`

PREVALANCE OF CHRONIC OTITIS MEDIA IN SCHOOL GOING CHILDREN IN AND AROUND KOLAR DISTRICT

By

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Dissertation submitted to

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH CENTRE, KOLAR

In partial fulfillment of the requirements for the degree of

MASTER OF SURGERY IN OTORHINOLARYNGOLOGY

Under the guidance of

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DR. PRATHYUSHA KONERU

LIST OF ABBREVIATIONS

CSOM	⇨	Chronic Suppurative Otitis Media
AOM	⇨	Acute Otitis Media
TM	⇨	Tympanic Membrane
PTA	⇨	Pure Tone Audiometry
YDL	⇨	Years with Disability
EAC	⇨	External Auditory Canal
NSSO	⇨	National Sample Survey Organization
OME	⇨	Otitis media with effusion
WHO	⇨	World health organization
TTD	⇨	Tubotympanic disease
AAD	⇨	Atticoantral disease
SES	⇨	Social economic status
IL	⇨	Interleukin
ENT	⇨	Ear, Nose, Throat
OPD	⇨	Out patient department

ABSTRACT

Background:

Among the five special senses in the human body hearing plays an important role in the development of an individual. Auditory sense is particularly important sense, as it allows us to communicate with external world. In the developing countries Chronic otitis media(COM) is one of the most common ear diseases .[1] Many patients of chronic otitis media have history of childhood ear discharge .Chronic otitis media also contributes to the hearing impairment which may affect a child's overall growth as it occurs during the age of speech and language development.[2] Identifying the children with COM in young age is important so that the complications can be minimized.[3]In view of its preventable character, the magnitude of the problem needs to be assessed in school going children for early diagnosis and treatment.

Ear problems and decreased hearing are important community health problem among school children especially in developing nations. About 50% of ear diseases occur among the pediatric age group below 15 years and complications are high in this age group.[4] WHO also stated that ear diseases must be considered as public health problems if the prevalence of chronic suppurative otitis media among pediatric age group is more than 4% and recommended the need for appropriate screening programs of school children for early detection of ear diseases and hearing impairment to prevent psycho social consequences.[5]

Objectives:

To find out prevalence of Chronic supportive otitis media among school children between the age of 6 to 13 years in and around Kolar district.

Methods:

The study was carried out in schools in and around Kolar district from December 2016 to June 2018. Screening of 605 school going children in and around Kolar district for CSOM. Students were examined according to proforma, which were distributed to the children or to the respective class teachers to fill up the primary information in consultation with parents regarding the demographic data of child .

Students were examined with help of otoscope and 512 HZ tuning fork for COM and complete ENT examination. Students who require further investigations like PTA and treatment is offered at department of ENT , R.L.J. Hospital, Tamaka, Kolar for further evaluation by pure tone audiometry and further treatment.

Students who are having CSOM and nasal block were mobilized to department of ENT , R.L.J. Hospital, Tamaka, Kolar for nasal endoscopy and for the children who are not cooperative X-ray nasopharynx lateral view was done for adenoid hypertrophy.

Results:

Overall prevalence of chronic otitis media was 6% in school children in and around Kolar district. In our study we assessed few risk factors which include age, sex, socioeconomic status (SES), passive smoking, exposure to household smoke, education of mother and father,

occupation of father and mother, birth order of the child, and adenoid hypertrophy. And we found that most of the risk factors were not statistically significant except adenoid hypertrophy.

Conclusion: The prevalence of CSOM in our study was found to be high (6%) as per the WHO otitis media expert committee recommendations. CSOM is an important preventable cause of hearing impairment, so this level of prevalence represents a cause of concern. All health-care providers should have a goal to increase awareness about ear diseases. Improvement of health care facilities and awareness among health-care providers would definitely help in decreasing the prevalence of ear diseases in developing countries like India. Students are backbone for our society they have the potential to change the health scenario of the society if properly groomed and educated for healthful living. Prevention of hearing impairment or early diagnosis of ear disorders and treatment of ear diseases is a better and cost effective option compared to rehabilitation.

KEYWORDS:

Chronic Otitis Media, Prevalence, Risk factors, Audiometry

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INTRODUCTION

Among the five special senses in the human body hearing plays an main role in the development of an individual. Auditory sense is particularly important sense, as it allows us to communicate with external world. In the developing countries Chronic otitis media(COM) is one of the most common ear diseases .[1] Many patients of chronic otitis media have history of childhood ear discharge .Chronic otitis media also contributes to the hearing impairment which may affect a child's overall growth as it occurs during the age of speech and language development.[2] Identifying the children with COM in young age is important so that the complications can be minimized.[3]In view of its preventable character, the magnitude of the problem needs to be assessed in school going children for early diagnosis and treatment.

Ear problems and decreased hearing are important community health problem among school children especially in developing nations. About 50% of ear diseases occur among the pediatric age group below 15 years and complications are high in this age group.[4] WHO also stated that ear diseases must be considered as public health problems if the prevalence of chronic suppurative otitis media among pediatric age group is more than 4% and suggested the need for appropriate screening programs of school children for early detection of ear diseases and decreased hearing to prevent psycho social consequences.[5]

In India, there is a significant burden of chronic otitis media. Therefore we are performing this observational study in Kolar region. No well designed study has been done to assess the prevalence of CSOM among school children in Kolar. Such data will be beneficial for Ministries of Health and Education. School Children are easily accessible and ear diseases among them can be subjected to easy and continuous monitoring and follow up. School survey is very useful parameter to screen more number of children for a particular age group.

Government primary school children, because of their low socio economic status and living conditions are more prone to ear problems than the private school children.[6]

Poor socioeconomic status, Low parental education, younger age, male sex, siblings or parents suffering from otitis media, recurrent respiratory tract infections, allergic rhinitis, adenoids and passive smoking, large family size, overcrowding, and exposure to wood smoke are some attributable risk factors in India.

WHO stated during 2004 that 275 million people suffer from hearing impairment and 80% of them are from low and middle income countries. In India, there are 63 million people suffering from hearing impairment. Indian population had estimated prevalence of 6.3% .

OBJECTIVES

To find out prevalence of Chronic suppurative otitis media among school children between the age of 6 to 13 years in and around Kolar district.

REVIEW OF LITERATURE

The studies conducted on ear diseases, hearing impairment and risk factors among the primary school children in different socio economical structure show wide variation. Even mild to moderate hearing impairment may result in poor educational performance.[7] Due to recent developments in standard of living, availability of health facilities and potent antibiotics over the past few decades the serious complications of ear problems like mastoiditis, brain abscess, meningitis, and hearing impairment have shown marked reduction. However, in developing nations, the problems like CSOM, complicated with mild to moderate hearing impairment is common, and poses serious public health problems.

According to WHO, at least 80% of the ear problems are reported from the developing Countries. Similarly, the prevalence of hearing impairment is also high among the developing nations causing serious public health problems. At least 50% of the ear problems occur among the pediatric age group. WHO stated that if prevalence rate of Chronic Suppurative Otitis Media (CSOM) greater than 4% in a defined population of children is an indication of major public health problem requiring urgent and specific attention. Serious consequences like hearing impairment, otitis media complications and psychosocial problems in turn impose heavy burden to individual, family, community and the country. A huge percentage of these patients can be treated by early diagnosis and suitable management. 50% of all ear diseases are preventable by primary prevention.

RISK FACTORS:

Reports from some south Indian and western studies reveal a number of extrinsic and intrinsic risk factors which may predispose a child to otitis media. The attributable risk factors are poor socioeconomic status, younger age, male sex, Low parental education, siblings or parents suffering from otitis media, recurrent respiratory tract infections, allergic

rhinitis, snoring (due to adenoids) and passive smoking Some of the developing countries reveal that the large family size, overcrowding, and exposure to wood smoke among households are the important risk factors.[8,9]

BURDEN OF THE DISEASE:

Loss of hearing is the second major cause for Years with Disability,(YLD)first being depression. It is responsible for 24.9million years lived with Disability globally and gives it a larger non fatal burden than alcohol related disorders, osteo arthritis and schizophrenia.[10]More than 3 billion dollars were being spent almost every year in the United States of America for treatment of otitis media. As per the Canadian study the amount used in treating otitis media represents 60% of what is necessary for diabetes mellitus treatment or 40% what is spent to treat diseases like emphysema, chronic bronchitis, and asthma.[11]

GLOBAL SCENARIO:

WHO stated during 2004 that 275 million people suffer from hearing impairment and 80% of them are from low and middle income countries. The extensive systematic literature review of various studies conducted by Lorenza et al in 15 countries of WHO region has estimated that chronic suppurative otitis media (CSOM) incidence is 4.76%, ie 31 million cases per year, among which 22.6% occur among children. Prevalence of otitis media causes hearing impairment in 30.32 per thousand and every year 21 thousand people die due to complications of otitis media. The incidence of AOM and CSOM in developed nations are less than 5% and 3% respectively compared with the developing nations which range from 9 to 30% respectively.[12]

INDIAN SCENARIO:

As per WHO estimates, in India, there are 63 million people suffering from hearing impairment. This places the estimated prevalence of 6.3% in Indian population. As per National Sample Survey Organization (NSSO) , there are 291 persons per one lakh people are suffering from hearing impairment. Rural population has been more affected than urban population. [13]

KARNATAKA SCENARIO:

A cross sectional study in Victoria and Bowring Hospitals attached to Bangalore Medical College& Research Institute during the year 2011-12, shows that of total 50 CSOM pediatric patients included in the study, all the cases are between 5 to 16 years. Female are more compared to males. Their chief complaints was ear discharge. The risk factors like multiple episodes of acute otitis media, living in crowded conditions, attending day care, passive smoking, Craniofacial anomalies, and upper respiratory tract infections were found to be statistically significant. In almost all developing countries, the incidence of otitis media is predominantly more in younger children. Thus, immediate attention is needed to deal with this massive public health problem at national level.

A cross sectional study, conducted in three selected schools in the field area of National Institute of Unani Medicine (NIUM), Bangalore in which, 546 school children up to 8th standard were screened to measure the Prevalence of *Amraz-e Gosh* (otological diseases) and associated risk factors among the Children of Secondary Level Schools, showed that among 352 children (64.47%) were found to have otological problems and remaining were normal. This study shows 17 students had CSOM which is 3.11%.

ANATOMY

SURGICAL ANATOMY:

DEVELOPMENT OF THE MIDDLE EAR

The middle ear cavity is endodermal in origin. It originates at about four weeks from the first pharyngeal pouch, which grows laterally, and expands rapidly to form two fundamental structures: primitive tympanic cavity is formed from the distal part of the tubotympanic recess; and the fibro cartilaginous Eustachian tube is developed by the constriction of the proximal part. The primitive tympanic cavity gradually expands like a growing bud to incorporate the ossicles and their associated muscles and blood vessels. The accompanying dissolution of the mesenchyme facilitates this progression. Starting in the inferior half of the future tympanic cavity, this extension is hindered, higher up by a projection of the otic capsule: the superior periotic process, which forms the superior part of the tympanic cavity, and lower down by the bony wall of the floor of the tympanic cavity, originating from separate bone or from a lamellar projection of the petrous pyramid. Progression occurs in the sagittal plane late in fetal life leading to, epitympanic recesses, antrum, and mastoid air cells. It takes about thirty three weeks for the virtual completion of the expansion of the middle ear. The epitympanum follows approximately four weeks later.

MALLEUS AND INCUS

The anlage of the ossicles has been the subject of much discussion. The consensus now holds that the ossicles have multiple origins. It is believed that the manubrium of the malleus and the incus long process develop from the hyoid visceral bar, where as the malleus head and incus body differentiate from the mandibular visceral bar.

Malleus anterior process emerges from intramembranous ossification distinct from the visceral bars. Therefore, it is helpful to have a distinction among the mandibular and hyoid

visceral bars as opposed to Meckel's and Reichert's cartilages. Lying within the branchial arches is a condensation of mesenchymal tissue. With maturation it differentiates into cartilage and eventually becomes bone in some regions. Visceral bar is the term used to describe the entire masses of condensed mesenchymal tissue, whereas the terms Meckel's and Reichert's cartilages refer only to the cartilage formed from the ventromedial portions of mandibular and hyoid visceral bars, respectively. At approximately four weeks of gestation, areas of condensation of mesenchyme come into view at the dorsolateral ends of the mandibular and hyoid bars. An interbranchial bridge is formed which connects the superior end of the mandibular visceral bar to the middle region of the hyoid visceral bar; it is this bridge that gives rise to the blastema of the malleus and incus.

STAPES:

The stapes, like the malleus and incus, has a dual origin first described by Gradenigo in 1887. Stapes development involves a complex morphogenesis starting as a blastema at 41weeks. A stapedial "ring," which arises from mesenchyme of the hyoid visceral bar, gives rise to the capitulum, crura, and tympanic (lateral) surface of the footplate. The lamina stapedialis, which gives rise to the annular ligament and the labyrinthine surface of the footplate, evolve from otic capsule and retains some of its cartilaginous structure throughout life. A blastemal mass is all that is recognizable of the future stapes at the fourth week of gestation. This blastema is composed of the condensed mesenchymal cells of the dorsolateral end of the hyoid visceral bar, adjacent to the 7th nerve, and stapedial artery. By the sixteenth week, the ossicles attain adult size, and ossification begins at ossification centers.

SURGICAL ANATOMY OF MIDDLE EAR CLEFT

The middle ear cleft consists of the Eustachian tube, tympanic cavity and the mastoid air cell system. The tympanic cavity is a biconcave, air-filled space within the temporal bone. It is bounded by the osseous labyrinth medially and laterally by tympanic membrane. It contains

the ossicles and their tendons that attach them to the muscles of middle ear. The tympanic segment of the facial nerve runs along its medial wall.[14]

THE TYMPANIC CAVITY

The tympanic cavity is a biconcave disc that measures around 15 mm in antero-posterior and vertical dimensions. In its transverse dimension, it expands superiorly to 6mm and inferiorly to 4mm from a constriction of 2mm. Tympanic cavity is divided into 3 compartments: the epitympanum, the mesotympanum and the hypotympanum. The *epitympanum* or the *attic* is the portion of middle ear space above the level of malleolar folds. It contains the head of the malleus and the short process / body of the incus and communicates with the mastoid antrum via a narrow passage, the aditus ad antrum. The *mesotympanum* lies immediately deep to the pars tensa of tympanic membrane and contains the manubrium of the malleus, long and lenticular process of the incus, the stapes, tensor tympani, stapedial tendon and the chorda tympani nerve. The *hypotympanum* is the part of the middle ear that lies below the floor of external auditory canal (EAC) and anteriorly there lies the opening of the Eustachian tube.[15] The tympanic cavity can be compared with a six walled chamber having the roof, floor, medial and lateral walls, anterior and posterior walls.

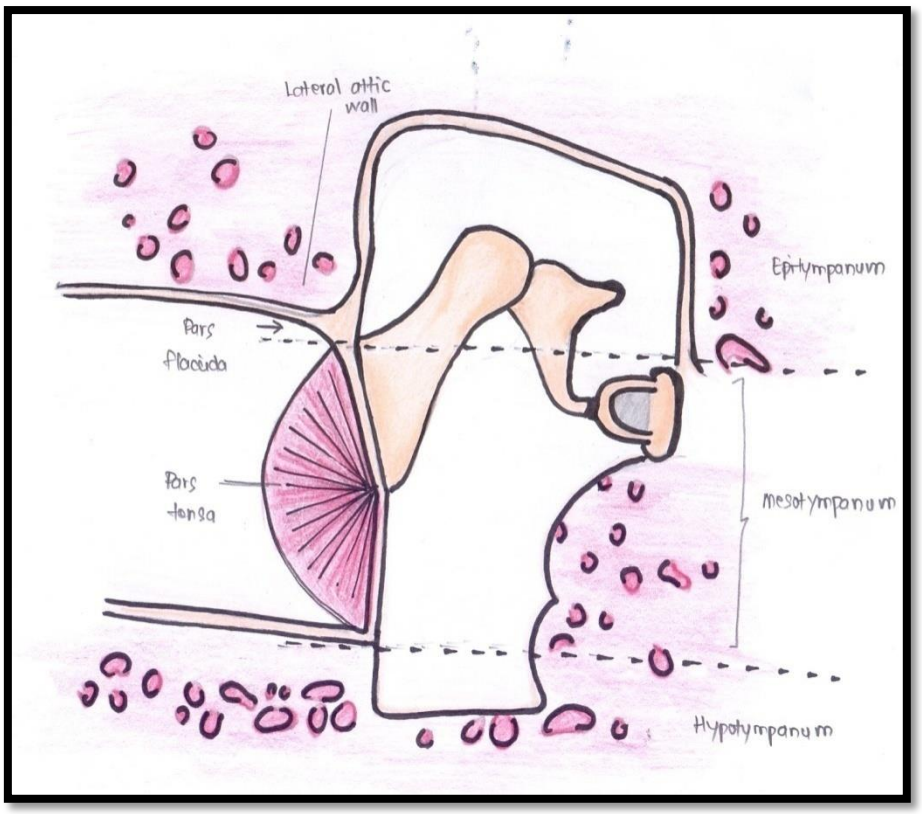


FIG 1:- Compartments of tympanic cavity.

THE SUPERIOR WALL (TEGMEN TYMPANI) OR ROOF

Tympanic cavity roof is formed by tegmen tympani, and is separated from the dura of the middle cranial fossa. It also includes part of petrous and squamous bone and the petrosquamous suture line. This is not well developed in the young children and does not ossify until adult life. The veins of the tympanic cavity lead to the superior petrosal sinus that passes through petrosquamous suture line.

THE FLOOR OF THE TYMPANIC CAVITY

It separates hypotympanum from dome of jugular bulb. Tympanic branch of the glossopharyngeal nerve passes via the skull base enters the tympanic cavity through an opening at the junction of the medial wall and floor of the tympanic cavity.

LATERAL WALL OF TYMPANIC CAVITY

The lateral wall of the tympanic cavity is formed by:

Superiorly, the bony outer attic wall (scutum), centrally the tympanic membrane, inferiorly the bony lateral wall of hypotympanum. The medial surface of the lateral wall of the middle ear has three holes. A 2mm long slit know as petrotympanic fissure opens anteriorly above the tympanic membrane. It contains anterior mallear ligament and anterior tympanic branch of the maxillary artery to the tympanic cavity. The chorda tympani, gives a sensory supply to the anterior 2/3rd of the tongue and secretomotor fibres to the submandibular gland and enters the medial surface of petrotympanic fissure via separate anterior canaliculus (canal of Huguier) which is sometimes merged with the fissure. Then it turns posteriorly and runs between the fibrous and the mucosal layer of the tympanic membrane. It crosses the handle of malleus and reaches the posterior bony canal wall just medial to the tympanic sulcus, enters the posterior canaliculus and then passes obliquely downwards and medially through the posterior wall of tympanic cavity till it reaches the facial nerve.

THE MEDIAL WALL OF THE TYMPANIC CAVITY

The tympanic cavity is separated by the medial wall from the inner ear. Central part of the medial wall is occupied by a rounded elevation called promontory. It covers the basal turn of the cochlea and has grooves on its surface for nerves which form the tympanic plexus. Fenestra vestibuli (oval window),a nearly kidney-shaped opening that connects the vestibule, with the tympanic cavity but which in life is closed by the footplate of the stapes and its surrounding annular ligament.

Fenestra vestibuli size varies according to the size of the footplate of the stapes. On an average it is 3.25 mm long and 1.75 mm wide. Above the fenestra vestibuli is the facial nerve. Anterior to the oval window is a curved hook like projection called processuscochleariformis, which gives attachment to the tendon of tensor tympani.

The fenestra cochlea also called (round window), is closed by the secondary tympanic membrane (roundwindow membrane), which is located below and a little bit behind the

fenestra vestibuli from which it is separated by subiculum. A bridge of bone from the pyramidal eminence to the promontory on the posterior wall of the tympanic cavity is called the ponticulus. The subiculum is a bony ridge formed by posterior extension of the promontory below. Shape of the secondary tympanic membrane varies from round to oval and kidney shaped, with average longest diameter of 2.30 mm and shortest diameter of 1.87mm.[14]

The ampulla of the posterior semicircular canal is the closest vestibular structure to the membrane and its nerve (the singular nerve) runs almost parallel to and 1 mm away from the medial attachment of the deep portion of the posterior part of the membrane. The membrane is therefore a surgical landmark for the singular nerve. The facial canal runs superior to the promontory and fenestra vestibule in antero-posterior direction. It has a smooth rounded lateral surface that is occasionally deficient, and is marked anteriorly by the processus cochleariformis.[15] The dome of the lateral semicircular canal extends little lateral to the facial canal and is a major component of the posterior portion of epitympanum.[16]

THE ANTERIOR WALL OF THE TYMPANIC CAVITY:

The lower portion of the anterior wall is larger than the upper and consists of a thin plate of bone that covers the carotid artery as it enters the skull and before it turns anteriorly. This plate is perforated by the superior and inferior caroticotympanic nerves carrying sympathetic fibers to the tympanic plexus, and by one or more tympanic branches of internal carotid artery. Upper part of the anterior wall has two parallel tunnels placed one above the other. The lower opening widens and leads into the bony portion of the Eustachian tube. Upper part of the anterior wall has the canal for the tensor tympani muscle.[16,15]

THE POSTERIOR WALL OF TYMPANIC CAVITY:

Aditus is the opening through which the mastoid antrum opens into the attic and lies superior to pyramid in relation to bony prominence of horizontal semicircular canal medially, laterally

fossa incudis, houses the short process of the incus and the suspensory ligament , facial canal inferiorly. Pyramid contains stapedius muscle and its tendon which runs forward to insert into the neck of stapes. The facial recess is bounded laterally by tympanic annulus, medially by the 7th nerve, chorda tympani nerve passes through the wall between the two, with a varying degree of obliquity.[16]Sinus tympani is a deep recess and lies medial to the pyramid and is bounded by the ponticulus above and subiculum below .[16]

THE CONTENTS OF TYMPANIC CAVITY:

The tympanic cavity contains a chain of three small movable bones - the malleus, incus and stapes – two muscles, and chorda tympani nerve, tympanic plexus of nerves. The ossicles are the malleus, incus and stapes; the most lateral ossicle is malleus its handle is attached to the tympanic membrane. The stapes rests on the oval window.

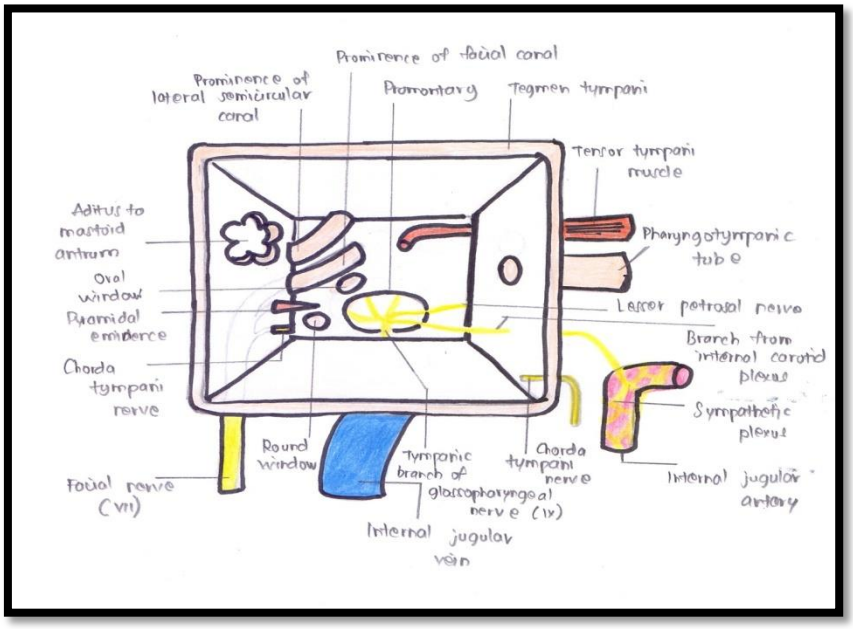


FIG 2:- Relations of tympanic cavity.

THE OSSICLES

Malleus

The most lateral of the ossicles is the malleus. It consists of four major parts and they are head, neck, anterior process and lateral process, handle respectively. The anterior process is a thin projection of bone which extends from the malleus neck into the petrotympanic fissure called as Glasserian fissure, this is accompanied by the chorda tympani nerve that is held to the walls of the Glasserian fissure by the anterior malleal ligament, the posterior incudal ligament part, serves to act as the axis of rotation for the ossicles. The malleus is held in place by five ligaments, one articulation, the tensor tympani tendon, and the tympanic membrane. Three of the five ligaments have a suspensory function; they are:

(1) Anterior suspensory ligament which lies superior to the anterior malleal ligament and attaches the malleus head to the anterior wall of the epitympanum.

(2) Lateral suspensory ligament is attached to the malleus neck and the bony margins of the notch of Rivinus.

(3) Superior suspensory ligament which bridges the gap between the malleus head and the tegmen of the epitympanum. Tensor tympani muscle tendon extends laterally from the cochleariform process to attach to the neck and manubrium of the malleus.

Incus

The incus, consists of a body, short process,long process, and lenticular process. The body of the incus and head of the malleus are present in the epitympanum. The incus short process extends posteriorly, occupying the fossa incudis(posterior incudal recess).The long process reaches inferiorly, paralleling the manubrium, to end in the lenticular process; the convex surface of this long process articulates with the concave surface of the stapes head (capitulum).Three ligaments are chief supports for the incus to be in place. Posterior incudal

recess has the short process that is secured by posterior incudal ligament. Anteriorly, the medial and lateral incudomalleal ligaments secure body of the incus to the malleus head.

The Stapes

The stapes is the smallest and the most medial link of the ossicular chain; it consists of a head, footplate (the basis stapedis), and two crura or legs. The anterior crus is straighter and more delicate than the posterior. There is an irregular area near the superior aspect of the posterior crus to which the stapedius tendon variably attaches the footplate, in association with the annular ligament, seals the oval window. The shape, thickness, and curvature of the footplate are inconstant. Stapes head articulates with the lenticular process of the incus at its fovea, and it may have a muscular process for the attachment of the stapedius tendon.

The relative thickness and curvature of the crura vary among individuals, as does the location for attachment of the stapedius tendon.

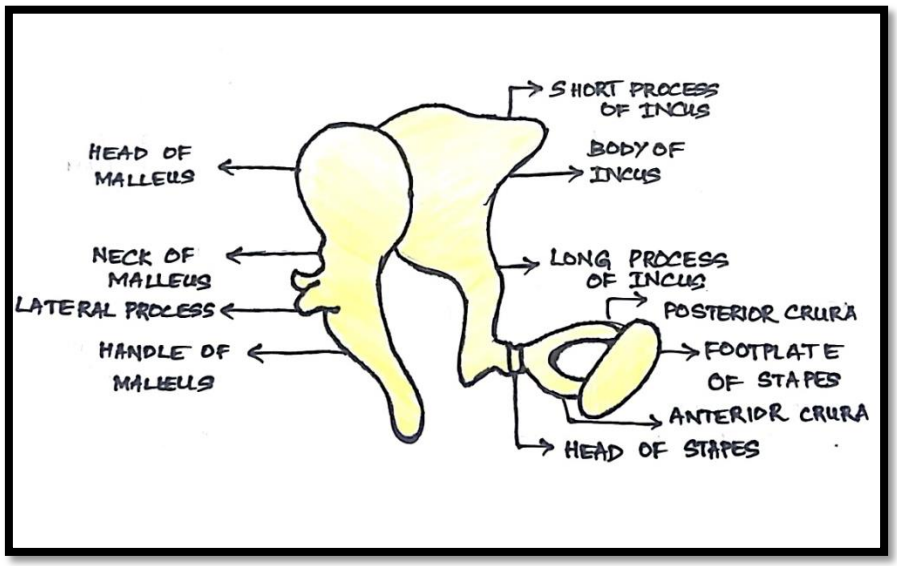


FIG 3:-Assembly of the ossicles.

Auditory muscles

The two auditory muscles tensor tympani and stapedius muscle exert a dampening effect on the amplitude of the vibratory waves, thus protecting the cochlea from excessive stimulation by loud noise.[17]

Tensor tympani

It arises from cartilaginous portion of auditory tube, the neighboring portion of greater wing of the sphenoid, as well as from bony canal, above the Eustachian tube. It is inserted into the handle of malleus (medial aspect). Tensor tympani contracts at definite frequency (0.5 to 1 kHz) resulting in decreased conductivity.

Nerve supply

It is supplied by mandibular division of trigeminal nerve, through a branch to the medial pterygoid muscle.

Stapedius

It lies in a bony cavity. Origin - From the fasciculi of the posterior belly of digastric muscle. It is inserted into posterior crura or stapes neck.

Nerve supply

Supplied by nerve to stapedius which indeed is a branch of facial nerve.

TABLE 1 :- ARTERIAL SUPPLY OF THE TYMPANIC CAVITY

The following are the arterial supply of the tympanic cavity:

ARTERY	BRANCH	SUPPLY
Maxillary artery	Anterior tympanic branch	Tympanic membrane
Posterior auricular artery	Stylomastoid branch	Posterior part of tympanic cavity and mastoid air cells.
Middle meningeal artery	Superficial petrosal branch	Greater petrosal nerve
Middle meningeal artery	Superior tympanic branch	Enters through canal of Tensor tympani
Ascending pharyngeal artery	Inferior tympanic branch	Passes along tympanic branch of Glossopharyngeal nerve
Internal carotid artery(ICA)	Caroticotympanic branch	Passes into tympanic cavity through anterior wall

Veins

Veins drain into pterygoid plexus and superior petrosal sinus.

Lymphatic drainage

Drains tympanum and mastoid antrum into the parotid and upper deep cervical lymph nodes.

Nerve supply

Derived from a plexus which branches over the promontory (Tympanic plexus). Jacobson's nerve a branch of glossopharyngeal nerve.

Tympanic plexus

It is formed by

1. Jacobson's nerve –which is a tympanic branch of 9^{th} cranial nerve.

2. Cervical sympathetic plexus (superior and inferior caroticotympanic plexus branches) which surround internal carotid artery.

This plexus supplies the following structures:

1. The mucosa lining the middle ear cleft (auditory tube, middle ear, mastoid air cells)

2. Branch to greater superficial petrosal nerve.

3. Gives a branch to otic ganglion (lesser superficial petrosal nerve).

Mucosa of the tympanic cavity

Middle ear mucosa is to some degree a respiratory mucosa carrying cilia on its surface and being able to secrete mucus. 3 distinct mucociliary tracts or pathways can be identified - epitympanic, promontoric and hypotympanic the later being the largest. At the tympanic orifice part of the eustachian tube each of these pathways coalesces. Mucus comes from the globlet cells and mucous glands. Which are collections of mucus-producing cells linked to the surface by a short duct. In the middle ear, the glands are sometimes absent; globlet cells are present around the opening of the eustachian tube, they are few in numbers.

Goblet cells produce mucus in the middle ear space. Their presence indicates the ability of the middle ear mucosa to undergo change into respiratory epithelium. The mucous membrane lines the bony walls of the middle ear, and covers the ossicles and supporting ligaments. The folds formed by the mucosa also cover the tendons of the two intratympanic muscles (tensor tympani and stapedius).These mucosal folds have the blood vessels that supply the tympanic cavity. These mucosal folds separate the middle ear space into compartments. The epitympanic space is separated from mesotympanum by tympanic diaphragm and is ventilated only by way of two small openings between the various mucosal, folds the anterior and posterior isthmus tympani . Proctor described the mucosal folds in detail.

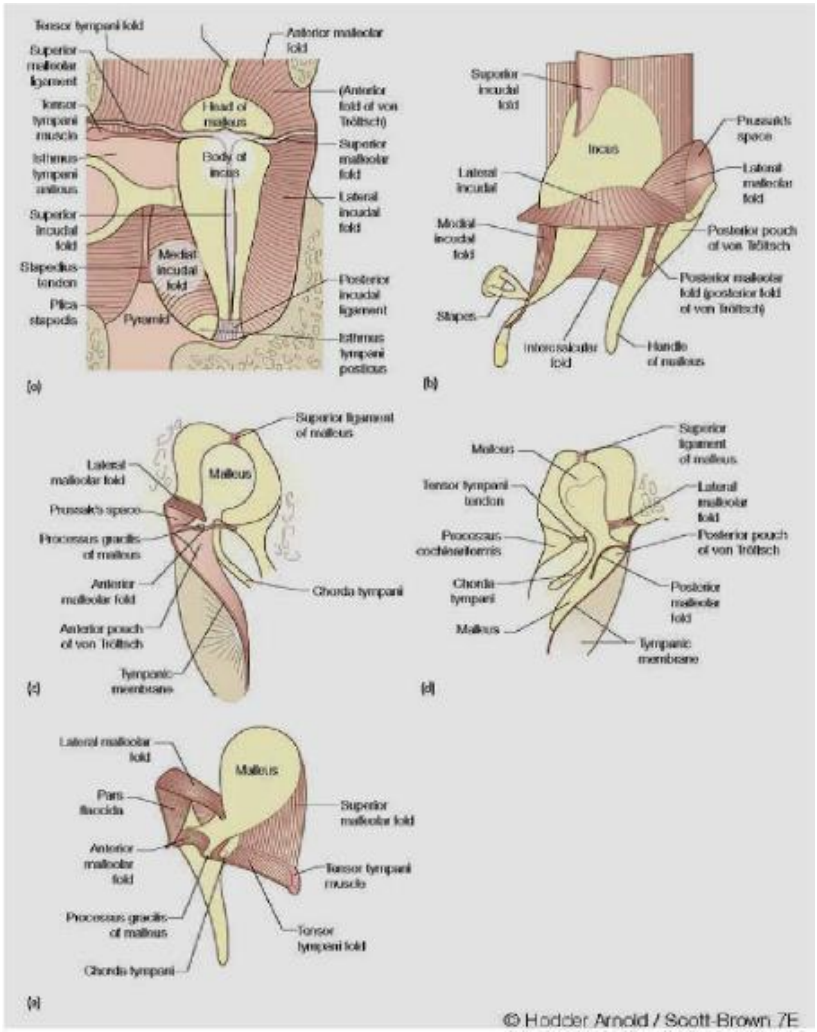


FIG 4: Ligaments and muscles attached to ossicles[16]

EUSTACHIAN TUBE:

Auditory tube or pharyngotympanic tube connects tympanic cavity with the nasopharynx. It is 36mm long in adults. It runs downwards, forwards and medially from the middle ear. Eustachian tube is divided into two parts1)Bony and 2)Fibrocartilaginous part. Bony part is posterolateral, 12mm of total length and fibrocartilaginous is anteriomedial, 24mm in length and opens into nasopharynx. Pseudostratified ciliated coloumnar epithelium lines the eustachian tube. It interspread with mucous secreting globlet cells. Number of glands and goblet cells decreases, and the ciliary carpet becomes less profuse towards the middle ear. Thin plate of bone forms the roof of the tube, above which is the tensor tympani muscle. Carotid artery lies medial to the tube. Eustachian tube is triangular or rectangular in cross-section. The fibrocartilaginous part of the tube has a plate of cartilage forming its back wall. At the upper border, the cartilage is bent forwards to form a short flange that makes up part of the front wall. The rest of the anterolateral wall comprises fibrous tissue. Medial end of eustachian tube lies under the mucosa of the nasopharynx that forms the tubal elevation. Eustachian tube opens 1-1.25 cm behind the inferior turbinate. Salpingopharyngeal fold extends from the lower part of the tubal elevation along the wall of the pharynx. As levatorpalati enters the soft palate, it results in a small swelling immedietly below the opening of the tube. Fossa of Rosenmuller lies behind the tubal elevation. Around the tubal orifice and in the fossa of Rosenmuller, Lymphoid tissue is present and may be prominent in childhood.

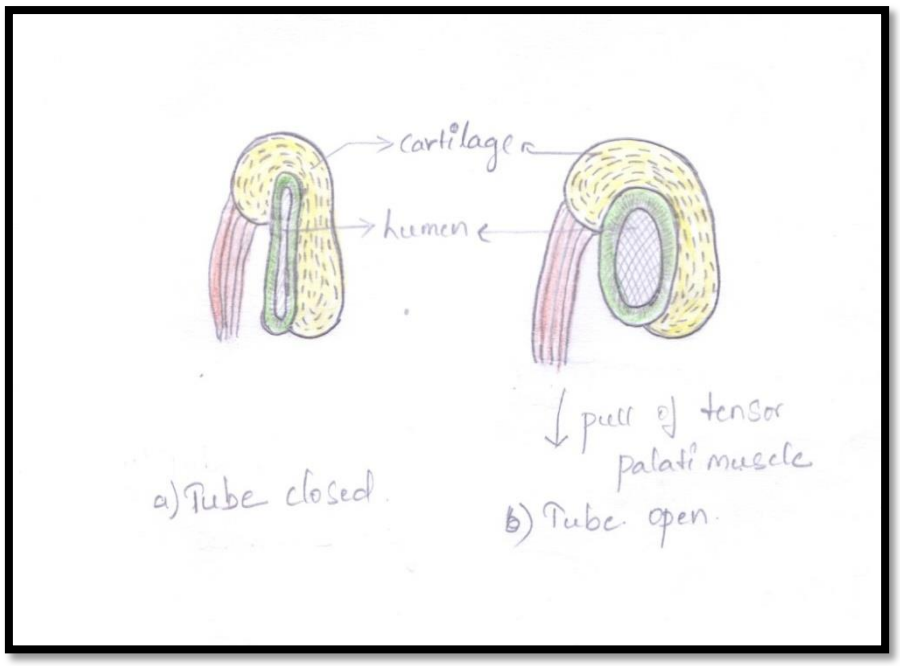


FIG 5: Cartilaginous portion of the Right Eustachian tube

Mastoid air cell system[18,19]

Air cells of the mastoid are lined with flattened non-ciliated squamous epithelium. Depending on the development of air cells, there are 3 types of mastoids

1) Well-pneumatised also known as cellular: Air cells are well developed and intervening septum are thin.

2) Sclerotic / acellular: No cells or marrow spaces

3) Diploic: Mastoid consists of marrow spaces that have persisted from the late fetal life and a few air cells

TEMPORAL FASCIA

Deep temporal fascia covers temporalis muscle which in turn is covered by superficial temporal fascia.[20]Temporal fascia is overlapped by auricularis superior and anterior, the

epicranial aponeurosis and part of orbicularis oculi. Superficial temporal vessels and the auriculotemporal nerve pass over it. Above it is attached to superior temporal line, below it is attached to the lateral and medial margin of the superior border of the zygomatic arch. Between the layers are the zygomatic branch of superficial temporal artery, zygomatic temporal branch of the maxillary nerve and fat.

The deep surface of the fascia offers attachment to the superficial fibres of temporalis. The size of this fascia alters with its hydration.[21]

CONDUCTIVE PATHWAY OF EAR

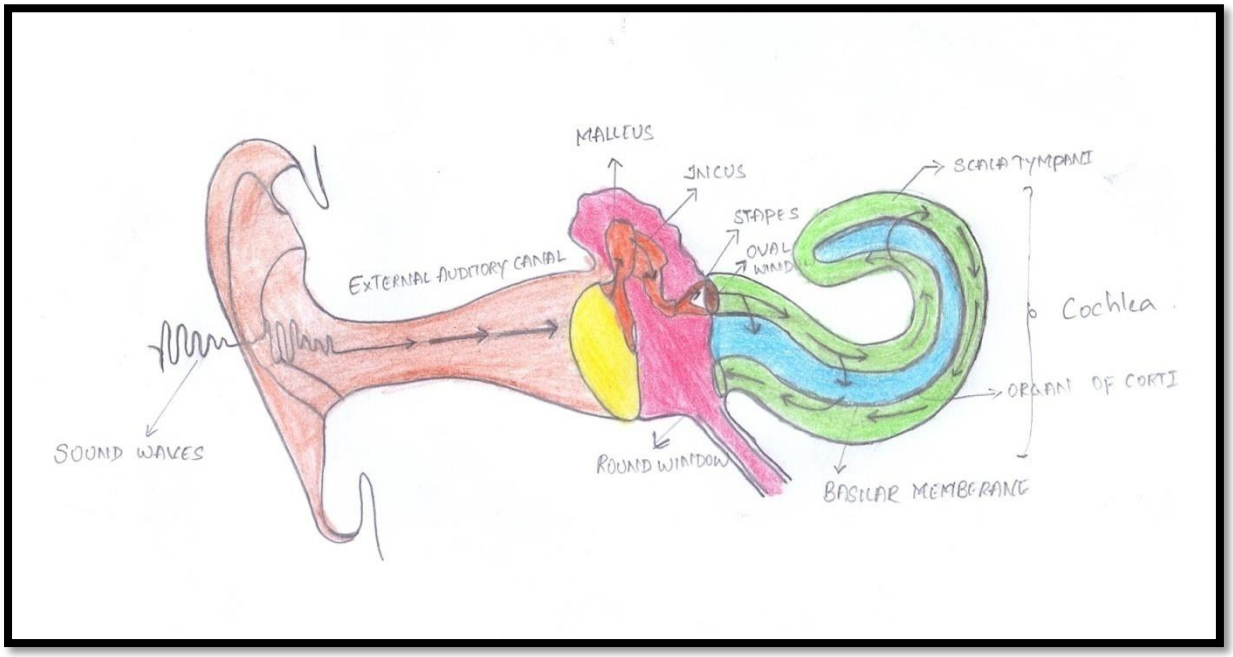


FIG 6:-CONDUCTIVE PATHWAY OF EAR

ACOUSTIC MECHANISMS IN MIDDLE EAR AND SOUND TRANSFER TO INNER EAR

The propagating media in which Sound is travelling, consisting of alternating condensation and rarefaction of the molecules. From a source this energy travels, expanding globally, and losing energy proportionate to the square of the distance. The sound wave speed is proportional to its density. Sound thus travels fastest through solids>liquid>gases. Impedance is defined as resistance to the passage of sound through a medium. It is also known as acoustic resistance.[22]

THE ACOUSTIC TRANSFORMER

The main contributors to the human acoustic transformer are the pinna, the external auditory canal and the middle ear sound conduction system.

AURICLE

The most powerful cues for sound localization are provided by binaural interations. However, the outer ear provides important cues which are useful in monaural localization and, where binaural hearing is concerned, in making us to distinguish in front from behind and up from down .The pinna serves an important role of gathering sound arriving from an arc of 135 degrees relative to the direction of the head. The horn-shaped concha then acts like a megaphone to concentrate the sound at the entrance of the auditory canal.[22]This action increases the sound pressure upto 6dB (twice).

EXTERNAL AUDITORY CANAL

In a frequency selective way, the resonance in the external auditory meatus changes the sound pressure at the tympanic membrane. If a tube is one quarter of the wave length long and one end is opened while the other is blocked With a hard termination, the low pressure will be seen at the open end and there will be high pressure at the closed end when the tube

is placed in sound field. This phenomenon is seen in the human external meatus at a frequency of about 3 kHz. Here the resonance adds at 10-12db at the tympanic membrane.[23]

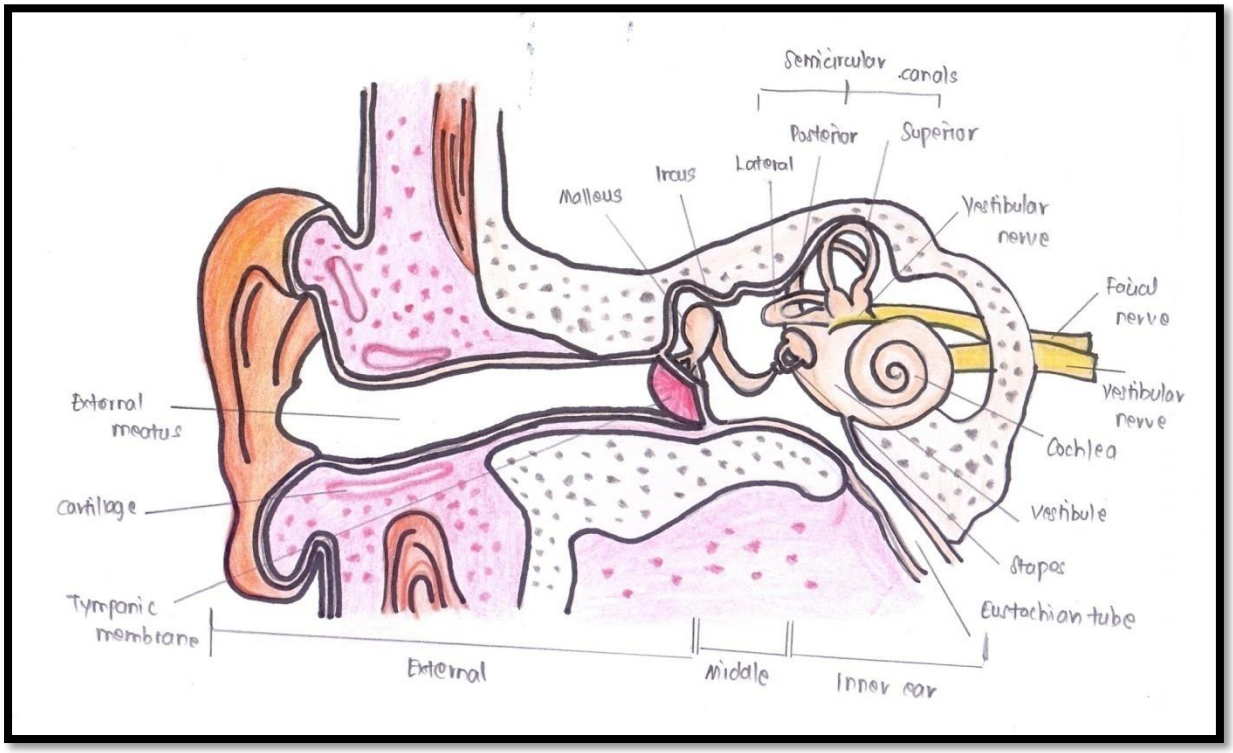


FIG7:-Showing external, middle and internal ear.

MIDDLE EAR TRANSFORMER MECHANISM

The transformer system of the middle ear, works as a complex. It can be divided into three stages: that provided by the eardrum *(catenary lever)*, that provided by ossicles *(ossicular lever)* and that provided by the difference in area between the tympanic membrane and the stapes footplate *(hydraulic lever).*[22]

CATENARY LEVER

The curved tympanic membrane acts as a cantenary lever when stretched, exerts greater force upon its point of attachment. Because the fibrous annulus is immobile, sound energy applied to the tympanic membrane is amplified at its central attachment, the tip of handle of malleus (umbo).

OSSICULAR LEVERAGE

This is the lever action caused due to difference in lengths of the handle of malleus and long process of incus around the axis of rotation of the ossicles. It is an imaginary line joining the anterior malleal ligament to the incudal ligament that anchors the incus short process. Pressure gain, is the result of the area ratio and the ossicular lever, can be quantified and measured using the ratio of sound pressure in the vestibule to the sound pressure in the ear canal hydraulic lever. Sound pressure collected over the large area of the tympanic membrane and transmitted to the smaller footplate area results in an increase in force proportional to the ratio of the area.

HYDRAULIC ACTION

It depends on the relative surface areas of the tympanic membrane and thestapes footplate. surface area of the tympanic membrane(TM) is about 21 times that of the footplate. It is well known that the central 2/3rd the tympanicmembrane moves as one unit.The centre part of the tympanic membrane provides the area related to the footplate. The functional ratio of TM surface area to footplate area is then 2/3rdof 21:1 = 14:1, This is the mechanical advantage derived from the hydraulic action. The combined benefits of lever action and the hydraulic action provide an increase of pressure at the oval window of 14 x 1.3 or just over18 times.

TABLE 2:- SOUND-PRESSURE TRANSFORMATION

Catenary lever: Force acting on TM / Force acting on malleus	2
Ossicular lever: Force acting on Malleus / Force acting on stapes	1.15
Areal ratio: Area of TM/ area of footplate	21.0
Total lever advantage	34 dB
External ear contribution	15 dB
Total system gain	49 dB

PHASE PROTECTION

The electrical analogue of a pure tone sound is the sine wave. Points on this wave vary from 0 to 360 degrees. The fluids of the inner ear are incompressible; thus, sounds arriving at the oval window and round windows at the same phase exert a push-push effect and will not enter the labyrinth. If the two sound energies arriving at the two windows is 180 degrees out of phase (push—pull), there is maximum transfer of energy to the cochlear fluids. The middle ear provides phase protection to the windows. It has been shown that the cochlea is equally sensitive to sound entering the scalavestibuli via the stapes or entering the scala tympani through the round window.[23] The round window membrane is located in a niche in the posterior and inferior region of the middle ear and perpendicular to the plane of the stapes footplate.[22]

In the normal ear, sound is transmitted preferably to the oval window arriving with much greater energy and with an earlier phase than at the round window. The tympanic membrane also blocks the entrance of sound into the middle ear, reducing its level by an average 17 dB.[23]

Sound pressure transformation is the greatest factor influencing hearing efficiency. Even partial transformation makes sound protection (attenuation of arriving sound energy) of the round window less important. This is an important finding as applied to planning of surgical repair of the sound conduction system.[24] Therefore, it is better to reconstruct the ossicular system than to provide sound protection for the round window (Wullstein typeIV tympanoplasty or fenestration type surgery).[22]

The two elements that play the most important roles in phase protection are the tympanic membrane and the ossicular system. The tympanic membrane attenuates the sound energy passing directly into the middle ear by an average of 17 dB and slightly alters its phase angle. This effect prevents the simultaneous arrival of sound waves at both windows with equal intensity and phase. The ossicular chain directs the sound to the oval window with minimum loss from impedance mismatch. Both these mechanisms have the effect of minimizing phase cancellation in the middle ear and cochlea.[22]

BONE CONDUCTION AND THE MIDDLE EAR

Current concepts out lined by Tonndorf[25]consider three routes to contribute to bone-conduction hearing. The external meatal air column responds to low frequencies, due to vibration of the bony canal and the lag between vibration of the skull and the mandible, whose condyle lies just anterior to the cartilaginous canal.[22]The inertial component of bone conduction is due to the lag of the conductive apparatus in relation to vibrations of the skull, thus creating a relative movement of the stapes in the oval window. This is most important

between500 and 2000 Hz. Fixation or interruption of the ossicular canal reduces this energy transfer and causes falsely low scores on bone conduction testing.[22]

TRANSFER FUNCTION OF THE MIDDLE EAR

The middle ear together with the mastoid space constitutes a complex vibrating system whose impedance is made of several stiffness, mass, and frictional components. Together these determine the transfer function of the middle ear. Studies of this function show that the middle ear acts as a low-pass filter, allowing frequencies below the network resonance of1000Hz to pass while attenuating higher frequencies at a slope of 16 dB per octave.[22]

SENSORINEURAL FUNCTION

Air conducted sound waves are admitted to the cochlear perilymph through the oval window, and the information they convey emerges at the other end of thecochlea as nerve impulses in the afferent fibres of the cochlear nerve. The cochlea is filled with perilymph, on itself coiled 2¾ times. Entire length of this tube is divided into two channels by a cochlear partition. Oval window opens into the upper channel which is the scalavestibuli. Round window membrane sealed the end of the lower channel which is scala tympani. Helicotrema is the part where the scalatympani and scala vestibule meet each other. Reissner's membrane separatescala media and scala vestibuli. Scala media and scala tympani are separated by basilar membrane which supporting theorgan of corti and associated structure.The basilar membrane is 35 mm long gradually increases in width from 0.08 mm at the base to 0.5 mm at the apex. There is increase in mass and decrease in stiffness along the length of the membrane. Sensorineural function demands a description of movement of the cochlear partition by sound waves, of the conversion of the mechanical energy of movement to electrical energy (transduction) and of theelectrical events induced in the fibres of cochlear nerve.

MOVEMENT OF THE COCHLEAR PARTITION[26]

1. Helmholtz in his 'place' theory suggested that, basilar membrane consist of a series of tuned resonators. In this theory, any segment of the basilar membrane is activated by a sound wave of the resonant frequency of that segment, with high frequency waves exciting segments in the basal turn and low frequencies excitingthe more apical regions.

2. Rutherford's telephone theory: According to this the frequency of activating sound wave is signalled by the rate of discharge in the cochlear nerve fibres. The latent period of nervous action limits this theory to the perception only of frequencies below 1000 Hz, if the relationship between sound wave frequency and nerve impulse has a simple ratio of 1:1.

3. Wever's volley theory: Combines both place and telephone principles postulating that:

a. High frequencies are perceived as per place theory (in the basal turn).

b. Low frequency (below 1000 Hz) stimulate nerve action potentials at a rateequal to the stimulus frequency.

c. Intermediate frequencies - asynchronous discharges in groups of neurons, Which then combine actively to represent the frequency of stimulus.

4. Von Bekesy's Travelling wave theory: Every soundwave increases in amplitude till it reaches a maximum at certain point, that is specific for a frequency and dies. Successive waves produced by a sustained tonal stimulus have an envelope with a maximal displacement at a site determined by the stimulusfrequency. High frequency wave are activated at basal turn. Lower frequency waves reaches the maximum at the apex. The traveling wave uniquely represents the frequency of excitation and many of its physical characters may be used by brain for finer pitch assessment.

COCHLEAR TRANSDUCTION

Endolymph has a composition different from that of perilymph, which isan ultrafiltrate of plasma. Particularly the high potassium level of endolymph(150 mq/litre compared with 6 mEq/litre in perilymph) and the low endolymphaticsodium level (1.5 meq/litre compared with 150 meq/litre in the perilymph).

Electrically endolymph in the scala media has a positive potential of +80 mVrelative to that of perilymph. This is endocochlear potential. The interior of hair cellhas a potential negative relative to that of perilymph, of the order of -70 mV, so there is a potential difference of 150 mV between the endolymph and the interior of the hair cell.

The movement of tectorial membrane and basement membrane is such that it creates a shearing effect on the hair cells and the cilia which are attached to tectorial membrane. These movements bend the cilia and brings about opening of ion channels and the potassium ions enter hair cells generating action potential .This action potential is carried through the cochlear nerve towards cochlear nucleus.

ACUTE SUPPURATIVE OTITIS MEDIA

Definition: It is an acute inflammation of middle ear cleft by pyogenic organisms.

Middle ear cleft, includes Eustachian tube, middle ear, attic, antrum and mastoid air cells. Abrupt middle ear infection for short duration is also called acute otitis media.

Etiology:

Via Eustachian tube: The Eustachian tube of the young children is relatively incompetent. Most middle ear infections occur as ascending infection by this route, usually after an upper respiratory infection. Swimming and diving can also force water through the eustachian tube into the middle ear.[27]

Via external ear: Traumatic perforations of tympanic membrane due to any cause open a route to middle ear infection

Pre disposing factors:

Recurrent attacks of upper respiratory tract infections, common cold and exanthematous fevers like measles, Tonsillitis and adenoid hypertrophy, Chronic sinusitis, rhinitis, cleft palate and nasal allergy.

Signs and symptoms

Earache, fever, decreased hearing, tympanic membrane congestion or bulging, sometimes with perforation.

MEDICAL TREATMENT

Antibacterial therapy; It is indicated in all cases with fever and severe ear pain.

Decongestant nasal drops- used for 2 to 3 days.

Analgesics and antipyretic: Help to relieve pain and bring down temperature. It should be given for three days or till the symptoms subside.

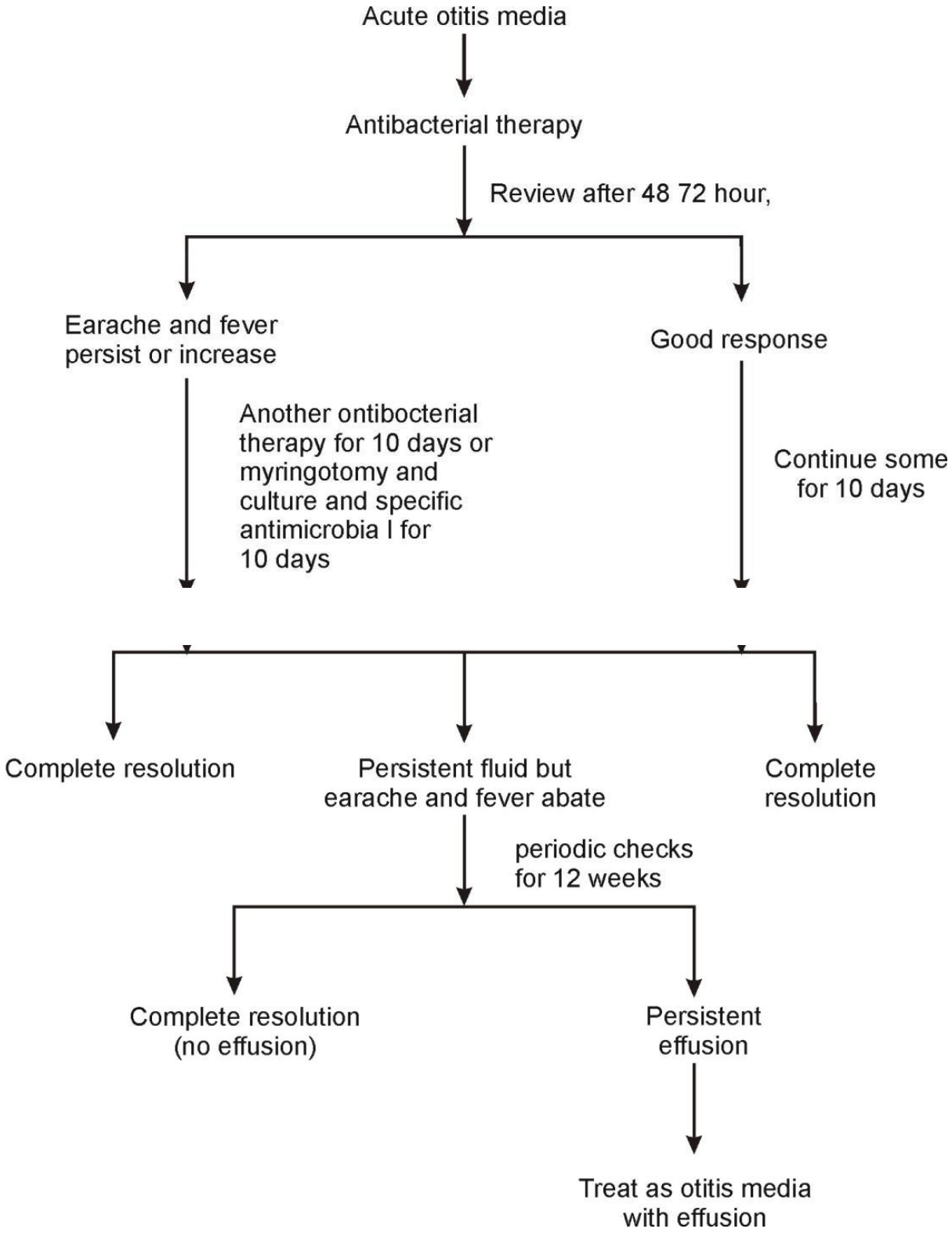
E**ar toilet:** If there is discharge in the ear, it is dry mopped with sterile cotton buds and a wick moistened with antibiotic may be inserted.

Dry local heat: It helps to relieve pain.

Advice to the patient

Keep the ear dry. In case of discharge, dry mopping of the ear with the clean cotton stick. Not to put any indigenous ear drops.

Treatment &Follow up for AOM:



The majority of complications followed by acute infection (74%) occur in children (below 15 yrs). In economically backward areas children may sometimes present with intra cranial complications as the first indication of acute otitis media.

All cases of acute suppurative otitis media should be carefully followed till tympanic membrane returns to its normal appearance and conductive deafness disappears.

Chronic suppurative otitis media.

Otitis media is defined as "an inflammation of the middle ear without reference to etiology or pathogenesis."[27] Otitis media also involves concomitant inflammation, of the mastoid air cell system, owing to its anatomic linkage to the middle ear cleft. Accordingly, otitis media is more correctly conceived of as an inflammatory disorder of the entire tympanomastoid compartment.

As per WHO, despite the shortage of accurate, standardized data, the prevalence of Chronic Otitis Media in Indian population is approximately 2% which is comparatively higher than that found in developed countries with the prevalence of<1%.[28] It is considered "Chronic" if the TM defect is present for greater than 3 months. Histologically, Chronic Otitis Media is defined as irreversible mucosal changes in the middle ear cleft.[29]This is characterized by intermittent or persistent chronic purulent drainage via perforated tympanic membrane and can be accompanied with cholesteatoma. Sometimes, a permanent, central perforation of the tympanic membrane can remain dry, with only rare intermittent drainage, that is, inactive COM. Chronic or recurrent mucoid otorrhoea, that is active COM is provoked by exposure of the tympanic mucosa to bacteria of the external auditory canal and the eustachian tube.

Pathophysiology.

Two theories concerning the middle ear infection have been proposed by different authors.

The first one proposes that the causative organisms gain access to the middle ear via the *Eustachian tube. This* is due to suction of infected mucous from nasopharyngeal cavity into the middle ear secondary to a high positive pressure in the former on and the slightly low pressure in the middle ear .[30]

Second theory says that the Eustachian tube, traumatic perforation of the tympanic membrane and inserted tympanostomy tubes are the initiators of acute otitis media and finally CSOM, but that the infection is exclusively maintained by recurrent entry of the causative organisms from the external ear through the resultant perforation on the tympanic membrane.

These two theories just explain the various roots of infection. One would appreciate that the recurrent otorrhoea frequently follows an upper respiratory tract infection and entry of unclean water into the ear via the external meatus.

CSOM is a multifactorial disease. It is due to complex interactions between bacteria, environment, host and genetic risk factors.[31] Innate host immune mechanisms such as the TLR4/MyD88 pathway are important in eliciting protective immune responses against bacteria.[32]Bacterial biofilms have gained attention in the pathogenesis of CSOM. Biofilms are resistant to antibiotics and other antimicrobial compounds.[33] Biofilms attach firmly to damaged tissue, such as exposed osteitic bone and ulcerated middle ear mucosa, or to otological implants such as tympanostomy tubes, further aggravating the problem of eradication.[34]

IL-8 plays a vital role in the development of chronicity of Otitis media and has been also affecting bacterial growth. Increased mRNA and protein levels of TNF-α, IL-6, IL-1β and IFN-γ were found in mucosa of the middle ear of CSOM patients compared with healthy individuals .[35]

MICROBIOLOGY.

The most commonly involved organisms cultured from the chronic otorrhoea(CSOM patients) are *Pseudomonas aeruginosa* (22-44%), *Staphylococcus aureus* (17-37%), *Proteus* species (10-15%), *Klebisellapneumoniae*(4-7%), *Proteus mirabilis(3-20%)proteus vulgaris(0.9-3%),E. coli (*1-21%),*Streptococcus pneumonia(1-3%)* diphteroids. Anaerobes (including Bacteroids, Peptostreptococcus, Peptococcus) are isolated in 20-50% of cases while mycosis (Aspergillae and Candida species) are isolated in 25% .A cross-sectional research study of bacteria in the middle ear, adenoid and tonsil specimens from pediatric patients with chronic serous otitis media using r RNA gene-based sequencing analysis showed that *Pseudomonas* species (82.7 %) is the most common pathogen that lies in the middle ear.[36] *P. aeruginosa* damages the tissues, interferes with normal body defenses and inactivates antibiotics by various enzymes and toxins.[37] In many circumstances, multiple organisms are involved in what appears to be a symbiotic relationship. Tuberculous otitis media have also been noted in some patients. Mycobacterium tuberculosis gains entry via the Eustachian tube from the infected sputum coughed into the nasopharynx from the lungs.

Complications and their management

Most complications are secondary to destructive osteoclastic process, vascular erosion and halisteresis. Most otologists agree that cholesteatoma formation is the main contributor for the complications because of the erosive nature of keratin and cholesterol elements that constitute it. However, some granulation tissue accompanying CSOM can also have erosive potential with devastating consequences just like cholesteatoma. CSOM complications are many, especially when no proper treatment is given with about 89. 3%of the patients presenting with various complications. According to the classification of CSOM, it is obvious that the unsafe form carries more risk of complications than the 'safe' form. Common

complication in the tympanic cavity is ossicular erosion which has aggravating effect on the conductive deafness. The conductive hearing loss may be due to the tympanic membrane perforation, disruption of the ossicular chain, aural polyps may also occur obstructing the ear canal or a combination**.** Surgical removal of the disease with ossicular reconstruction reduces the morbidity associated with decreased hearing loss.

spread of infection to the mastoid air cells results in mastoiditis or frank mastoid abscess. Initially the abscess is subperiosteal but it may burst through the skin forming a persistent post auricular sinus. Petrositis can occur when the disease spreads into the petrous apex, and can manifest as Gradenigo's syndrome which presents with retro-orbital pain, aural discharge and abducens palsy. This type of complication needs prompt investigations including CT scans and treatement using systemic antibiotics and petrosectomy.

Facial palsy can occur with or without cholesteatoma and must be explored surgically and the diseased mucosa and granulation removed. Labyrinthitis may develop over a period of time. Here the infection spreads into the inner ear through the oval or the round window or through a semicircular canals exposed by bony erosion.

In acute serous labyrinthitis with acute onset of vertigo and hearing loss, surgical exploration via mastoidectomy to remove the infected tissue and systemic antibiotics are mandatory. The most harmful variant is acute suppurative labyrinthitis with profound sensorineural deafness, tinnitus and vertigo, with or without nausea and/or vomiting and nystagmus. Treatment is aggressive surgical debridement plus labyrinthectomy to prevent more serious complications and also antibiotics and cultures and sensitivities are advisable. In most cases, the labyrinth is damaged and the patient ends with profound deafness and vestibular failure which are sequelae of labyrinthine sclerosis after bone remodeling. Lateral sinus thrombophlebitis may occur by extension of the infection from the mastoid into the lateral sinus. The risk here is the release of thrombi causing extensive thrombophlebitis which may extend to superior sagital

venous sinus destroying the arachnoid granulations and subsequently causing otitic hydrocephalus. Clinical signs may include alteration of the mental status seizures and fever. Mastoidectomy, drainage of the thrombus at the same sitting or sequentially. Intracranial abscess can be notoriously silent disease and must be looked for. Since tegmenantri or tegmen tympani may be the portal of entry, the abscesses frequently occur in the temporal lobe or cerebellum. However, such abscesses may also be located in the frontal or parietal lobes and even in the contralateral cerebral hemisphere.

CHOLESTEATOMA.

Known as characteristic epidermoid cyst that containing keratin. Two types of cholesteatoma are present they are (congenital and acquired) which are not *different* histologically. It is important to diagnose its presence and confirm it histologically because of its aggressive character.

Among the *four* types *of* congenital Cholesteatoma (cerebellopontine angle, petrous pyramid, jugular fossa and middle ear cleft), the Cholesteatoma of the middle ear cleft is relevant to this study. Differentiating a congenital from acquired type is a challenge in the attico-antral region. However, in clinical practice, the vast majority of cholesteatomas in the middle ear cleft are secondary to CSOM. These CSOM acquired cholesteatomas most of the time arise from the pars flaccida in the attic region or the posterior part of the tympanic membrane thereafter extend everywhere in the middle ear. Presence of a Cholesteatoma in the attic region may be recognized by destruction of the "scutum", lateral attic wall, ossicles and erosion of the medial attic wall. They can be associated with dehiscence or erosion of the facial canal and possibility of the labyrinthine fistula.

Diagnosis of acquired cholesteatoma is facilitated by presence in the CT scan of non-dependent homogenous soft tissue mass in an appropriate location. For some situations such as encephalocele in the mastoid cavity, expansible lesion to the petrous apex, lateral sinus

thrombosis, magnetic resonance, CT scan with contrast or magnetic resonance angiography are important imaging techniques.

The overall prevalence of chronic otitis media is estimated to be as 4.1%.[38] The prevalence of otitis media related hearing loss is about 30.82 per 10,000 globally.[39]

In a cross sectional study done in school going children at Aurangabad involving 4104 school children, prevalence of COM was found to be 3%(123) . Among these, 2.6% belonged to safe type. COM was more common in girls (57.72%) and in low income group (78%).[40]

Similar cross sectional studies involving primary school children in rural and urban areas of North India, showed overall prevalence of COM to be 6.1%. The prevalence was more in rural areas. Chronic Suppurative Otitis Media was significantly associated with nutritional status of the child, and lower socio economic group.[41]Tubotympanic type is 81.25%,and atticoantral type 18.75%. 29.90% study participants belonged to lower socioeconomic strata and 26.06% study participants belonged to upper lower strata.[42]

A study conducted in Pakistan. Screened 1473 students in urban and rural areas. Lower socio economic rural population was found to have significantly higher prevalence of COM. The prevalence of COM was 1.80% among government schools group and 1.24% among private schools group.[43]

Cross sectional study done in urban private schools of Nepal on 500 school going children. Prevalence of CSOM was 5%. Among them tubotympanic disease is seen in 76% and 24% had atticoantral disease. Among them 32.0% were active CSOM.[44]Almost similar prevalence was found in Middle East countries.

Therefore ear discharge, swimming in local pools, recurrent respiratory infections, and overcrowded housing are the strongest predictors for CSOM.[45]

MANAGEMENT OF CSOM.

A combination of aural toilet and topical antimicrobial drops is the primary standard of care for CSOM. Systemic or oral or parenteral antibiotics, serve as an option. They are less commonly used due to the fact that topical antibiotics in combination with aural toilet are found to achieve greater tissue concentrations than that of systemic antibiotics (almost 100–1000 times greater). Surgery, in the form of mastoidectomy, was traditionally the mainstay of therapy. Retrospective studies have shown that mastoidectomy is not superior to more conventional therapies such as aural toilet and topical and systemic antibiotics for uncomplicated CSOM. Tympanoplasty is another surgical technique which is often used for the persistent perforations after the active infection of CSOM has been treated. Surgical eradication of the cholesteatoma is indicated in chronic cholesteatomatous otitis media.

AURAL TOILET

"Aural toilet" refers to maintaining the chronic draining ear tidy and dry to the maximum extent possible. Techniques include in-office mopping with cotton swabs, suctioning to remove discharge and debris, and keeping an ear wick to stent open an edematous canal.[19]Some practitioners use various powders that helps dry the ear, many of them are topical antibiotics. One example is otic insufflation powder, which contains a mixture of chloramphenicol, sulfamethoxazol, and amphotericin B. There is no consensus on how often to do aural toilet or when to use the insufflation powder, but in case of previous treatment failure, the former can be performed daily, if feasible. Some practitioners recommend at least two to three times a week, depending on the severity and duration of symptoms.[46]

A small randomized controlled studies showed that aural toilet is not as effective as monotherapy and should be used along with medical therapy, ideally topical antibiotics for

the treatment of CSOM. Otorrhoea resolved frequently in groups treated with a combination of aural toilet, topical and systemic antibiotics, and topical boric acid compared with aural toilet alone or with no specific therapy.[47]

OTOTOPICAL ANTIBIOTICS

Antibiotic drops in combination with aural toilet are the main components of therapy for CSOM and have proved to be most effective in randomized controlled trials.

Most commonly used topical antibiotics are quinolones. They carry a minimum side-effects and are superior to aminoglycosides.[48] Quinolones are particularly effective against *P. aeruginosa* and don't show a potential side effect of cochleotoxicity and vestibulotoxicity, which are attributed to aminoglycosides. A randomized controlled trial demonstrated that ciprofloxacin is more effective compared with aminoglycoside, and another study showed the efficacy of ofloxacin topical antibiotic over oral amoxicillin-clavulanic acid in resolving otorrhoea.[49]

Combination ear drops are prescribed when there is an inflammation of the external auditory canal or middle ear mucosa, or when granulation tissue is present. Dexamethasone is frequently used in combination with ciprofloxacin for these conditions.[50]

These are used in developed countries. Due to their low cost and availability they are more common in resource-limited settings. Some of these include acetic acid, aluminium acetate (Burrow's solution), or combinations of these (Domeboro's solution), and iodine-based antiseptic solutions. Povidone–iodine-based antiseptic solution which acts as a broad-spectrum antiseptics against many microbes that can form colonies in the middle ear – bacteria, viruses, fungi and protozoa. One randomized controlled trial demonstrated

that povidone–iodine had the same efficacy as ciprofloxacin drops in resolving otorrhoea.[51]

SYSTEMIC ANTIBIOTICS

Upon failure of primary treatment to resolve otorrhoea after 3 weeks of therapy, alternative measures must be considered. Oral antibiotics are a second-line therapy for CSOM. Systemic therapy has not been found as effective as the direct delivery of topical antibiotics due to the inability to achieve effective concentrations at the affected tissues of the middle ear. Multiple factors affect drug efficacy which include bioavailability, organism resistance, scarring of middle ear tissues and decreased vascularization of the inner middle ear mucosa in chronic disease. [52] Topical agents such as quinolones are the drug of choice for the second-line therapy.[53]Amoxicillin/clavulanic acid (Augmentin) or erythromycin/sulfafurazole are other antibiotics that are recommended for children.

Due to the risk of systemic side effects and increased potential to breed antibiotic resistance, intravenous antibiotics should be used as the last-line medical option for CSOM patients. When possible, antibiotics should be culture directed, and an infectious disease consultation should be sought, when available. Because the majority organisms that are encountered in CSOM are *P. aeruginosa* and meticillin-resistant

S. aureus (MRSA), penicillin-based antibiotics and macrolides have very limited efficacy, as organism resistance rates are high.[47] Systemic antibiotics should be used for various degrees of primary treatment failure or when intracranial complications ensue during CSOM.

SURGERY

Surgery should be considered as a last resort after maximal medical therapy has been tried and exhausted for cases of CSOM that are particularly recalcitrant or recurrent. Tympanomastoidectomy in the form of surgery is also indicated in cases of CSOM in which there are complications, some of which could potentially be life threatening, such as significant hearing loss, facial nerve palsy, subperiosteal abscess, petrositis, dural venous sinus thrombosis, meningitis, cerebral abscess and labyrinthine fistula, among others.[58] Chronic cholesteatomatous otitis media requires surgery, usually in the form of tympanomastoidectomy in order to eradicate cholesteatoma, a usual underlying cause of chronic infection.[55] Mastoidectomy may be indicated to reduce the burden of disease in cases with abscess formation in the mastoid, tympanoplasty or recalcitrant disease.[56] A large percentage of perforations will heal on their own after resolution of infection, but in those that do not, tympanoplasty is indicated to improve the hearing ability and to help prevent recurrence of the infection by closing off the middle ear space. Patients must also practice dry ear precautions in order to decrease the rate of recurrent infection and otorrhoea.

MATERIALS AND METHODS

The study was carried out in schools in and around Kolar district from December 2016 to June 2018.

SAMPLE SIZE CALCULATION:-

SAMPLE SIZE:

Sample size was estimated by using the prevalence of CSOM 6.1% from the study by AshibParvez et al. using the formula

Sample size = $Z_{1-\alpha/2}^2$ p(1-p)/d^2

Here

$Z_{1-\alpha/2}$ = Is standard normal variant at 5% type 1 error ($p<0.05$) it is 1.96 and at 1%type 1 error ($p<0.01$) it is 2.58.As in majority of studies P values are considered significant below 0.05 hence 1.96 is used in formula.

P = Expected proportion in population based on previous studies or pilot studies.

d= Absolute error or precision – has to be decided by researcher.

P = 6.1% or 0.061

q = 93.9% or 0.939

d = 2% or 0.02

Using the above values at 95% Confidence level a sample size of 550 subjects will be included in the study.

Considering 10% Nonresponse a sample size of 550 + 55 ≈ 605 subjects will be included in the study.

SAMPLE SIZE: 605

STUDY SAMPLE:

The screening of school going children in and around Kolar district for CSOM. Students were examined according to proforma , which were distributed to the children or to the respective class teachers to fill up the primary information in consultation with parents regarding the demographic data of child .

Students were examined with help of otoscope and 512 HZ tuning fork for COM and complete ENT examination.

Students who require further investigations like PTA and treatment is offered at department of ENT , R.L.J. Hospital,Tamaka, Kolar for further evaluation by pure tone audiometry and further treatment.

Students who are having CSOM and nasal block were mobilized to department of ENT , R.L.J.Hospital, Tamaka, Kolar for nasal endoscopy and for the children who are not cooperative X,ray nasopharynx lateral view was done for adenoid hypertrophy.

STUDY DESIGN: School based, Cross sectional study.

STUDY AREA: Government primary, secondary schools and private schools in and around Kolar district.

STUDY PERIOD: December 2016 to June 2018.

STUDY POPULATION: Around 8 schools were randomly picked from the list of all schools of Kolar which came out to be 4 government schools and 4 private schools. All students who were fitting the inclusion criteria were involved in the study. Government Primary high School, Tamaka, Government lower primary high school (nundupalli) ,Government Secondary High School (banadahalli cross), Government Primary high School(janagata), R.L.Jalappa High School, R.V high school, Janagata (kambodi) and Kataripalya Government school were the selected schools.

INCLUSION CRITERIA:

All school going children in and around Kolar district between the ages of 6 to 13 years.

EXCLUSION CRITERIA:

Students not willing to be part of the study**.**

MATERIALS AND EQUIPMENT USED:

1. Proforma
2. Aural speculums
3. Crocodile forceps
4. Otoscopes
5. Batteries
6. 512 Hz Tuning fork
7. Jobson –Horne probes

QUESTIONNAIRE CONTAINS

HISTORY

1. Socio demographic details like Name of the child, age, sex, address,

parent's education ,occupation, total income of the family, members of the family, type of the house were asked.

2. History regarding predisposing factors for ear problems like family history of ear problems and hearing impairment, recurrent respiratory infections, snoring(due to adenoid hypertrophy), passive smoking (smoking habit of parents , caretakers), material used for cooking(household smoke) were elicited.

3. History regarding symptoms of ear problems like ear pain, ear discharge, duration of discharge, block sensation in the ear, itching in the ear, and response to calls (to rule out hearing impairment) were recorded.

EAR EXAMINATION:

OTOSCOPIC EXAMINATION.

Otoscopic examination was done as briefly summarized below:

a. The procedure was preliminarily explained to each subject who was assured of the painless nature of the examination. The examination was done in both ears starting with the normal ear where relevant.

b. Examination began with the inspection of the pinna, pre-auricular and post-auricular areas for any abnormalities.

c. Otoscopy was carried out using a battery powered otoscope. The pinna was gently pulled upwards and outwards (backwards only in young children) and the speculum of the otoscope gently inserted into the canal with die instrument held between the thumb and index finger with the ulnar aspect of the hand resting gently against the subject's cheek or neck.

d. The external auditory canal and tympanic membrane were then inspected and findings recorded in the proforma.

Children found to have CSOM, were re-examined, in case of active discharge which made visualization of the TM difficult. Aural toilet was then done using cotton wool carefully under clear vision and the ear reexamined. Likewise, children presenting wax or foreign bodies underwent syringing or removal by hook respectively.

TUNING FORK TESTS.

The 512 Hz tuning fork was used to determine the position of Rinne and Weber tests.

RINNE TEST.

The tuning fork prong was gently struck at a point about one third from its free end on die examiner's forearm near the olecranon. After confirming that the prongs were vibrating, the tuning fork was held with its acoustic axis coincident with the anatomical axis of the external auditory meatus of the subject within 2 cm of the meatal opening without touching the ear

(Air conduction). The subject was then asked if he/she could hear the sound produced by the tuning fork. The fork was then immediately transferred and base pressed firmly against the mastoid process. The fork was held for 2 seconds with counter pressure applied to the opposite side of the head with the other hand (Bone conduction). The subject was asked whether he/she could hear the tuning fork sound and if this sound was louder or quieter than when it was at the external auditory meatus. When the sound perceived by Air Conduction is louder than Bone Conduction, the test is positive. When the BC is louder than AC the test is negative. Negative Rinne test suggests conductive deafness of over 15 dB.

WEBER TEST.

The examiner applied the vibrating tuning fork to the forehead in the midline. The subject was asked to indicate if any sound was heard and whether it was heard in the middle of the head, in both ears equally, or directed to the right or left. Lateralization or centralization of the sound was then noted. Lateralization of the Weber to the affected ear confirms conductive deafness. Lateralization to the opposite ear suggests false negative Rinne which may indicate severe mixed or sensorineural deafness on the affected ear.

Children identified with impacted wax were treated with wax solving drops and the wax was removed in ENT OPD, R.L.J.Hospital,Tamaka, Kolar. Children identified with COM were treated initially with ear drops and antibiotics and haven been advised to keep the ear dry. Students who require further work up like Pure tone audoimetry and chronic otitis media cases were being followed at department of ENT, R.L.J.Hospital,Tamaka, Kolar for further management.

Figure 8:- Photograph of the tympanic membrane showing a subtotal perforation

Figure 9:- Photograph of the tympanic membrane showing a medium size perforation in the anterior quadrant

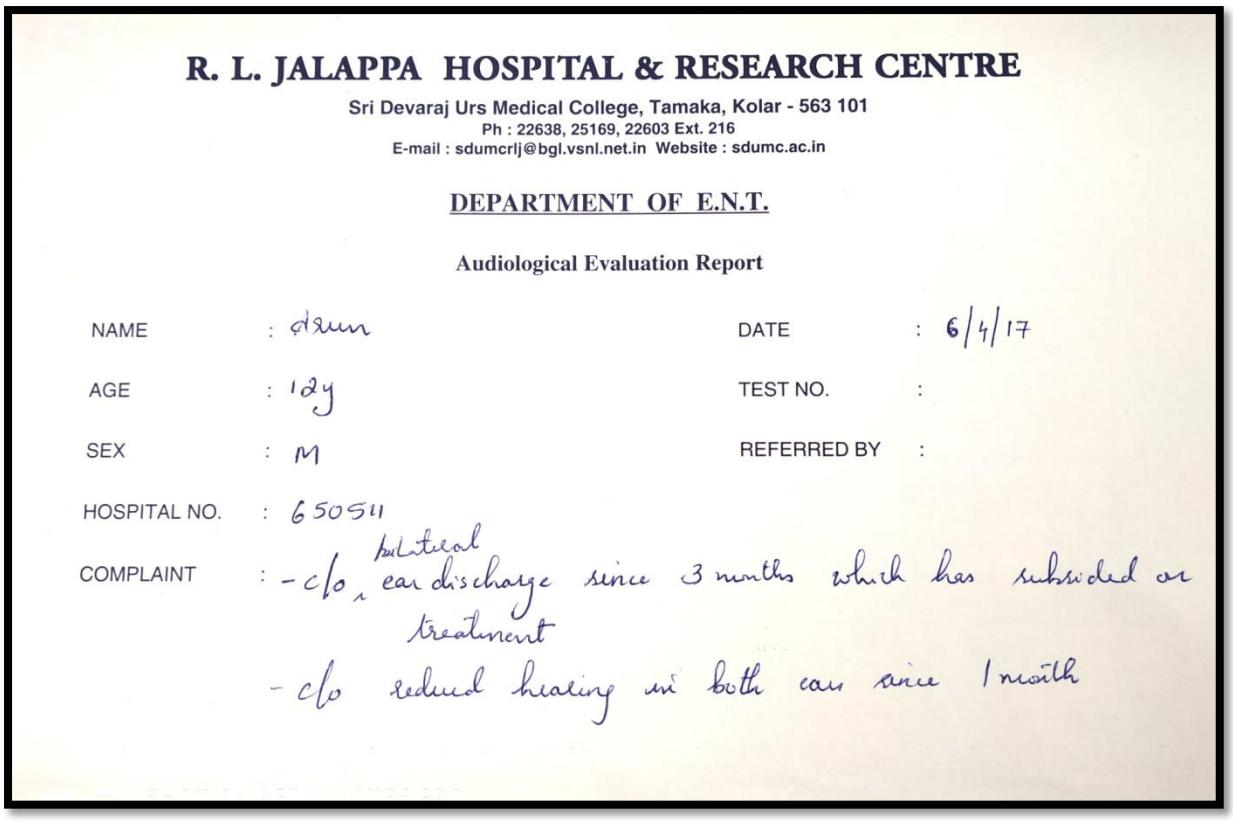
PURE TONE AUDIOMETRY

The test subject was made to sit comfortably on the chair by the audiologist. Continuous and not pulse sound was presented via a supraaural earphone. The child ear under test was exposed to a pure tone at 50 dB and the child would indicate the whole duration of the stimulus. The stimulus was repeated for at least two times. If no response was elicited, the stimulus would be increased by 20dB and repeated until the response was well heard by the child. The sound level was thereby reduced in 5 dB steps until the child could not hear. The lowest sound level in terms of decibels was taken as the true threshold at that frequency. Screening was performed at a tone 1,2 and 4 kHz frequencies by using Audiometer.

Subjects who failed to hear the screening tone at any of the frequencies would undergo further audiometric testing for thresholds to determine the severity of the hearing impairment.

Results were recorded in the audiogram form. Type of hearing loss was be defined by using the WHO grading system. Thus, the severity of hearing loss was determined by using air conduction thresholds, bone conduction threshold and tuning fork test results.

Figure 10:- Photograph of PTA-Assessment of Air Conduction



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DEPARTMENT OF E.N.T.

Audiological Evaluation Report

NAME : drum
DATE : 6/4/17
AGE : 12y
TEST NO. :
SEX : M
REFERRED BY :
HOSPITAL NO. : 650511
COMPLAINT : - c/o bilateral ear discharge since 3 months which has subsided on treatment
- c/o reduced hearing in both ears since 1 month

Figure 11: Pure tone audiogram

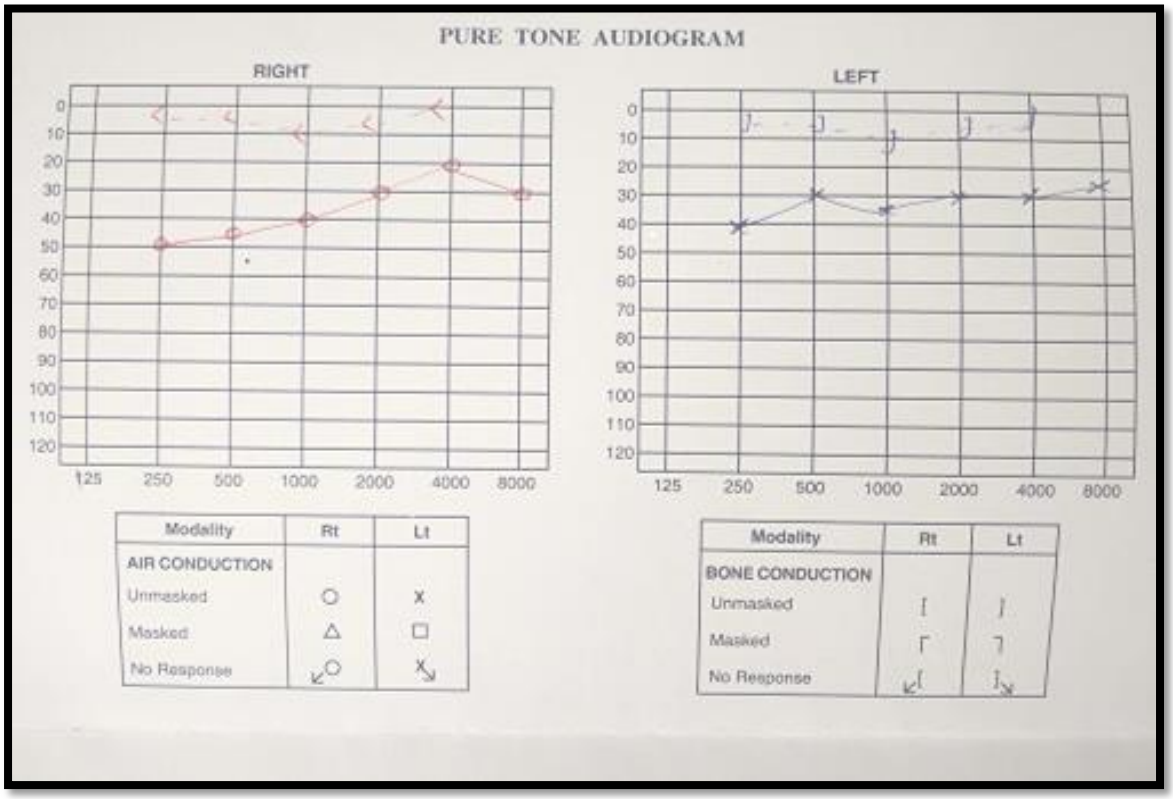

Figure 12 : Pure tone audiogram of the same patient showing 33.75dB hearing loss on the right side and 31.25dB hearing loss on the left side.

RESULTS

Statistical Analysis:

Data was entered into Microsoft excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. **Chi-square test or Fischer's exact test** (for 2x2 tables only) was used as test of significance for qualitative data.

Graphical representation of data: MS Excel and MS word was used to obtain various types of graphs such as bar diagram, Pie diagram.

p value (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

Statistical software: MS Excel**,** SPSS version 22 **(**IBM SPSS Statistics, Somers NY, USA) was used to analyze data.

Total 605 students were examined for the study.

Table 3:- Distribution of study participants according to education of father

SL NO	EDUCATION OF FATHER	NUMBER	PERCENTAGE
1	Did not attend school	193	31.9
2	Primary School	40	6.6
3	Middle	81	13.4
4	High School	157	26.0
5	Pre university	61	10.1
6	Graduation	70	11.6
7	Post graduation	3	0.5
	Total	605	100

Out of 605 study participants, around 193(31.9%) study participants father were uneducated/ did not have formal school , 157(26%) had completed High school and 81(13.4%) had completed middle schooling.

Table 4:- Distribution of study participants according to education of mother

	EDUCATION OF MOTHER	NUMBER	PERCENTAGE
1	Did not attend school	266	44.0
2	Primary School	42	6.9
3	Middle	75	12.4
4	High School	137	22.6
5	Pre University	44	7.3
6	Graduation	38	6.3
7	Post-Graduation	3	0.5
	Total	605	100

Out of 605 study participants, around 266(44%) of study participants mothers were uneducated/ did not have formal school, 137(22.6%) had completed High school and 75(12.4%) had completed Middle school.

Table 5:- Distribution of study participants according to occupation of father.

SL NO	OCCUPATION OF FATHER	NUMBER	PERCENTAGE
1	Unemployed	3	0.5
2	Unskilled/semiskilled	400	66.1
3	Skilled	158	26.1
4	Business	24	4.0
5	Professional	20	3.3
	Total	605	100

Out of 605 study participants , around 400(66.1%) study participants father were semiskilled and around 158(26.1%) were skilled workers

Graph 1:- Graph showing Distribution of subjects according to occupation of father.

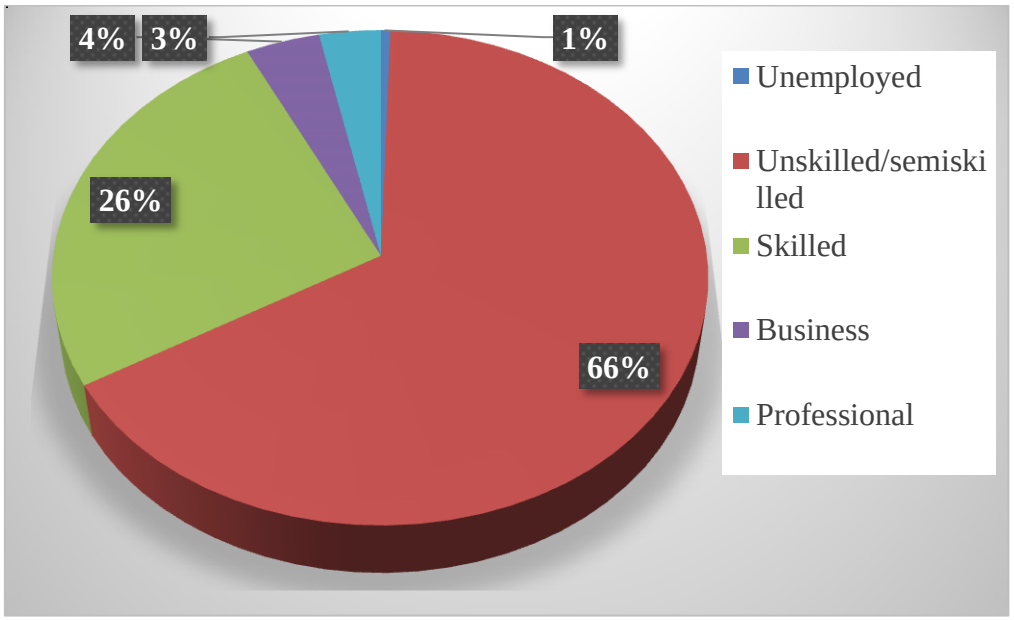

Table 6:- Distribution of subjects according to occupation of mother

SL NO	OCCUPATION OF MOTHER	NUMBER	PERCENTAGE
1	Home maker	395	65.3
2	Unskilled/semiskilled	149	24.6
3	Skilled	54	8.9
4	Business	2	0.3
5	Professional	5	0.8
	Total	605	100

Out of 605 study participants, 395(65.3%) study participants mother were home makers and 149(24.6%) were semiskilled workers.

Table 7:- Distribution of study participants according to birth order

SL NO	Birth order	GIRLS n(%)*	BOYS n(%)*	Total n(%)*
1	**1st – 2nd**	207(34.21)	319(52.72)	526(86.9)
2	**More than 2nd**	34(5.62)	45(7.44)	79(13.1)
	Total N (%)#	**241(39.83)**	**364(60.16)**	**605(100)**

N(number) *Column Percentage # Row Percentage

Out of 241 girl participants , around 207(34.2%) belonged to birth of first-second order and out of 364 boy participants 319 (52.7%) belonged to birth of first -second order.

Table 8:- Distribution of study participants according to family Size

	FAMILY SIZE	NUMBER	PERCENTAGE
1	Less than 5	438	72.4
2	More than 5	167	27.6
	Total	**605**	**100**

Out of 605 study participants, around 438(72.4%) had family size less than 5.

Table 9:- Distribution of study participants according to type of family.

	TYPE OF FAMILY	NUMBER	PERCENTAGE
1	Extended	19	3.1
2	Joint	166	27.4
3	Nuclear	420	69.4
	Total	**605**	**100**

Out of 605 study participants, 420(69.4%) belonged to nuclear family.

Graph 2:- Graph showing Distribution of subjects according to type of family.

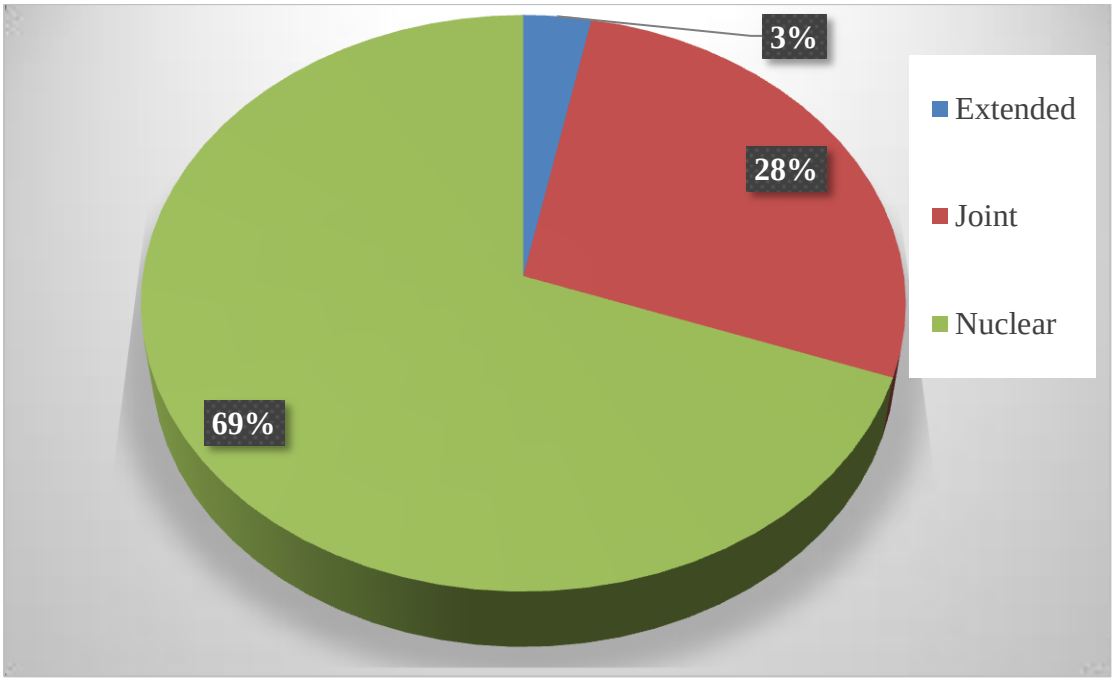

Table 10:- Distribution of study participants according to type of house.

SL NO	TYPE OF HOUSE	NUMBER	PERCENTAGE
1	KACHA	1	0.2
2	PUCCKA	604	99.8
	Total	**605**	**100**

Out of 605 study participants, 604(99.8%) stayed in Puccka house.

Table 11:- Distribution of subjects according to modified BG Prasad classification 2018

SOCIOECONOMIC STATUS	NUMBER	PERCENTAGE
I	189	31.2
II	143	23.6
III	142	23.5
IV	66	10.90
V	65	10.7
Total	605	100

Majority of subject 31.2% were in SES I followed SES II in 23.6% ,23.5% were in SES III,10.9% were in SES IV and 10.7% were in SES V.

Graph 3:- Graph showing Distribution of subjects according to SES

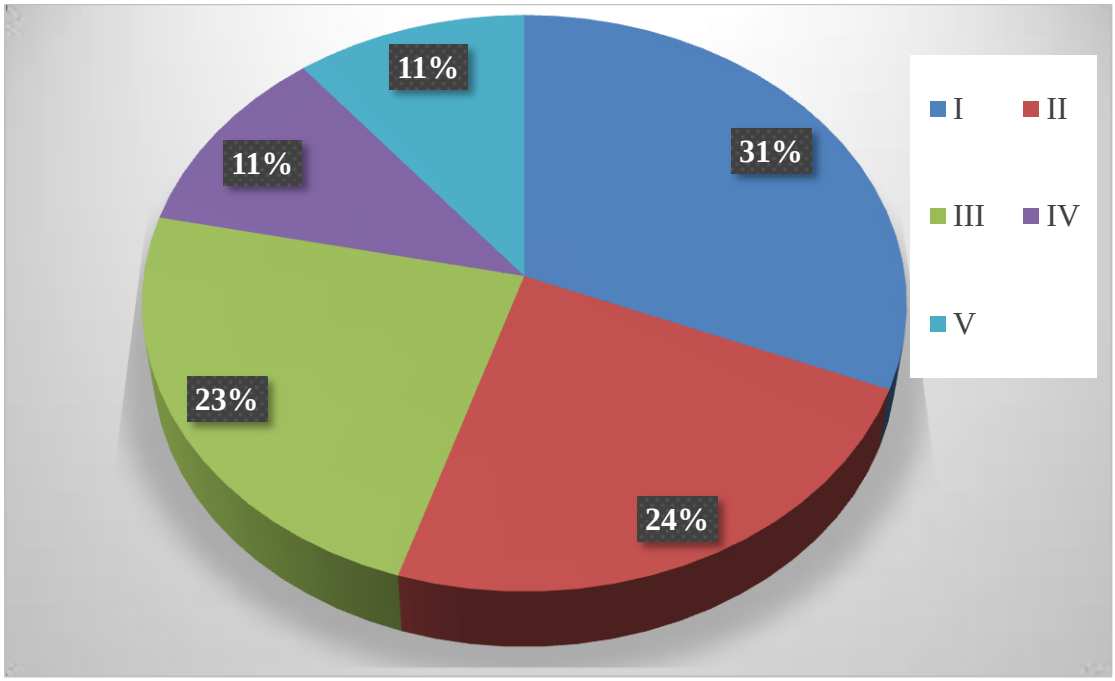

Table 12:- Distribution of study participants according to passive smoking at home.

SL NO	PARENTAL SMOKING	NUMBER	PERCENTAGE
1	NO	510	84.3
2	YES	95	15.7
	Total	605	100

Out of 605 study participants, 510(84.3%) had no history of exposure to passive smoking at home.

Graph 4:- Graph showing distribution of subjects according to parental passive smoking.

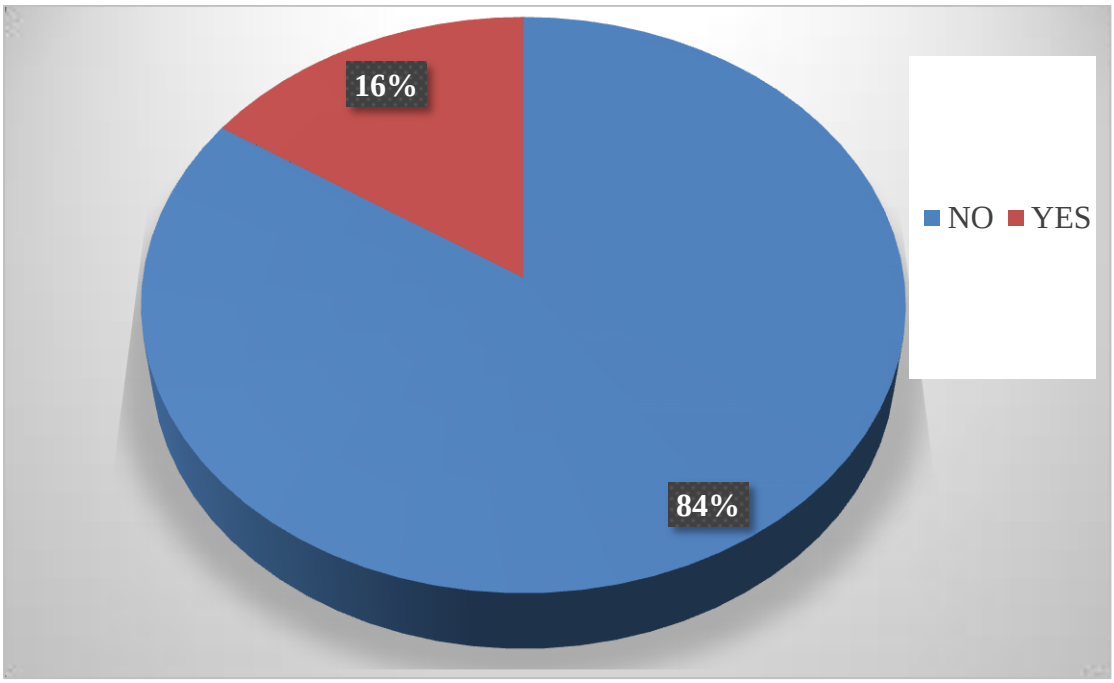

Table 13:- Distribution of study participants according to type of fuel used for cooking.

SL NO	FUEL USED	NUMBER	PERCENTAGE
1	FIREWOOD	28	4.6
2	LPG	577	95.4
	Total	**605**	**100**

Out of 605 study participants, 577(95.4%) used LPG fuel for cooking .

Graph 5:- Graph showing distribution of subjects according to type of fuel used for cooking

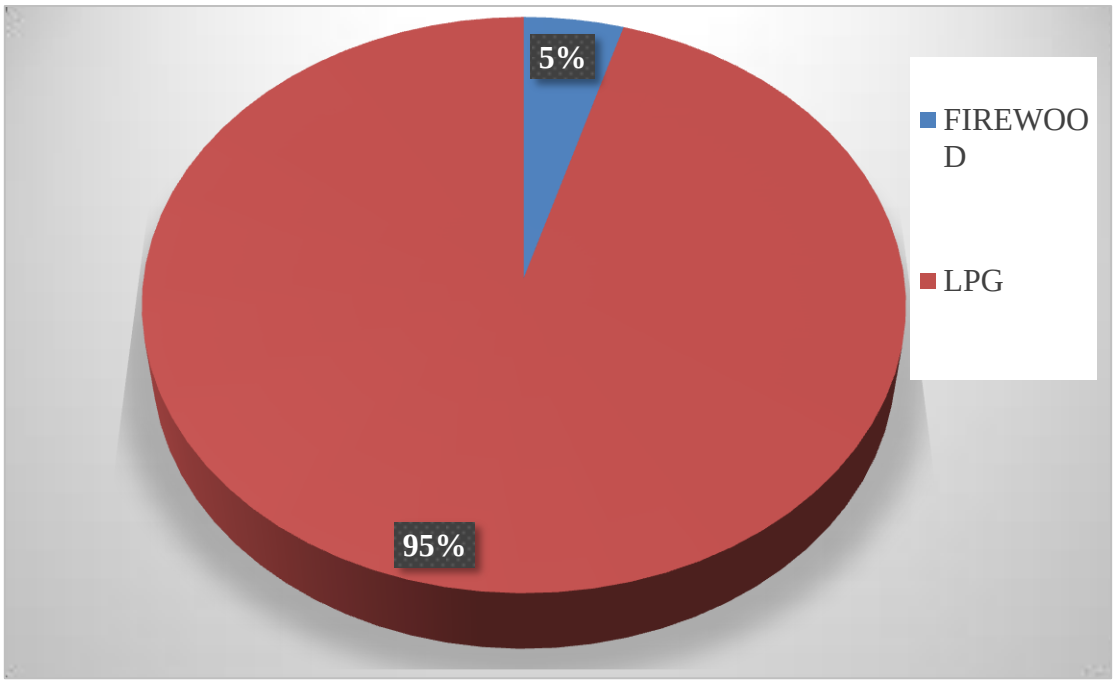

Table14:- Distribution of study participants according to Chronic Otitis Media and gender

	Chronic Otitis Media	GIRLS n(%)*	BOYS n(%)*	Total n(%)*	p value
1	**Present**	14(5.8)	22(6.0)	36(6.0)	0.9
2	**Absent**	227(94.2)	342(94)	569(94.0)	
	Total N(%)#	**241(100)**	**364(100)**	**605(100)**	

n(number) , *Column Percentage , #row percentage

The overall prevalence of Chronic otitis media was 6%,the prevalence is almost same in boys and girls.

Graph 6:- Graph showing Distribution of subjects according to sex and Chronic Otitis Media

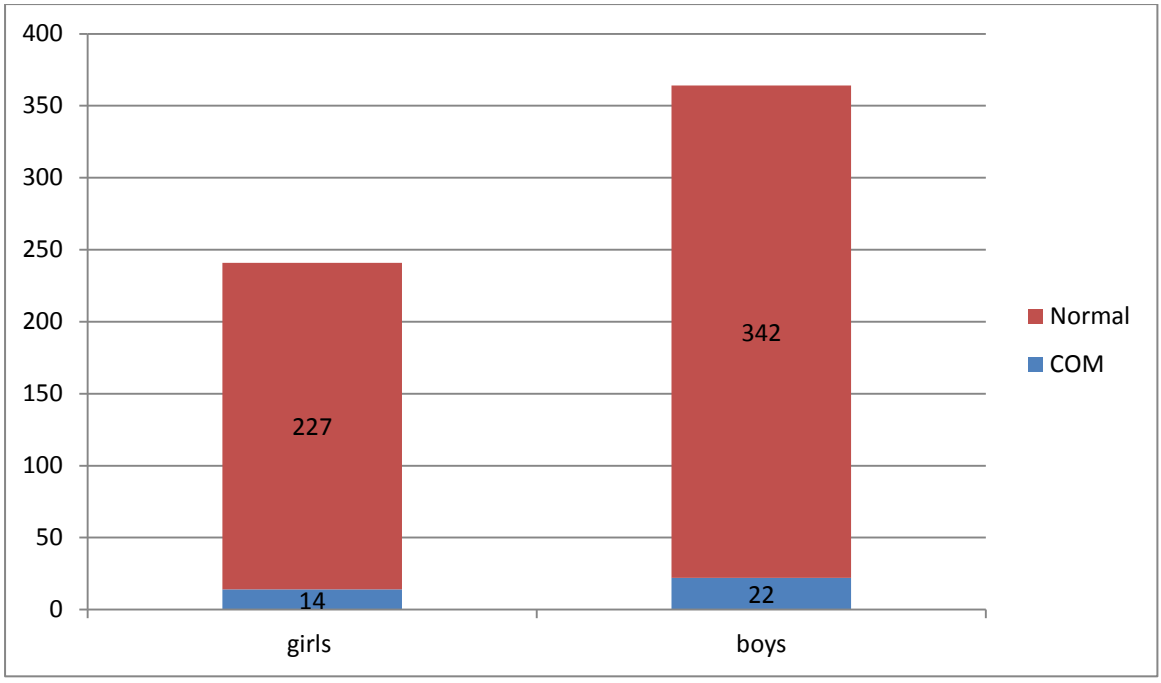

Table 15:- Distribution of diagnosed Chronic otitis media participants according to hearing loss

SL NO	HEARING LOSS	GIRLS n(%)*	BOYS n(%)*	TOTAL n(%)*	P VALUE
1	**NO**	1(7.2)	5(22.8)	23(63.9)	0.7
2	**YES**	13(92.8)	17(77.2)	13(36.1)	
	Total N(%)#	**14(100)**	**22(100)**	**36(100.0)**	

n(number) , *Column Percentage , #row percentage

92.8% of girls who were diagnosed with Chronic Otitis media had hearing loss however the association was not statistically significant.

Table 16:- Distribution of subjects according to type of CSOM

SL NO	TYPE		GIRLS n(%)*	BOYS n(%)*	TOTAL n(%)
1	UNSAFE TYPE	Marginal perforation	1(7.14)	3(13.5)	7(19.5)
		Retraction pocket with cholesteatoma	0	3(13.5)	
2	SAFE TYPE	Central perforation	13(92.86)	16(73)	29(80.5)
	Total N(%)#		14(100)	22(100)	36(100.0)

n(number) , *Column Percentage , #row percentage

Among all the students 80.5% have safe CSOM and 19.5% has unsafe CSOM.

Table 17:- Frequency distribution of different type of Chronic Otitis Media

SL.NO	TYPES OF OTITIS MEDIA	FREQUENCY	PERCENT
1	B/L COM(AAD)	1	2.8
2	B/L COM(TTD)	9	25.0
3	LT COM(AAD)	3	8.3
4	LT COM(TTD)	6	16.7
5	RT COM(AAD)	3	8.3
6	RT COM(TTD)	14	38.9
	Total	36	100.0

Majority of subject who had Chronic Otitis Media 38.9% had RT side TTD type, followed by 25% had bilateral TTD type, 16.7% had Lt side TTD, 8.3% Lt and Rt side AAD type each and only 2.8% had Bilateral AAD type.

Graph 7:- Graph showing Frequency distribution of different type of Chronic Otitis Media

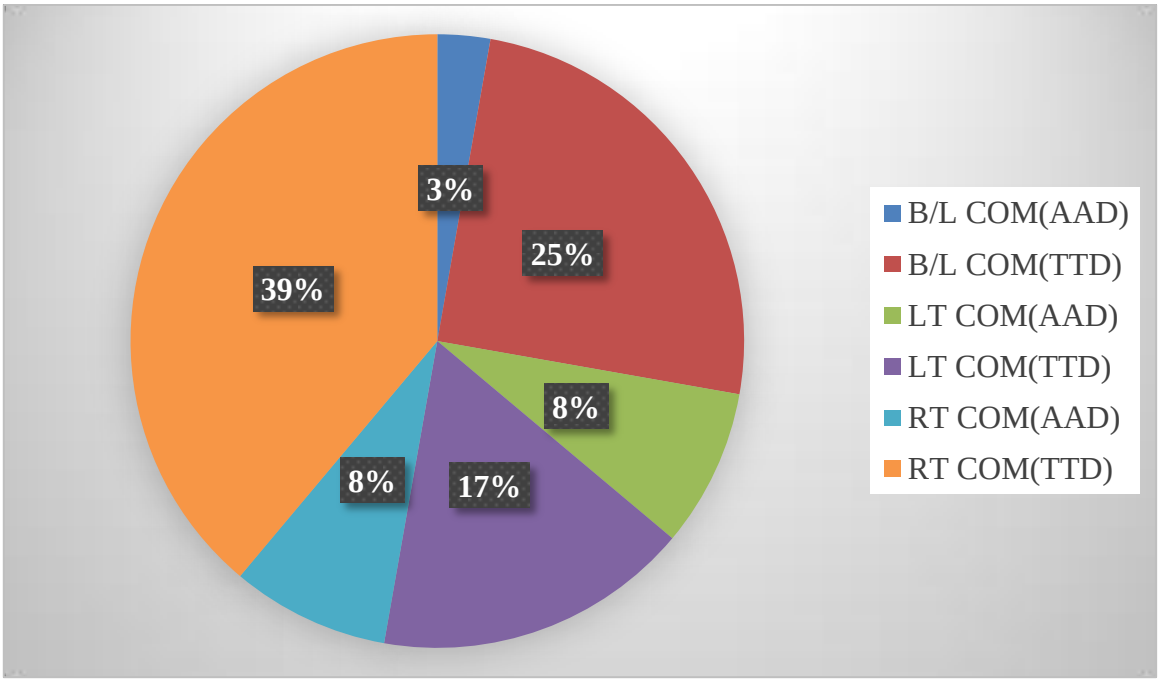

Table 18:- Distribution of subjects according to age group and Chronic Otitis Media.

SL NO	AGE GROUP	COM				TOTAL	P VALUE
		BOYS n(%)*		GIRLS n(%)*			
1	**6-8yrs**	3	13.6	2	14.28	5	0.9
2	**9-11yrs**	11	50	7	50	18	
3	**≥ 12yrs**	8	36.34	5	35.71	13	
	Total N(%)#	22	100	14	100	36	

n(number) , *Column Percentage , #row percentage

50 % of boys who belonged to age group of 9-11 years had Chronic otitis media however this association was not statistically significant.

Table 19:- Distribution of subjects according to sex and Chronic Otitis Media.

SL NO	Sex	COM		Total	
1	Female	14	38.9%	241	39.8%
2	Male	22	61.1%	364	60.2%
	Total	36	100%	605	100%

Majority of subject were 60.2% were male and 39.8% were in female. Majority of subject 61.1% who had Chronic Otitis Media were in Male than and 38.9% of them were female.

Table 20:- Distribution of subjects according to education of father and Chronic Otitis Media

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SL NO	FATHERS EDUCATION	COM PRESENT
1	Did not attend school	10 (27.8%)
2	Primary School	4 (11.1%)
3	Middle	4(11.1%)
4	High School	12(33.3%)
5	Pre University	0(.0)
6	College	6(16.7%)
7	Post Graduation	0(.0%)
	Total	**36**

Around 12(33%) participants father who had completed High school had Chronic Otitis media.

Table 21:- Distribution of subjects according to education of mother and Chronic Otitis Media

SL NO	EDUCATION OF MOTHER	COM		Total	p value
		GIRLS n(%)*	BOYS n(%)*		
1	Did not attend school	11(50)	4(23.58)	15	0.3
2	Primary School	1(4.5)	1(7.14)	2	
3	Middle	1(4.5)	3(21.4)	4	
4	High School	9(40.1)	3(21.4)	12	
5	Pre University	0	1(7.14)	1	

6	College	0	1(7.14)	1	
7	Post Graduation	0	1(7.14)	1	
	Total	**22(100)**	**14(100)**	**36**	

n(number) , *Column Percentage , #row percentage

40.1% of study participants whose mother had completed high schooling had COM among girls however this association was not statically significant.

Table 22:- Distribution of subjects according to occupation of father and Chronic Otitis Media.

SL NO	**OCCUPATION OF FATHER**	**COM**		**Total**	**p value**
		BOYS n(%)*	**GIRLS n(%)***		
1	**Unemployed**	0 (0)	0(0)	0	0.8
2	**Unskilled/semiskilled**	12(57.14)	9(60)	21	
3	**Skilled**	9(42.85)	5(33.3)	14	
4	**Business**	0(0)	0(0)	0	
5	**Professional**	0(0)	1(6.67)	1	
	Total N(%)#	21	15	36	

n(number) , *Column Percentage , #row percentage

57.1% of study participants father who were unskilled were boys having COM however this association between COM and fathers occupation was not statistically significant.

Table 23:- Distribution of subjects according to occupation of mother and Chronic Otitis Media

SL NO	OCCUPATION OF MOTHER	COM	
1	Housewife	23	63.9%
2	Unskilled/semi-skilled	12	33.3%
3	Skilled	1	2.8%
4	Business	0	.0%
5	Professional	0	.0%
	Total	36	100%

Majority of subject who had Chronic Otitis Media mother's occupation 63.9% were housewife followed by unskilled/semiskilled 33.3%, skilled 2.8%.

Table 24:- Distribution of subjects according to birth order and Chronic Otitis Media.

SL NO	BIRTH ORDER	COM		TOTAL	P VALUE
		BOYS n(%)*	GIRLS n(%)*		
1	$1^{st} – 2^{nd}$	16(72.72)	12(85.71)	28	0.3
2	More than 2^{nd}	6(27.28)	2(14.29)	8	
	Total	**22(100)**	**14(100)**		

n(number) , *Column Percentage

72.2 % of boys who had COM belonged to birth order of 1^{st} -2^{nd} however this association between Birth order and COM was not statistically significant.

Table 25:- Distribution of subjects according to type of family and Chronic Otitis Media.

SL NO	TYPE OF FAMILY	COM		TOTAL		P VALUE
		BOYS n(%)*	GIRLS n(%)*			
1	EXTENDED	1(4.55)	0(0)	19	3.1%	0.07
2	JOINT	3(13.64)	7(50)	166	27.4%	
3	NUCLEAR	18(81.81)	7(50)	420	69.4%	
	Total N(%)#	22(100)	14(100)	605	100%	

n(number) , *Column Percentage , #row percentage

81.1% of boys who had COM belonged to nuclear family however there was no statistically significant difference found between type of family and Chronic Otitis Media.

Table 26:- Distribution of subjects according to type of house and Chronic Otitis Media.

SL NO	TYPE OF HOUSE	COM		TOTAL	
		BOYS n(%)*	GIRLS n(%)*		
1	KACHA	0	0	1	.2%
2	PUCCKA	22	14	604	99.8%
	Total N(%)#	22	14	605	100%

n(number) , *Column Percentage , #row percentage

All subject who had Chronic Otitis Media belonged to puccka type of house.

Table 27:- Association between SES and Chronic Otitis Media.

SL NO	SES	COM		Total	p value
		BOYS n(%)*	GIRLS n(%)*		
1	I	1((4.55)	1(7.14)	2	0.8
2	II	1(4.55)	1(7.14)	2	
3	III	9(40.1)	7(50)	16	
4	IV	6(27.28)	4(28.58)	10	
5	V	5(22.72)	1(7.14)	6	
	Total N(%)#	22(100)	14(100)	36	

n(number) , *Column Percentage , #row percentage

40.1% of boys who had COM belonged to Class III modified BG Prasad classification however this association between SES and occurrence of COM had no statistical significance.

Table 28:- Association between exposure to passive smoking and Chronic Otitis Media

SL NO	PASSIVE SMOKING	COM		TOTAL	P VALUE
		BOYS n(%)*	GIRLS n(%)*		
1	NO	15(68.19)	10(71.4)	25	0.83
2	YES	7(31.81)	4(28.6)	11	
	Total N(%)#	22(100)	14(100)	36	

n(number) , *Column Percentage , #row percentage

31.8 % of Boys who had Chronic Otitis Media had history of exposure to passive smoking however there was no statistically significant difference found between passive smoking and Chronic Otitis Media

Table 29:- Association between type of fuel used at home for cooking and Chronic Otitis Media.

SL NO	TYPE OF FUEL	COM		TOTAL	P VALUE
		BOYS n(%)*	GIRLS n(%)*		
1	FIREWOOD	2(9.1)	1(7.14)	3	0.83
2	LPG	20(90.9)	13(92.86)	33	
	Total N(%)#	22(100)	14(100)	36	

n(number) , *Column Percentage , #row percentage

90.9% of boys who had COM used LPG how ever there was no statistically significant difference found between type of fuel used and Chronic Otitis Media.

Table 30: Association between COM and Nasal blockage with Adenoid hypertrophy.

		COM		Total	p value
		positive	Negative		
Nasal Block + Adenoid	Present	32(100%)	0	32	0.001
	Absent	4(0.7%)	569(99.3%)	573	
Total	Count	36	569	605	

Around 32 of those who were found positive for nasal blockage and adenoid hypertrophy had been diagnosed with CSOM and this association was found to be statistically significant.

DISCUSSION

This is a community based study done on 605 school students in and around Kolar district. Which included both government and private schools. This study was conducted to find out the prevalence of chronic suppurative otitis media in and around Kolar among school children aged between 6-13 years.

Among these 605 students 241(39.83%) are girls and 364(60.17%) are boys. 36(6%) out of 605students are positive for CSOM. Among them 14(5.8%) are girls and 22(6 %) are boys. Majority of subjects i.e 50% who had Chronic otitis Media were in 9-11yrs age group, followed by 36.34% who were 12yrs or more and 13.6% of them were in 6-8yrs.

Out of 605 subjects 241(39.83%) girls, 14(5.8%) were found to have CSOM. And out of 364(60.17%) boys, 22(6%) were found to have CSOM. The overall prevalence of Chronic otitis media was 6%, the prevalence was almost same in boys and girls in our study.

This is similar to study done in Aligarh, India from August 2010 to July 2011.It was a cross sectional study in which 630 primary school children are studied in rural and urban areas. Age wise majority of the children were in the age group of 8-10 years (38.5%) followed by 6-8 years (36.4%). Male to female ratio was approximately same (49.9% males vs. 51.1% females). [41]

Low prevalence of CSOM compared to our study was seen in the study done in China and it shows the prevalence of CSOM to be 0.19%[57]. In another study done in Tamil Nadu, India, shows that the prevalence of CSOM was 1.4%.[27] Study done in Maharashtra, India have reported the prevalence of CSOM to be 3.0 %. Study conducted in Saudi Arabia, the prevalence of CSOM was found to be 1.31 %.Of these boys were (44%) and girls were (56%).[58]

In a study conducted at department of Otorhinolaryngology, Muhimbili University College of Health Sciences. 802 primary school children were examined in Dares Salaam, Tanzania, the CSOM prevalence was found to be 2.6 %.[59]The reasons for these variation from our study may be different geographical location with respect to climatic conditions and socio economic status, different age group of the school children studied and different criteria used for diagnosing CSOM.

Various studies have reported the prevalence of CSOM to be much higher than that our study. For instance, in a study conducted by Adhikari P in Nepal, the prevalence of CSOM was reported to be 7.6 %.[44] Study done in Tamil Nadu the prevalence of CSOM was found to be 7.8 %, while study done in Haryana prevalence of CSOM was 15.3 % which is much higher than our study.[60,61]

In our study among the girls who had COM,7(19.4%)students had mild hearing loss,5 (13.8%)had moderate loss, and one (2.77%)had severe hearing loss and one(2.77%) child had no hearing loss. Out of 22 boys 8(22.22%) had mild hearing loss and 5(13.8%) had moderate,4 (11.11%)had severe hearing loss and remaining 5 (13.88%)boys had no hearing loss as per WHO classification.

Study done in Department of Otorhinolaryngology, University of Ilorin,Nigeria invoving 1500 school students. They detected CSOM in 35 children. Among them 52 ears are affected of which 18 (34.6%) had a pure-tone average (PTA) within normal limits, 20 (38.5%) had a mild conductive hearing loss, and 14 (26.9%) had a moderate loss.[62]

In a similar study done in Bareilly (UP), North India in 2016. 495 children were evaluated for hearing loss in these 14 (43.75%) children presented with moderate hearing impairment and 10 (31.25%) has mild hearing impairment.[42]

The literature on prevalence of this disease is sparingly available particularly in recent years. In our study we assessed few risk factors which include age, sex, socioeconomic status (SES), passive smoking, exposure to household smoke, education of mother and father, occupation of father and mother, birth order of the child, and adenoid hypertrophy. And we found that most of the risk factors were not statistically significant. No significant difference was observed in prevalence of CSOM with respect to gender of children. Socioeconomic status (SES) of the children included in our study was also assessed by using Modified BG Prasad's socio-economic classification taking into account per capita monthly income. No significant associated was found between CSOM and SES of children.

Similar results were documented by a Study done in Christian medical college, Vellore, Tamil Nadu where age, sex, SES, parental education and exposure to household smoke were taken as risk factors for CSOM.[27] However this study documented passive smoking as important risk factors for otitis media and this finding doesn't match with our study. Risk of CSOM in passive smokers documented in few studies can be due to transient immobility of cilia and damage to respiratory epithelium by tobacco predisposing them to bacterial infections. Persistent rhinorrhea in chronic smokers may also contribute to CSOM.

In our study about 95(15.7%) children are found to have exposed to passive smoking of their father and only 11(11.57%) of these children who had exposure to passive smoking has CSOM. However statistical analysis did not identify this passive smoking as risk factor.

A Study done in Nigeria[63] also shows no correlation between passive smoking and otitis media which is similar to our study.

Study done in the university of Ibadan, Nigeria, found a positive correlation between CSOM and number of individuals in the family.[63] This could have been due to neglect of the children in large family. However in our study there is no statistical significance association between

CSOM and number of individuals in the family this could have been due to proximity of health care including tertiary hospital care in Kolar region. The fact that our study was conducted on school going children suggest that there was no neglect of health of these children even in large families. Therefore family size did not correlate with CSOM in our study.

In our study majority of the children's father were Unskilled/ Semiskilled laborers(58.3%) while majority of the children's mothers were uneducated(41.6%)/did not have formal school.

Similar to my study a study done in Aligarh, India from August 2010 to July 2011 showed that most of the children's father were Unskilled/ Semiskilled laborers (38.8%) followed by skilled laborers (30.6%) while most of the children's mothers were illiterate (60.2%) followed by just literate/non-formally educated.[41]

In our study most of the children with Chronic suppurative Otitis Media had tubotympanic disease(TTD) 80.5% and 19.5% of these children had Atticoantral disease(AAD). Among TTD 48.27%% had right side disease, followed by 31.05% had bilateral TTD type, 20.68% had left side TTD. Among AAD 42.85% had right side disease and14.30% had bilateral disease and 42.85% had left side disease.

A cross-sectional study done in Bareilly, North India also shows similar findings 81.25% of children with CSOM(TTD) and 18.75% has AAD. [42]

All most all patients who had CSOM were found to have hypertrophied adenoids or history of adenoidectomy for the same. Out of 36 students who are having CSOM 32 students have either adenoid hypertrophy or history of adenoidectomy. In the remaining 569 students 122(21.4%) has history of nasal block. Only children with CSOM were called to hospital for further evaluation (audiometry). In the students with CSOM and nasal block, nasal endoscopy was done and in uncooperative patients xray nasopharynx lateral view was done. These

patients were accompanied by their mother when they came to the hospital for audiometry and majority of mothers were uneducated. Adenoid hypertrophied is a risk factor for otitis media in our study and it is a well know fact documented in literature. This is similar to the study done in Yavatmal city from January 2000 to December 2000 which showed statistically significance association between CSOM and adenoid hypertrophy.[40]

In developing countries like India, ear disease is the major public health concern. In various regions of the country the pattern of ear diseases differ. In children ear diseases are very much influenced by parental education, overcrowding, recurrent respiratory tract infections, socio economic status, allergic rhinitis, snoring and passive smoking. In developing countries WHO suggests that, children should be screened at school entry by using a simple audiometer and the external auditory canal (EAC) should be inspected for any ear discharge this is to know the extent of ear problems in the community.[64]

Inadequate antibiotic treatment, nasal disease, frequent upper respiratory tract infections(URTI) and poor living conditions with poor access to medical care is related to the development of CSOM. Hygiene and nutrition are associated with higher prevalence rates, and improvement in these aspects will help in the prevention of the disease in Indian based pediatric population.

CONCLUSION:

The prevalence of CSOM in our study was found to be high (6%) as per the WHO otitis media expert committee recommendations. CSOM is an important preventable cause of hearing impairment, so this level of prevalence represents a cause of concern. In developing countries like India the incidence is predominantly high in younger children**.** All health-care providers should have a goal to increase awareness about ear diseases. Improvement of health care facilities and awareness among health-care providers would definitely help in decreasing the prevalence of ear diseases in developing countries like India. Students are backbone for our society they have the potential to change the health scenario of the society if properly groomed and educated for healthful living. Prevention of hearing impairment or early diagnosis of ear disorders and treatment of ear diseases is a better and cost effective option compared to rehabilitation.

SUMMARY

Among the five special senses in the human body hearing plays a significant role in the development of an individual. Auditory sense is particularly important sense, as it allows us to communicate with external world. In the developing countries Chronic otitis media(COM) is one of the most common ear diseases.[1] Many patients of chronic otitis media have history of childhood ear discharge .Chronic otitis media also contributes to the hearing impairment which may affect a child's overall growth as it occurs during the age of speech and language development.[2] Identifying the children with COM in young age is important so that the complications can be minimized.[3]In view of its preventable character, the magnitude of the problem needs to be assessed in school going children for early diagnosis and treatment.

Ear problems and decreased hearing are important community health problem among school children especially in developing nations. About 50% of ear diseases occur among the pediatric age group below 15 years and complications are high in this age group.[4] WHO also stated that ear diseases must be considered as public health problems if the prevalence of chronic suppurative otitis media among pediatric age group is more than 4% and recommended the need for appropriate screening programs of school children for early detection of ear diseases and hearing impairment to prevent psycho social consequences.[5].

In India, there is a significant burden of chronic otitis media. Therefore we are performing this observational study in Kolar region. No well designed study has been done to exclusively document the prevalence of CSOM among school children in Kolar. Such data will be beneficial for Ministries of Health and Education. This study may contribute to the National Program for Prevention of Deafness in Kolar to plan an efficient prevention and management strategy.

Screening of 605 school going children in and around Kolar district from December 2016 to June 2018.

Students were examined according to proforma, which were distributed to the children or to the respective class teachers to fill up the primary information in consultation with parents regarding the demographic data of child .

Students were examined with help of otoscope and 512 HZ tuning fork for COM and complete ENT examination.

Students who require further investigations like PTA and treatment is offered at department of ENT , R.L.J.Hospital,Tamaka, Kolar for further evaluation by pure tone audiometry and further treatment.

Students who are having CSOM and nasal block were mobilized to department of ENT , R.L.J.Hospital, Tamaka, Kolar for nasal endoscopy and for the children who are not cooperative X,-ray nasopharynx lateral view was done for adenoid hypertrophy.

In our study we assessed few risk factors which include age, sex, socioeconomic status (SES), passive smoking, exposure to household smoke, education of mother and father, occupation of father and mother and adenoid hypertrophy. And we found that most of the risk factors were not statistically significant. No significant difference was observed in prevalence of CSOM with respect to gender of children. Socioeconomic status (SES) of the children included in our study was also assessed by using Modified BG Prasad's socio-economic classification taking into account per capita monthly income. No significant associated was found between CSOM and SES of children.

All most all patients who had CSOM were found to have hypertrophied adenoids or history of adenoidectomy for the same. Out of 36 students who are having CSOM 32 students have

either adenoid hypertrophy or history of adenoidectomy. In the remaining 569 students 122(21.4%) has history of nasal block. Only children with CSOM were called to hospital for further evaluation (audiometry). In the students with CSOM and nasal block, nasal endoscopy is done and in uncooperative patients x-ray nasopharynx lateral view was done. These patients were accompanied by their mother when they came to the hospital for audiometry and majority of mothers were uneducated. Adenoid hypertrophied is a risk factor for otitis media in our study and it is a well know fact documented in literature. This is similar to the study done in Yavatmal city from January 2000 to December 2000 which showed statistically significance association between CSOM and adenoid hypertrophy.[40]

The prevalence of CSOM in our study was found to be high as per the WHO otitis media expert committee recommendations. CSOM is an important preventable cause of hearing impairment, so this level of prevalence represents a cause of concern.

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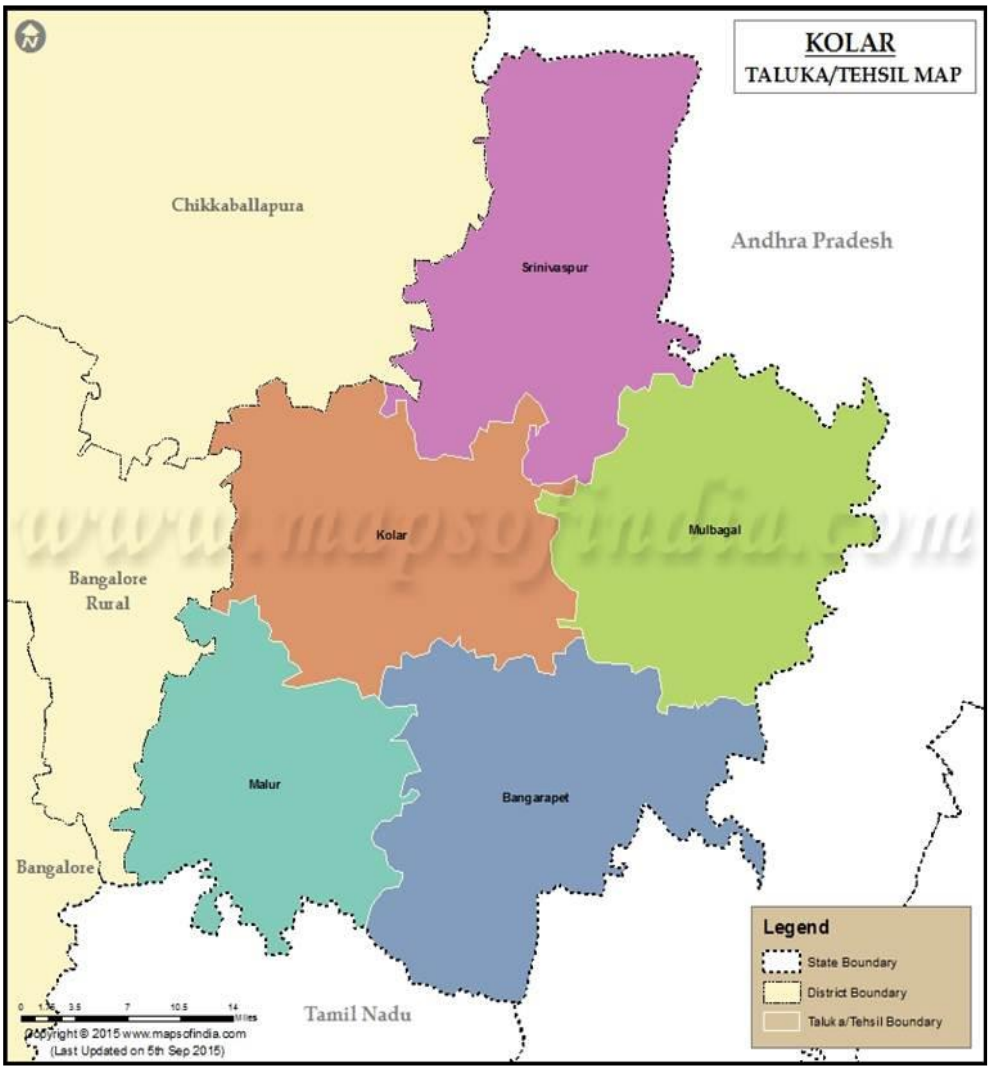
ANNEXURE – I

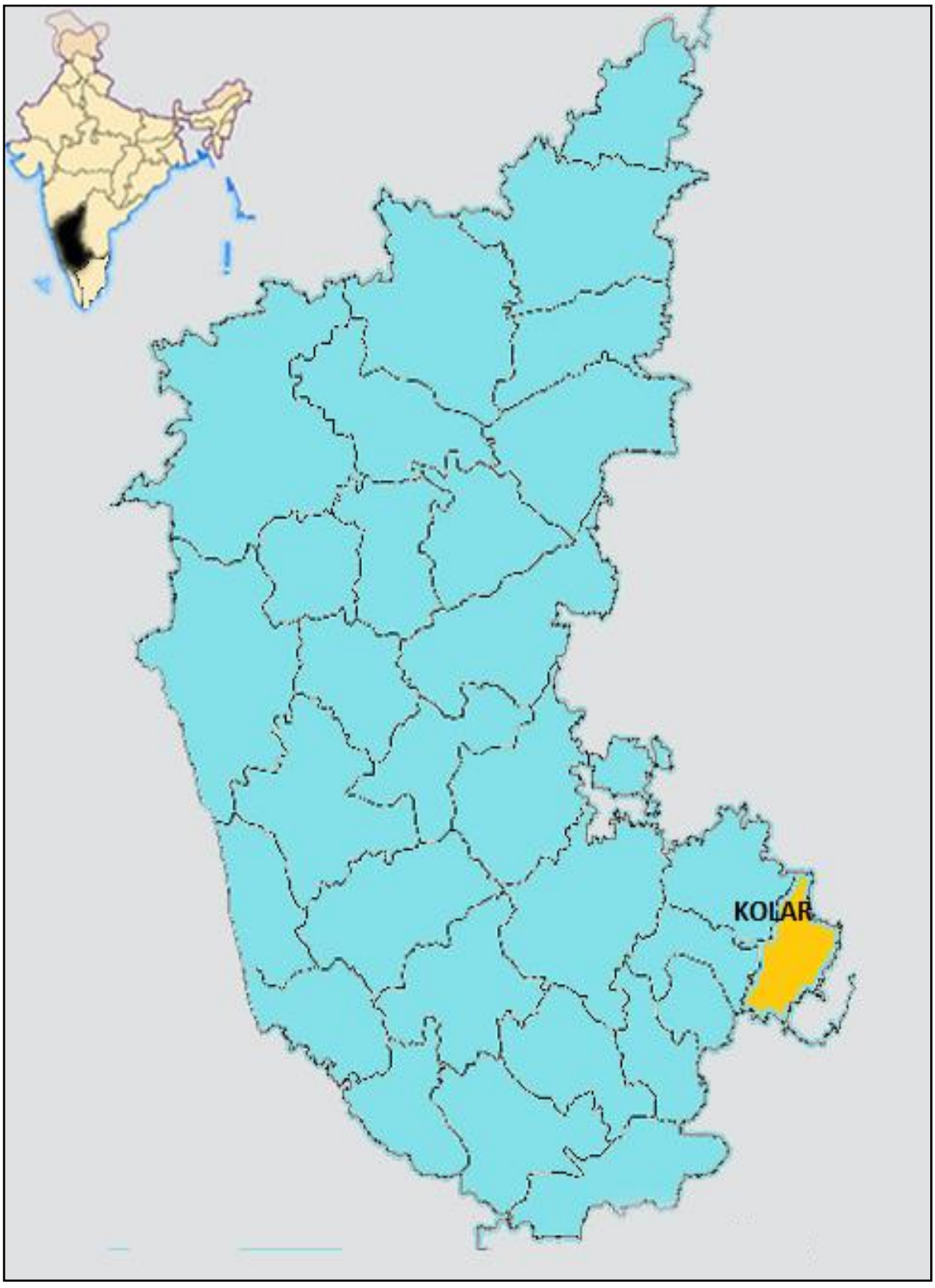
GANTT CHART

STEP	ACTIVITY	TIME PERIOD											
		2016			2017			2018					
		Aug to Nov	Nov	Dec	Jan	Feb to Mar	April to Dec	Jan to June	July to Aug	Aug to Sep	Sep to Oct	Nov to Dec	
1	Topic search and selection												
2	Synopsis submission												
3	Approval by IEC												
4	Proforma Preparation and validation												
5	Pilot project												
6	Review of literature												
7	Data collection												
8	Data analysis												
9	Dissertation writing												
10	Submission of dissertation												

ANNEXURE – II

MAP SHOWING KARNATAKA STATE AND KOLAR DISTRICT IN KARNATAKA




KOLAR

ANNEXURE – III

LIST OF SCHOOLS SELECTED FOR THE STUDY

SL.NO	SCHOOLS	NO OF CHILDREN INCLUDED
1	Government Primary high School, Tamaka	84
2	Government lower primary high school (nundupalli)	18
3	Government Secondary High School (banadahalli cross)	32
4	Government Primary high School(janagata)	36
5	R.L.Jalappa High School	189
6	R.V high school	19
7	janagata(kambodi)	192
8	kataripalya government school	35

ANNEXURE – IV

DEFINITION OF VARIABLES

OPERATIONAL DEFINITIONS

AGE: The age was recorded as stated by the subject and also from the school register.

PER CAPITA INCOME:

Per capita income is total family income divided by family size.

PCI = Total family income/Family members.[107]

TYPE OF FAMILY

Nuclear: One which is composed of the husband, the wife, the minor children and direct dependent.

Joint: Composed of two or more couple and their children, including older persons related to them.

Extended family: Representatives from three generations residing there among the households.[109]

WHO Grading system

Grade 0 or None	25 dB or less	No/slight problem Hears Whispers
Grade 1 or Slight	26 - 40 dB	Hears/ repeat word in normal voice at 1m
Grade 2 or moderate	41 - 60 dB	Hears/ repeat word in raised voice at 1m
Grade 3 or severe	61 - 80 dB	Hears words shouted into the better ear
Grade 4 or profound	81 dB or more	Cannot hear /understand shouted voice

ANNEXURE – V

SOCIO ECONOMIC CLASS BASED ON MODIFIED B.G.PRASAD'SCLASSIFICATION -2018

Calculated as: New income Value =2.86 x(old value x 4.63 x 4.93).

(All India Average Consumer price index for industrial Workers in Jan=2018=286)

CLASS	**OLD CLASSIFICATION 1961**	**FOR Jan 2018**
I	Rs100 & above	Rs 6528 & above
II	Rs50-99	Rs 3264-6527
III	Rs30-49	Rs1959-3263
IV	Rs15-29	Rs 979-1958
V	Rs<15	Rs < 978

PROFORMA

SOCIO DEMOGRAPHIC DATA:

1) NAME 2) AGE: 3) SEX 4) Std:

5) ADRESS OF THE SCHOOL:

6) ADDRESS OF CHILD:

7) PHONE NO:

8) PARENT EDUCATION:

FATHER-uneducated/primary /middle/high school/puc/college/pg

MOTHER-uneducated/primary/ middle/high school/puc/college/pg

9)OCCUPATION OF FATHER:

OCCUPATION OF MOTHER:

10) FAMILY INCOME: total income/monthly

11) SEQUENCE OF ORDER OF CHILD: BIRTH ORDER:-

No of siblings-

12) NO OF PEOPLE LIVING IN A HOUSE:-

13) TYPE OF FAMILY: nuclear/joint/extended

14) TYPE OF HOUSE:-kacha/puccka/kachapuccka

HISTORY AND EXAMINATION:-

15) HISTORY OF ANY EAR DISCHARGE:-Yes/No

	AGE	ONSET	DURATION	AGGRAVATING	RELIVING
RT EAR					
LT EAR					
BOTH					

16) H/O DECREASED HEARING:- YES/NO

SIDE: RT/LT/BOTH

DURATION:

AGE OF ONSET:

17) ASSOCIATED SYMPTOMS: nasal block/ mouth breathing/snoring

18) No of Days of missing school due to ear problem:

19) H/O PARENTAL INDOOR SMOKING: YES/NO

20) COOKING:-

Fuel for cooking/firewood/LPG/cow dung

21) H/O TRAUMA TO EAR:- yes/no

22) PAST HISTORY

ANY SIMILAR /RELATED COMPLAINTS

23) FAMILY HISTORY

HISTORY OF ANY SIMILAR C/O IN FAMILY –yes/no

24)GENERAL PHYSICAL EXAMINATION

HEIGHT WEIGHT:

BUILT: NORMAL/MODERATE/POOR

BMI: Weight(kg)/Height(m^2)

25) ENT EXAMINATION

EXAMINATION OF EAR	RIGHT	LEFT
AURICLE		
PRE AURICULAR REGION		
POST AURICULAR REGION		
EAC		
TM		

26) TUNING FORK TEST

RINNE

WEBER

ABC

FACIAL NERVE

27) THROAT

ORAL CAVITY:

OROPHARYNX:-

28) EXAMINATION OF NOSE:

29) EXAMINATION OF NECK:

30) PROVISIONAL DIAGNOSIS:-

CONSENT FORM

STUDY TITLE: Prevalance of chronic otitis media in school going children in and around Kolar district.

PG GUIDE: DR.K.C PRASAD

PRINCIPAL INVESTIGATOR: DR. PRATHYUSHA KONERU

Name of the subject:

Age :

Address :

I the parent/guardian of _____ agree for the participation in the 'Study of prevalance of chronic otitis media in school going children in and around Kolar district'. I agree for collection of all the information listed by you in the information sheet.

I have been explained about the study in the way I can understand it (both verbally and writing). The child has the liberty to quit the study anytime. I agree for the participation in the study on my own will.

Name and signature

Witness

1.

2.

Chief Researcher/ Guide signature Date:

INFORMATION SHEET

My name is Dr. Prathyusha koneru, Post Graduate in the department of ENT, Sri Devaraj Urs Medical College, and Kolar. We are carrying out a study on prevalance of chronic otitis media in school going children in and around Kolar district. The study has been reviewed by the local ethical review board and will be started only after their formal approval.

Chronic otitis media (COM) is one of the most common ear diseases in the developing countries. Many patients of chronic otitis media have history of childhood ear discharge. Chronic otitis media also contributes to the hearing impairment which may affect a child's overall growth as it occurs during the age of speech and language development. Identifying the children with COM in young age is important so that the complications can be minimised. In view of its preventable character, the magnitude of the problem needs to be assessed in school going children for early diagnosis and treatment.

In this regard, I will ask the child some questions about him/her and the household. honest answer to these questions will help us better understand the health status . We would greatly appreciate your help in responding to this survey. The survey will take about half an hour to ask the questions.

Participation in this study doesn't involve any cost. This study is not only beneficial to the child but also to the community in large. The results gathered from this study will be beneficial to the Government.

All the information collected from the child will be strictly confidential and will not be disclosed to any outsider unless compelled by law. This information collected will be used only for research. The study involves collecting socio demographic information along with clinical examination, and Pure tone audiometry. There is no compulsion to participate in this study. You required to sign only if you voluntarily agree for the child's participation in this study.

Further, he/she are at liberty to withdraw from the study at any time,if you wish to do so. Be assured that the withdrawal will not affect the treatment by the concerned physician in any way. It is up to you to decide whether to permit for participation. This document will be stored in the safe locker in the department of ent in the College and a copy is given to you for information.

For any further clarification you are free to contact the Principal investigator Dr. Prathyusha.k; E mail: prathyukoneru5@gmail.com; Mobile No: 9493487388.