less than 6 months and group 2 included all children who were breast fed for more

than 6 months .However, we did not find any significant association between the duration of breast feeding and otitis media(p=0.097)

Persistent rhinorrhoea:

Upper respiratory tract infection lasting more than 2 weeks is defined as persistent rhinorrhoea. Our results showed that there was a strong association between history of persistent rhinorrhoea and the otitis media(p= 0.003).

Snoring and mouth breathing are signs that the child may present with during episodes of persistent rhinorrhoea. Consequently, we found that these signs also have significant association with the disease.(p=<0.001 and p=<0.002 respectively)

Logistic regression analysis :

To determine which risk factors to include as confounders in the model, we evaluated the association between each potential confounder and otitis media using CHI square statistics. We included all the potential confounders that were associated in a univariate analysis with a p-values of 0 .2 or less [poor housing (p = 0.21), breast feeding less than 6 months(p=0.097), day care attendance (p = 0.178) in the logistic regression model. They remained in the model if they changed the β coefficient for persistent rhinorrhea more then 10% when they were removed from the model. None of the variables that were included in the model changed the β coefficient for persistent rhinorrhea more than 10%. Therefore, there were no significant confounders identified in this study. We found that the odds for developing otitis media in children with history of persistent rhinorrhea was 4 times higher as compared to those without history of persistent rhinorrhea.

Table VI: Unconditional Logistic regression model for the association of odds for otitis media with age, attendance in balwaadi, poor housing, poor breast feeding practice and persistent rhinorrhea

Risk Factors	β coefficient	Odds Ratio	pvalue
Persistent Rhinorrhea	1.415	4.115	.006
Age in Months	.007	1.007	.592
Attendance in Balwadi	.629	1.876	.217
Poor Housing	.006	1.006	.991
Breast Feeding (less than 6 months)	.874	.417	.250

Discussion:

This research was aimed at studying the prevalence of Otitis media and determining the risk factors for Otitis media in children aged 1-6 years in a rural South Indian population. According to WHO guidelines countries are categorized based on the prevalence of otitis media (Table VII) .

Table VII. Classification of countries according to CSOM prevalence

Group	Population
Highest (>4%)-Urgent attention needed to deal with a massive public health problem	Tanzania, India, Solomon Islands, Guam, Australian Aborigines,Greenland
High (2–4%) – avoidable burden of disease must be addressed	Nigeria, Angola, Mozambique, Republic of Korea, Thailand,Philippines, Malaysia, Vietnam, Micronesia, China, Eskimos
Low (1–2%)	Brazil, Kenya
Lowest (<1%)	Gambia, Saudi Arabia, Israel, Australia, United Kingdom,Denmark, Finland, American Indians

We found that the prevalence of otitis media was 5% in this rural population .This makes otitis media a major health problem in this study area. As the same conditions may prevail in many other parts of the country otitis media is a national health priority.

The results from different epidemiologic studies vary owing to differences in definition of disease, case finding methods, observation intervals, prevalence windows,

prevalence of risk factors and population characteristics. The existing studies have used prospective cohort study designs (Casselbrant et al,1985; Paradise et al 1997;Pukander et al 1982;Wald et al 1988;Etzel et al.,1992) cross sectional studies(Teele et al.,1989; Casselbrant et al,1985;Castagno et al,2002;Jacob et al,1997;Cherian et al, 2000)and case control study design(Kraemer et al, 1983;Cherian et al,2000). A few studies are retrospective cohort (Duncan et al, 1993).The present study used a cross sectional survey design to assess the overall prevalence of OM similar to some previously described studies (Teele et al,1989; Casselbrant et al,1985;Castagno et al,2002;Jacob et al,1997;Cherian et al, 2000). Additionally a case control study design was used to assess risk factors for OM only a few studies have used this design.

Previous studies have shown that otitis media is associated with younger age group. The peak age specific attack rate occurs between 6 and 18 months of age. The reason for this is the maturing anatomic, physiologic and immunologic factors in the younger child. The highest incidence of AOM occurs between 6 and 11 months of age and the onset of first episode of AOM before 6 months of age is a powerful predictor for recurrent AOM (Teele et al,1989).The risk for persistent MEE after an AOM episode has also been shown to inversely correlate with age(Teele et al,1992) .However in the present study did not reveal as significant association between young age and otitis media. The small sample size and a low power of the study could also be a reason for not being able to appreciate the true association between age and otitis media.

Most studies of otitis media have reported no apparent gender based difference in the incidence of the disease. Some studies have found males to have a significantly higher incidence of AOM and more recurrent episodes of AOM than females (Teele et al,1989;Pukander et al, 1982),although the reason for sex predilection is not known . In our study there were almost equal number of males and females in both with and without otits media. We did not find significant relationship between sex and the disease .

Almost universally, studies identify day-care center attendance as a very important risk factor for developing otitis media .Children in day-care centers are at increased risk for URI probably because of the large number of susceptible children in close contact. In South India, children attend balwaadi,where they are taught to play, study and eat together and the chances for cross infection between the children are very high . The prevalence of MEE, has been shown to be highest in children cared for in day-care centers with many children, intermediate in children in family day care with fewer children, and lowest in children cared for at home (Fiellau-Nikolajsen , 1979).However in our study there was no significant association between this risk factor and the disease. This is probably because most of the children(58%) were school going age group and were studying in centre consisting of 40-50 children in each class.

Passive smoking by children may be due to parental smoking or household smoke generated by wood fuel used in cooking .In developing countries the latter is a more important cause than the former. An association between OM and passive exposure to smoking has been reported by many investigators (Etzel et al.,1992) although other

investigators, have not been able to demonstrate such an association (Birch and Elbrond ,1987) .In our study we did not find any significant association between this risk factor and the disease because most of the household were using Liquefied Petroleum Gas (LPG) and children were not exposed to smoke within the house.

Breast-feeding has a protective effect against middle ear disease. However, there is controversy regarding the duration of breast-feeding necessary for protection.Many studies have reported fewer recurrences of AOM among children who were breast-fed exclusively for a prolonged period of time. Duncan and colleagues (1993) followed 1,013 infants in a 1-year study and found that infants exclusively breast-fed for 4 months or longer had half the mean number of AOM episodes compared with infants who were not breast-fed at all and 40% less than infants breast-fed less than 4 months. The recurrence rate in infants exclusively breast-fed for 6 months or longer was 10% compared with 20.5% in infants who were breast-fed less than 4 months. Some investigators have found no association between the duration of breast-feeding and the recurrence rate of AOM (Harsten et al, 1989) .In our study however, we did not find any significant association between the duration of breast feeding and otitis media because most of the children were breast fed for more than 6 months.

Socioeconomic status and access to health care are factors that may affect the incidence of OM. It has been generally thought that OM is more common among people in the lower socioeconomic strata owing to poor sanitary conditions and crowding. Paradise and colleagues (1997) followed 2,253 infants for 2 years and found an inverse

relationship between the cumulative proportion of days with MEE and socioeconomic status. Castagno and Lavinsky (2002) also found a higher prevalence of OME in children in the lower socioeconomic class in southern Brazil. However, many studies revealed no correlation between socioeconomic status of the child's family and incidence of MEE (Birch and Elbrond ,1987; Teele et al , 1989).

We found that the association between the socioeconomic status and prevalence of otitis media was not significant. In general the population we screened were economically better off and were literate .

Both epidemiologic evidence and clinical experience strongly suggest that otitis media is frequently a complication of URI. This supports the hypothesis that an episode of URI plays an important role in the etiology of OM. Our study has revealed that persistent rhinorrhoea being a significant risk factor for development of otitis media and the associated symptoms such as snoring and mouth breathing are important pointers towards the child developing otitis media. Children with persistent rhinorrhoea are four times at a higher risk as compared to other children for developing otitis media. Persistent rhinorrhoea in North America is considered to be a sign of sinusitis in children below 6 years of age and antibiotic treatment is recommended .In contrast ,in rural south India this risk factor is frequently overlooked and not regarded as requiring treatment , so the prevalence of persistent rhinorrhoea is very high and so is the prevalence of otitis media.

Cherian et al (2000) found that among children with persistent rhinorrhoea 11.7 percent also had otorrhoea and so there is a strong association between persistent rhinorrhoea and otorrhoea .The association between chronic otitis and chronic purulent rhinitis has also been noted in the Australian aboriginals (Gibson et al, 1996). In our study we found that there was a strong association between persistent rhinorrhoea and the presence of otitis media(p= 0.006) and the odds ratio for the disease being four. Snoring and mouth breathing are signs that the child may present with during episodes of persistent rhinorrhoea. Consequently , we found that these signs also have significant association with the disease.(p=<0.001 and p=<0.002 respectively).

Conclusion:

It is evident that the prevalence of otitis media in this region as per the results of our study is among the highest in the world. The multifactorial nature of otitis media must be stressed. Frequent upper respiratory tract infections not treated adequately seem to be the number one risk factor for otitis media in this population. Therefore we recommend that there is an urgent need to raise awareness in the community regarding the risk factors, signs and symptoms and consequences of otitis media and to improve access to medical facilities

Persistent rhinorrhoea a significant risk factor in the present study should be treated as early as possible to avoid development of otitis media.Other measures of prevention should include health education and creating public awareness of otitis media and common risk factors .Special emphasis should be placed on early treatment of upper respiratory tract infection in children . Regular school visits and camps to screen children for otitis media should be part of a designated national health programme for ear care.

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APPENDIX

ANALYSIS OF RISK FACTORS IN OTITIS MEDIA

PART I

Interviewer:----------

1. Date: 2. Serial No: 3. FI no……..

4. Place…….. 5. Informant_

6. Name: 7.DOB / / 8. Sex: 1.Male 2.Female

9. Address:…….
……..

10. Mentally Challenged: 1. Yes 2. No 11. Cleft Palate: 1. Yes 2. No

12. Immunosuppressed: 1. Yes 2. No

13.Generalised systemic illness: 1.Yes 2.No

14. Occupation (Highest)

1. Unemployed 2. Unskilled 3.Semiskilled 4. Skilled

5. Clerical/shop owner/farm owner 6. Semi-profession 7. Profession ☐

15. Education (Highest)

1. Illiterate 2.Primary School 3. Middle School 4. High School

5. Intermediate 6. Degree (B.A, B.Sc, BCom/ DIPLOMA) ☐

7. Masters Degree

16. Type of house

1. Hut 2. Katcha 3. Mixed 4. Group 5. Tiled/Pucca

6.Mansion (two storeys or more)

17. Kuppuswamy score: ☐

PART II

1. Height: 2.Weight: 3. Mid-arm circumference :

4. Ventilation 1. Y 2. N

5. Attending Balwadi 1. Y 2. N

6. Immunisation status:

6.1 BCG 1. Y 2. N

6.2 OPV 1. Y 2. N

6.3 DPT 1. Y 2. N

6.4 MMR 1. Y 2. N

6.5 HiB 1. Y 2. N

6.6 Measles 1.Y 2. N

7. Duration of breast feeding: 1. Nil 2. < 3 months 3. 3 to ≤6 months

4. > 6 months

8. Smoking among members in the household : 1.Yes 2.No

9. Fire wood cooking inside the house: 1. Yes 2. No

10. H/O bathing in the ponds: 1. Yes 2. No

11. Snoring: 1.Yes 2.No 12. Mouth breathing: 1.Yes 2.No

13 .H/O Persistent rhinorrhea (cold more than 2weeks): 1. Yes 2. No

14. H/O Seasonal increase in URI 1. No 2. Summer 3. Monsoon 4.Winter

15. Frequent Sneezing: 1.Yes 2.No

16. Past H/O ear discharge: 1. Yes 2. No [if No or only 1 episode go to Q

No. 17]

17. H/O of seasonal increase in ear discharge 1. No 2. Summer 3. Monsoon

4.Winter

18. H/o ear discharge in sibling: 1.Yes 2.No

19. Previous surgery .1.Nil 2. Adenoidectomy 2. Tonsillectomy

3. Grommets 4. Tympanoplasty 5.Mastoidectomy

20. Cost of treatment for ear infection for the recent episode:

1.Medicine ----------

2.Consultation fees ----------

3.Travel cost ----------

4.Total ----------

PART III.

CLINICAL EXAMINATION:

1. Nose: 1. Normal 2. Mucopus 3. Blood clot

2. Ear : RIGHT:2.1 External canal: .1 Normal 2. Wax 3. Discharge

2.1.1 Type of discharge 1. Mucoid 2. Purulent

LEFT: 2.2 External canal: .1 Normal 2. Wax 3. Discharge

2.2.1 Type of discharge :RIGHT: 1. Mucoid 2. Purulent

LEFT : 1.Mucoid 2.Purulent

2.3 Tympanic membrane:

RIGHT : 1 Normal 2. Retraction 3. Perforation

4. Tympanosclerotic patch 5. PSRP 6. Attic perforation 7. Cholesteatoma

LEFT: 1 Normal 2. Retraction 3. Perforation

4 Tympanosclerotic patch 5. PSRP 6. Attic perforation 7. Cholesteatoma

3. Pharynx: 3.1 Tonsils 1 Normal 2 Enlarged

4 .Audiometry : RIGHT: 1. Normal 2. Abnormal

LEFT: 1.Normal 2.Abnormal

4.1 Threshold if abnormal:

5. Tympanometry: Right: TYPE 1. A 2. B 3. C

LEFT: TYPE 1.A 2.B 3.C

6. Throat swab done : 1.Yes 2. No
Report

7.DIAGNOSIS:

7.1 RIGHT :

1. OTITIS EXTERNA 2. ASOM 3. OME 4. CSOM - TTD

5. CSOM- AAD 6. TYMPANOSCLEROSIS 7.OTHERS

7.2 LEFT:

1. OTITIS EXTERNA 2.ASOM 3. OME 4. CSOM - TTD

5. CSOM- AAD 6. TYMPANOSCLEROSIS 7.OTHERS

(Appendix)

Informed Consent

Date:

Place:

I Mr/Mrs…….. has been explained about the research programme and the need for my child/children to undergo Ear, Nose , Throat examination and Audiometric evaluation. I was also informed about the throat swab examination and that the above mentioned tests are not invasive and does not involve any cost to us. I would also cooperate to the best of my ability in answering the questions in the proforma. I give consent for examination of my child/children with a clear mind.

Signature,

Data Analysis Sheet:

DATE	DOB	MONTHS	SERIAL	PLACE	AREA	NAME	SEX	MC	CP	IS	GSI	OCC	EDU	TOH	HT	WT	BMI	WTAZ	MAC	Vent	BAL	BCG	OPV	DT

TYPE																						
CASE	19/07/2006	04/09/2001	58	1	KEELALATUR	1	HARISH	2	0	0	0	0	4	4	4	103	17	16.02	-0.68	16	1	0	1	1
CONTROL	19/07/2006	08/04/2005	15	1	KEELALATHUR	1	SANTHYA	1	0	0	0	0	3	4	5	71	7	13.76	-2.5	14	1	0	1	1
CASE	19/07/2006	11/03/2005	16	2	KEELALATHUR	1	ASIONI	1	0	0	0	0	4	4	4	73	9	16.70	-1.31	14	1	0	1	1
CONTROL	06/06/2006	06/06/2005	12	2	KEELALATHUR COL	1	HEMIMA	1	0	0	0	0	7	4	5	74	8	14.06	-1.46	14	1	0	1	1
CASE	02/08/2006	30/10/2002	46	3	KEELALATHUR MOTUR	1	VIGNESH	2	0	0	0	0	2	3	5	97	15	15.90	-0.65	16	0	1	1	1
CONTROL	02/08/2006	01/04/2001	64	3	KEELALATHUR	1	MAHALAKSHMI	1	0	0	0	0	2	2	5	101	14	13.74	-1.85	15	1	0	1	1
CASE	23/08/2006	07/09/2005	11	4	KEELALATHUR	1	RAMYA	1	0	0	0	0	4	4	5	69	5	10.50	-4.24	15	1	0	1	1
CONTROL	23/08/2006	29/08/2004	24	4	NAGAL	1	JAYACHANDRAN	2	0	0	0	0	2	4	4	95	11	12.18	-1.17	14	1	0	1	1
CASE	26/09/2006	26/02/2001	67	5	K.A.MOTTUR	1	SANJOY	2	0	0	0	0	4	4	5	96	13	13.02	-3.05	15	1	0	1	1
CONTROL	26/09/2006	20/09/2002	48	5	NAGAL	1	ARAVIND	2	0	0	0	0	3	3	5	98	13	13.53	-1.96	17	1	1	1	1
CASE	26/09/2006	08/07/2000	74	6	NAGAL	1	DINESH	2	0	0	0	0	3	4	5	112	17	13.55	-1.73	15	1	0	1	1
CONTROL	26/09/2006	16/10/2001	59	6	NAGAL COLONY	1	JEYANANDAN	2	0	0	0	0	3	4	5	97	12	12.75	-3.12	14	1	0	1	1
CASE	27/10/2006	06/04/2004	27	7	KEELALATHUR	1	DANUSH	2	0	0	0	0	3	3	1	87	10	13.21	-2.23	15	0	1	1	1
CONTROL	27/10/2006	15/07/2001	63	7	KEELALATHUR	1	DARANI	1	0	0	0	0	3	4	5	108	16	13.71	-1.08	16	1	0	1	1
CASE	08/11/2006	14/12/2000	71	8	KEELALATHUR	1	GOWTHAM	1	0	0	0	0	4	4	5	92	12	14.17	-1.85	15	1	0	1	1
CONTROL	08/11/2006	17/08/2003	39	8	K.A.MOTTUR	1	SANTHYA	1	0	0	0	0	3	2	4	88	10	12.91	-2.98	13	1	0	1	1
CASE	27/10/2006	10/10/2004	24	9	KEELALATHUR	1	MEGALAI	1	0	0	0	0	3	4	1	81	9	13.71	-2.45	13	1	0	1	1
CONTROL	27/10/2006	16/11/2001	59	9	KEELALATHUR	1	NALINI	1	0	0	0	0	4	1	1	108	15	12.86	-1.34	15	0	0	1	1
CASE	13/10/2006	19/01/2003	45	10	KEELALATHUR	1	SWETA	1	0	0	0	0	7	7	5	100	15	15.00	-0.3	16	1	0	1	1
CONTROL	17/10/2006	29/03/2004	31	10	SETHUUVANDAI	1	VINCENTRAJ	2	0	0	0	0	6	4	5	87	13	17.10	-0.45	16	1	1	1	1
CASE	27/10/2006	18/08/2001	62	11	KEELALATHUR	1	ATHITHAYAN	2	0	0	0	0	3	2	4	101	13	12.74	-2.81	14	1	1	1	1
CONTROL	27/10/2006	12/01/2002	57	11	KEELALATHUR	1	VIGNESHKUMAR	2	0	0	0	0	3	5	1	104	14	12.94	-2.05	15	1	0	1	1
CASE	13/10/2006	24/03/2005	19	12	KEELALATHUR	1	MONISHRAJ	2	0	0	0	0	4	4	5	78	11	18.02	-0.5	16	1	0	1	1
CONTROL	13/10/2006	07/02/2003	44	12	KEELALATHUR	1	LOKESH	2	0	0	0	1	3	4	5	94	14	14.57	-1.13	15	1	0	1	1
CASE	27/10/2006	16/12/2002	46	13	KEELALATHUR	1	SARANYA	1	0	0	0	0	4	4	5	94	13	14.71	-1.63	16	1	0	1	1
CONTROL	13/10/2006	14/04/2003	42	13	KEELALATHUR	1	RAGUL	2	0	0	0	1	4	4	5	93	13	15.03	-1.52	14	1	1	1	1
CASE	06/10/2006	07/05/2003	41	14	KEELALATHUR	1	SRINIVASAN	2	0	0	0	0	3	3	5	94	12	13.58	-2.02	16	1	1	1	1
CONTROL	06/10/2006	23/02/2005	20	14	KEELALATHUR	1	MALATHI	1	0	0	0	0	3	4	5	72	6	11.57	-3.85	13	1	0	1	1
CASE	06/10/2006	27/03/2004	31	15	KEELALATHUR	1	SARATH	2	0	0	0	0	3	3	5	85	10	13.84	-2.56	14	1	1	1	1
CONTROL	06/10/2006	03/07/2001	63	15	KEELALATHUR	1	YUVARAJ	2	0	0	0	0	3	6	5	105	15	13.60	-1.93	15	1	0	1	1

CASE	06/10/2006	21/09/2002	49	16	KEELALATHUR	1	BARATH	2	0	0	0	0	3	3	5	92	12	14.17	-2.5	14	1	1	1	1
CONTROL	13/10/2006	24/10/2002	48	16	KEELALATHUR	1	VASHNAVI	1	0	0	0	0	3	4	3	100	15	15.00	-0.54	16	1	0	1	1
CASE	13/10/2006	12/11/2004	23	17	KEELALATHUR	1	SANTHOSH	2	0	0	0	0	3	4	5	86	11	14.87	-1.08	15	1	0	1	1
CONTROL	13/10/2006	14/08/2001	62	17	KEELALATHUR	1	VIJAY KUMAR	2	0	0	0	0	2	2	4	108	18	15.42	-0.46	17	1	0	1	1
CASE	13/10/2006	11/01/2005	21	18	KEELALATHUR	1	GOMATHY	1	0	0	0	0	4	2	4	82	10	14.87	-1.14	14	0	0	1	1
CONTROL	13/10/2006	15/06/2003	40	18	KEELALATHUR	1	SUJATHA	1	0	0	0	1	3	4	5	88	12	15.49	-1.77	15	0	1	1	1
CASE	13/10/2006	19/11/2004	23	19	KEELALATHUR	1	KARTHIKEYAN	2	0	0	0	0	3	5	5	84	11	15.58	-1.05	16	1	0	1	1
CONTROL	13/10/2006	28/10/2003	36	19	KEELALATHUR	1	PRASANTH	2	0	0	0	0	3	4	5	93	12	13.87	-1.6	14	1	1	1	1
CASE	27/10/2006	13/11/2001	59	20	SETHUUVANDAI	1	JANSI RANI	1	0	0	0	0	3	4	5	108	15	12.86	-1.7	16	1	0	1	1
CONTROL	22/11/2006	20/01/2001	70	20	SETHUUVANDAI	1	SUJITHA	1	0	0	0	0	3	2	5	105	18	16.32	-0.55	17	1	0	1	1
CASE	13/10/2006	01/01/2002	57	21	KEELALATHUR	1	SINDU	1	0	0	0	0	4	2	4	100	15	15.00	-2.82	16	0	1	1	1
CONTROL	13/10/2006	14/04/2001	66	21	KEELALATHUR	1	MAGAMI STANLEY	2	0	0	0	0	1	6	1	107	18	15.72	-0.75	17	0	1	1	1
CASE	27/10/2006	03/07/2003	39	22	KEELALATHUR	1	AKASH	2	0	0	0	0	3	2	4	95	13	14.40	-1.35	15	1	1	1	1
CONTROL	08/11/2006	29/11/2000	72	22	KEELALATHUR	1	MURUGAN	2	0	0	0	0	3	2	2	120	20	13.88	-0.24	16	0	0	1	1
CASE	15/11/2006	22/09/2005	14	23	KEELALATHUR	1	GOPI	2	0	0	0	0	3	4	5	62	10	###	-0.56	13	1	0	1	1
CONTROL	15/11/2006	25/03/2003	44	23	NAGAL M.V	1	MADHAN	2	0	0	0	0	3	3	1	94	15	16.97	-0.54	14	1	0	1	1
CASE	17/11/2006	16/12/2003	35	24	KEELALATHUR	1	MONESH KUMAR	2	0	0	0	0	3	4	5	97	13	13.81	-0.93	15	0	1	1	1
CONTROL	17/11/2006	28/12/2000	71	24	KEELALATHUR	1	RAJKUMAR	2	0	0	0	0	4	1	5	115	18	13.61	-1.06	16	1	0	1	1
CASE	22/11/2006	02/03/2002	56	25	SETHUUVANDAI	1	BAKKIYALAKSHMI	1	0	0	0	0	4	4	5	96	15	16.27	-1.18	16	1	1	1	1
CONTROL	22/11/2006	18/03/2002	56	25	SETHUUVANDAI	1	LEELAVATHY	1	0	0	0	0	4	4	5	86	14	18.92	-1.68	15	1	0	1	1
CASE	20/11/2006	10/08/2003	39	1	MALAYAPATTU	2	PRAVEEN KUMAR	2	0	0	0	0	3	3	5	93	12	13.87	-1.9	14	0	1	1	1
CONTROL	20/11/2006	13/07/2001	64	2	MALIYAPATTU	2	PRIYANKA	1	0	0	0	1	3	3	5	106	15	13.34	-1.62	15	0	0	1	1
CASE	20/11/2006	05/05/2002	54	9	MALIYAPATTU	2	GAJENDIRAN	1	0	0	0	1	3	4	5	100	11	11.11	-3.35	14	0	1	1	1
CONTROL	20/11/2006	25/03/2005	20	10	MALIYAPATTU	2	MOHANAPRIYA	1	0	0	0	0	3	4	5	75	8	14.33	-3.11	15	0	0	1	1
CASE	20/11/2006	26/03/2004	32	15	MALAYAPATTU	2	VASUGI	1	0	0	0	0	3	3	1	93	10	11.68	-2.44		0	1	1	1
CONTROL	21/11/2006	04/01/2002	58	16	MALAYAPATTU	2	GOWTHAM	2	0	0	0	1	3	4	5	93	13	15.16	-2.6	16	0	1	1	1
CASE	20/11/2006	14/03/2002	56	19	MALAYAPATTU	2	SARASWATHI	1	0	0	0	0	3	4	4	101	14	13.72	-1.98	14	0	0	1	1
CONTROL	21/11/2006	17/01/2005	22	20	MALIYAPATTU	2	GOWRI	1	0	0	0	1	3	2	4	78	10	0.60	-1.29	15	0	0	1	1
CASE	20/11/2006	25/03/2002	56	21	MALAYAPATTU H.COL	2	AJOI	2	0	0	0	1	3	2	4	100	13	13.07	-2.44	13	1	0	1	1
CONTROL	20/11/2006	07/01/2002	58	22	MALAYAPATTU	2	SAKTHI	2	0	0	0	0	3	3	4	90	12	14.91	-3.07	15	1	1	1	1
CASE	06/12/2006	18/11/2003	37	44	PANAMADANGI	2	MENAGA	1	0	0	0	1	3	4	1	84	13	18.64	-0.81	16	1	0	1	1

CONTROL	06/12/2006	26/04/2004	32	45	PANAMADANGI	2	AJITH	2	0	0	0	1	3	3	1	80	11	17.05	-1.93	14	0	1	1	1
CASE	06/12/2006	31/03/2001	69	66	PANAMADANGI	2	KEERDHANA	1	0	0	0	1	3	4	5	103	13	12.25	-2.99	14	0	0	1	1
CONTROL	06/12/2006	15/01/2001	71	67	PANAMADANGI	2	PRAKASH	2	0	0	0	0	3	2	1	109	15	12.62	-2.38	16	0	0	1	1
CASE	05/01/2007	28/03/2003	46	106	PALATHUR	2	JEGAN	2	0	0	0	1	4	2	5	89	11	13.79	-2.85	14	1	1	1	1
CONTROL	05/01/2007	06/12/2004	25	107	PALLATHUR	2	DINESH KUMAR	2	0	0	0	1	4	4	5	85	9	12.39	-3.02	14	1	1	1	1
CASE	05/01/2007	24/06/2003	43	115	PALLATHUR	2	SELVAKUMAR	2	0	0	0	1	3	4	5	90	12	14.98	-2.11	15	1	1	1	1
CONTROL	05/01/2007	03/06/2005	19	116	PALLATHUR	2	ANANTHI	1	0	0	0	0	3	2	1	66	6	13.69	-4.24	16	0	0	1	1
CASE	05/01/2007	15/12/2003	37	131	PALLATHUR	2	MOHANRAJ	2	0	0	0	0	3	4	5	95	13	14.04	-1.08	16	0	1	1	1
CONTROL	05/01/2007	28/02/2004	35	132	PALLATHUR	2	SONIYA	1	0	0	0	1	3	3	5	76	9	15.62	-3.34	15	0	0	1	1
CASE	05/01/2007	11/02/2004	35	133	RAMAMPURAM	2	RITHIKA	1	0	0	0	1	4	3	1	82	10	14.98	-2.69	15	0	1	1	1
CONTROL	05/01/2007	30/04/2004	33	134	PALALATHUR	2	MOHANAPRIYA	1	0	0	0	1	3	4	1	75	9	16.12	-3.19	14	0	0	1	1
CASE	08/01/2007	22/05/2001	68	166	PANAMADANGI	2	SEVANTHI	1	0	0	0	1	3	4	1	106	14	12.46	-2.26	14	0	0	1	1
CONTROL	08/01/2007	07/05/2003	44	167	PANAMADANGI	2	ISWARIYA	1	0	0	0	1	3	4	1	88	11	14.20	-2.69	14	0	1	1	1
CASE	11/01/2007	15/10/2001	63	207	KALAMPATTU	2	SANJOYKUMAR	2	0	0	0	1	3	4	1	99	15	15.30	-1.92	15	0	0	1	1
CONTROL	11/01/2007	23/08/2001	65	208	KALAMPATTU	2	RITHIKA	1	0	0	0	0	3	4	5	102	15	14.41	-1.64	15	1	0	1	1
CASE	20/01/2007	11/02/2002	59	226	PALLATHUR	2	PONDURANGAN	2	0	0	0	1	3	3	5	106	16	14.23	-1.21	15	1	0	1	1
CONTROL	20/01/2007	01/10/2000	75	227	PALLATHUR`	2	PRITHVIRAJ	2	0	0	0	1	4	3	5	109	14	11.78	-3.04	14	1	0	1	1
CASE	30/01/2007	26/06/2003	43	248	K.A.MOTTUR	2	VIJAY	2	0	0	0	0	3	3	5	97	11	11.69	-2.72	17	0	0	1	1
CONTROL	30/01/2007	27/10/2004	27	249	K.A.MOTTUR	2	NARMADHA	1	0	0	0	0	3	3	5	80	8	12.40	-3.52	14	0	1	1	1
CASE	24/02/2007	26/05/2003	45	329	PALLATHUR	2	SANJOY	2	0	0	0	1	3	6	5	87	11	14.43	-2.83	16	1	0	1	1
CONTROL	24/02/2007	13/03/2005	23	330	PALLATHUR	2	SUGEETHA	1	0	0	0	0	3	6	5	76	9	15.49	-2.28	15	1	0	1	1