"A ONE YEAR COMPARATIVE STUDY TO EVALUATE THE ASSOCIATION OF IRON DEFICIENCY ANEMIA IN CHILDREN WITH CSOM AND WITHOUT CSOM"

By

REGISTRATION NO: BE0121010

Dissertation

Submitted to

KLE Academy of Higher Education and Research,
Belagavi, Karnataka

In partial fulfilment
of the requirements for the degree of

MASTER OF SURGERY

IN

OTORHINOLARYNGOLOGY AND HEAD AND NECK SURGERY

DEPARTMENT OF OTORHINOLARYNGOLOGY AND HEAD AND NECK SURGERY,
JAWAHARLAL NEHRU MEDICAL COLLEGE,
BELAGAVI, KARNATAKA

DECEMBER-2024 / JANUARY -2025

KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH BELAGAVI, KARNATAKA

ENDORSEMENT BY THE HOD, PRINCIPAL/ HEAD OF THE INSTITUTION

This is to certify that the dissertation entitled **"A ONE YEAR COMPARATIVE STUDY TO EVALUATE THE ASSOCIATION OF IRON DEFICIENCY ANEMIA IN CHILDREN WITH CSOM AND WITHOUT CSOM"** is a bonafide research work done by **REGISTRATION NO: BE0121010.**

Dr. RAJENDRA B. METGUDMATH
MS (ENT & HNS), Fellowship In Head and Neck Surgery
Department of Otorhinolaryngology
and Head & Neck Surgery,
KAHER's J.N.Medical College,
Nehru Nagar, Belagavi -590010

Date: 28/06/2024
Place: Belagavi

Dr. (Mrs)N. S. MAHANTASHETTI M.D(Peads)
Principal
KAHER's J.N.Medical College,
Nehru Nagar, Belagavi -590010

PRINCIPAL
J.N. Medical College,
BELAGAVI- 590 010

Date: 29/06/2024
Place: Belagavi

UNDERTAKING

I, **Reg.No.BE0121010,** hereby declare that the information and the data mentioned in my dissertation entitled **"A ONE YEAR COMPARATIVE STUDY TO EVALUATE THE ASSOCIATION OF IRON DEFICIENCY ANEMIA IN CHILDREN WITH CSOM AND WITHOUT CSOM"** belongs to me and is original. I am aware of the definition of plagiarism as detailed below:

- An act or instance of using or closely imitating the language and thoughts of another author without authorization and the representation of that author's work as one's own, as by not crediting the original author.
- A piece of writing or other work reflecting such unauthorized use or imitation.
- The deliberate or reckless representation of another's words, thoughts or ideas as one's own without attribution in connection with submission of academic work, whether graded or otherwise.

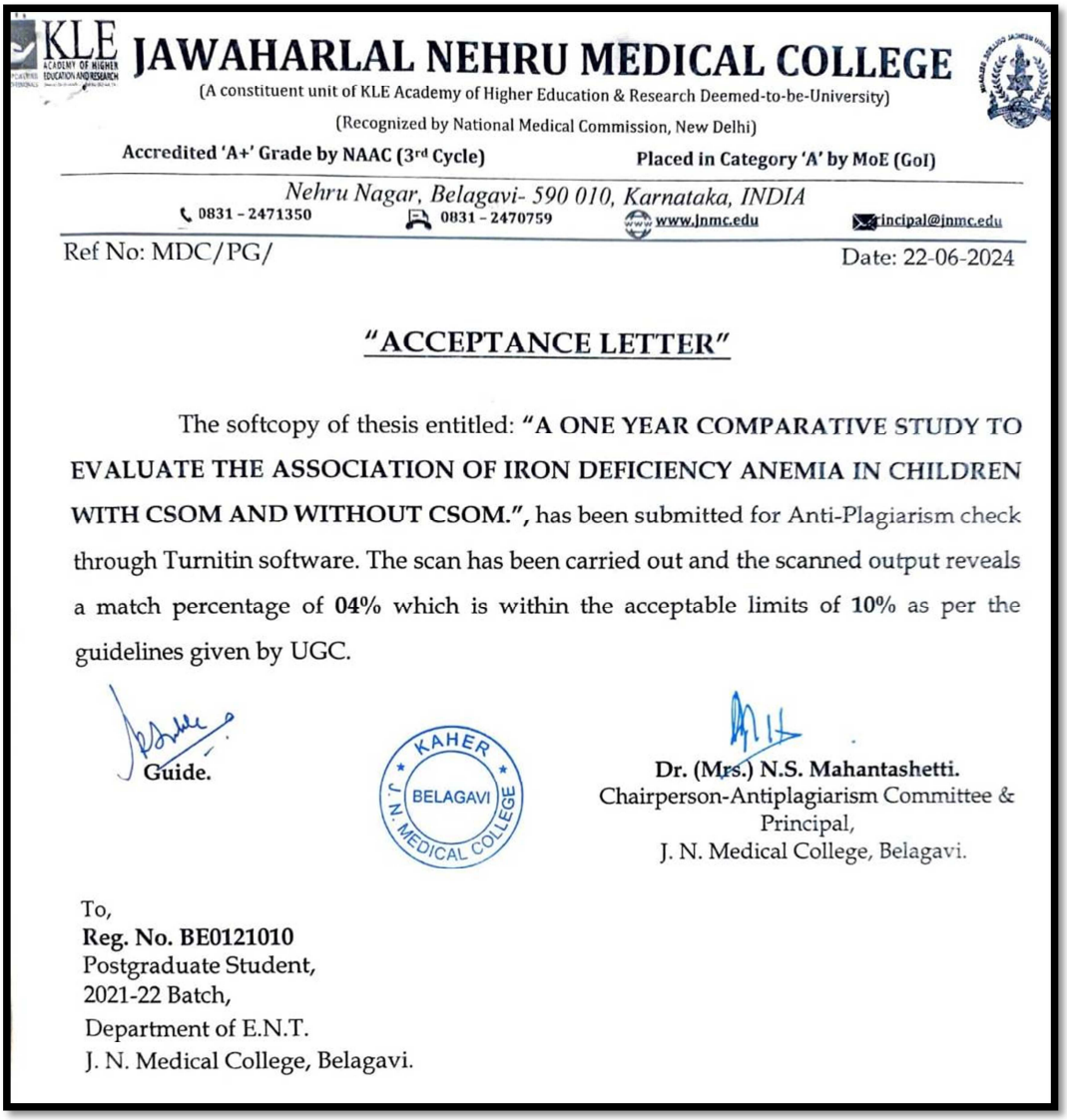
I hereby declare that the dissertation prepared by me is original one and does not involve plagiarism anywhere. In case at a later stage, it is found that I have indulged in plagiarism, then I am solely responsible for the same and the institution is at liberty to take any disciplinary action against me including cancellation of dissertation or any other penalties imposed by the University.

Date: 28/6/24

Place: Belagavi

REG. NO: BE0121010

PLAGIARISM CERTIFICATE



KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH

JAWAHARLAL NEHRU MEDICAL COLLEGE

(A constituent unit of KLE Academy of Higher Education & Research Deemed-to-be-University)

(Recognized by National Medical Commission, New Delhi)

Accredited 'A+' Grade by NAAC (3rd Cycle) **Placed in Category 'A' by MoE (GoI)**

Nehru Nagar, Belagavi- 590 010, Karnataka, INDIA

0831 - 2471350 0831 - 2470759 www.jnmc.edu principal@jnmc.edu

Ref No: MDC/PG/ Date: 22-06-2024

"ACCEPTANCE LETTER"

The softcopy of thesis entitled: **"A ONE YEAR COMPARATIVE STUDY TO EVALUATE THE ASSOCIATION OF IRON DEFICIENCY ANEMIA IN CHILDREN WITH CSOM AND WITHOUT CSOM."**, has been submitted for Anti-Plagiarism check through Turnitin software. The scan has been carried out and the scanned output reveals a match percentage of **04%** which is within the acceptable limits of **10%** as per the guidelines given by UGC.

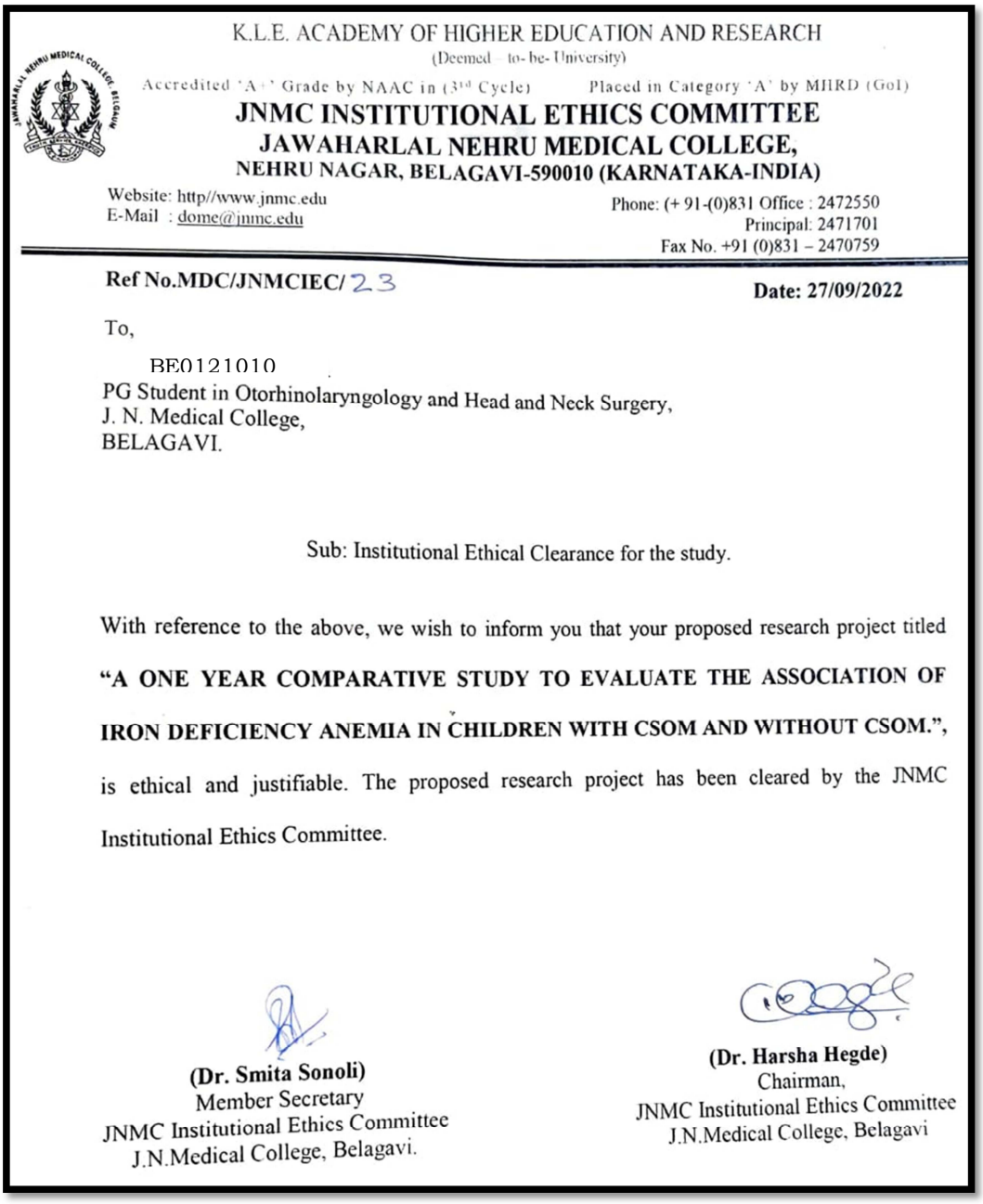
Guide.

KAHER BELAGAVI J.N. MEDICAL COLLEGE

Dr. (Mrs.) N.S. Mahantashetti.
Chairperson-Antiplagiarism Committee &
Principal,
J. N. Medical College, Belagavi.

To,
Reg. No. BE0121010
Postgraduate Student,
2021-22 Batch,
Department of E.N.T.
J. N. Medical College, Belagavi.

ETHICAL CLEARANCE LETTER



K.L.E. ACADEMY OF HIGHER EDUCATION AND RESEARCH
(Deemed – to-be- University)
Accredited 'A+' Grade by NAAC in (3rd Cycle) Placed in Category 'A' by MHRD (GoI)

JNMC INSTITUTIONAL ETHICS COMMITTEE
JAWAHARLAL NEHRU MEDICAL COLLEGE,
NEHRU NAGAR, BELAGAVI-590010 (KARNATAKA-INDIA)

Website: http//www.jnmc.edu
E-Mail : dome@jnmc.edu

Phone: (+ 91-(0)831 Office : 2472550
Principal: 2471701
Fax No. +91 (0)831 – 2470759

Ref No.MDC/JNMCIEC/ 23 **Date: 27/09/2022**

To,

BE0121010
PG Student in Otorhinolaryngology and Head and Neck Surgery,
J. N. Medical College,
BELAGAVI.

Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled **"A ONE YEAR COMPARATIVE STUDY TO EVALUATE THE ASSOCIATION OF IRON DEFICIENCY ANEMIA IN CHILDREN WITH CSOM AND WITHOUT CSOM."**, is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee.

(Dr. Smita Sonoli)
Member Secretary
JNMC Institutional Ethics Committee
J.N.Medical College, Belagavi.

(Dr. Harsha Hegde)
Chairman,
JNMC Institutional Ethics Committee
J.N.Medical College, Belagavi

ABSTRACT

Context: Iron deficiency is a prevalent condition in India's pediatric population. It affects the immune system, cognitive and motor development, and increases susceptibility to infections. Chronic Otitis Media is a common childhood disease in the pediatric population. CSOM is influenced by factors like poor immunity. The study investigates potential associations between iron deficiency and CSOM, examining whether they occur simultaneously or if those with iron deficiency anemia are prone to develop CSOM.

Objective: To evaluate the association between iron deficiency anemia and chronic otitis media in children.

Material and Methods: The study included 40 children aged between 5-18 years. They were divided into two groups consisting of 20 children each. The first group were the children with CSOM and second group without CSOM on inspection. All the children were examined for Iron deficiency anemia by checking Hemoglobin and serum iron profile and the results were compared.

Statistical analysis: Comparative analysis between case and control groups using a chi-square test or fisher extract test and independence *t*-test. Statistical analysis was performed with SPSS 24.0 software. The correlation was considered as significant statistically if p-value < 0.05.

Results: In our study, among the 20 children in CSOM group, the Hb was similar to the children in non CSOM group. The serum iron levels, serum ferritin levels, serum transferrin percentages were reduced in CSOM group compared to non CSOM group and TIBC was increased in CSOM group

Conclusion: In conclusion, based on the results, Iron deficiency anemia is a possible risk factor for CSOM.

Keywords: COM, Iron deficiency anemia, Ferritin,

LIST OF ABBREVIATIONS

GLOSSARY	ABBREVIATIONS
CSOM	CHRONIC SUPPURATIVE OTITIS MEDIA
ET	EUSTACHIAN TUBE
COME	CHRONIC OTITIS MEDIA WITH EFFUSION
OM	OTITIS MEDIA
COM	CHRONIC OTITIS MEDIA
URTI	UPPER RESPIRATORY TRACT INFECTIONS
TM	TYMPANIC MEMBRANE
IL	INTERLEUKIN
RANK	RECEPTOR ACTIVATOR OF NUCLEAR FACTOR KAPPA BETA
HIF	HYPOXIA INDUCIBLE FACTOR
VEGF	VASCULAR ENDOTHELIAL GROWTH FACTOR
Fe^{+3}	FERRIC ION
TIBC	TOTAL IRON BINDING CAPACITY
TLR	TOLL LIKE RECEPTOR
IDA	IRON DEFICIENCY ANEMIA

TABLE OF CONTENTS

LIST OF TABLES

LIST OF GRAPHS

LIST OF PHOTOGRAPHS

LIST OF FIGURES

INTRODUCTION

Iron deficiency is the most common condition that affects the pediatric population in India with prevalence rate of up to 76.3%[1]. Iron plays an important factor in the development of immune system as well as child's cognitive and motor development. Iron deficiency causes reduced immunity and increased susceptibility to infections[2].

Iron plays a crucial function in immunity, it promotes the growth of immune cells, especially lymphocytes, which are involved in the production of a specific response to infection[3].

It is necessary for the differentiation of monocytes from macrophages. It is also needed by macrophages to carry out crucial antimicrobial effector processes, such as the NADPH-dependent oxidative burst[3].

Cytokines mediate significant alterations in iron metabolism induced by infection or inflammation. When determining an individual's iron status, it is essential to consider the impact of infection and inflammation on iron metabolism.[4]

Chronic Otitis Media is one of the most common diseases in childhood. It affects approximately 7-8% of children in India [1]. Definition of CSOM is "inflammation of the mucoperiosteal lining of the tympanomastoid compartment with persistent ear discharge through existing perforation of the tympanic membrane"[2].

It is a condition that is influenced by numerous variables which include poor immunity, recurrent upper respiratory tract infections, eustachian tube dysfunction etc.,[2].

Given the prevalence of both conditions in our nation and their occurrence within a comparable range of socioeconomic strata, we have endeavored to explore potential associations between the two entities.

The question of whether they occur simultaneously in a comparable group of patients or whether those with iron deficiency anemia, more likely to develop CSOM is investigated.

OBJECTIVE

To know the association between iron deficiency anemia and chronic otitis media in children.

REVIEW OF LITERATURE

Anatomy:

The term "middle ear cleft" refers to the region of the middle ear along with the Eustachian tube, aditus, antrum, and mastoid cells[7]. It is an air filled with cavity and it is lined by non-keratinized stratified squamous epithelium majorly. The anterior and inferior portions are lined by mucociliary epithelium with goblet cells[8].

The tympanic cavity is present within the temporal bone and is divided into three parts: epitympanum, mesotympanum and hypotympanum. Epitympanum is the region lying above the pars tensa and medial to pars flaccida, Mesotympanum is the region medial to pars tensa and hypotympanum is the region below the level of pars tensa[9].

The middle ear communicates anteriorly to the nasopharynx via the eustachian tube, posteriorly with the mastoid cavity through the aditus[8]. They enable gaseous exchange and pressure equalization as ET and Mastoid air cell system are interconnected. [7,8]

The eustachian tube runs laterally, superiorly, and posteriorly from the nasopharynx to the tympanic cavity. It is 36mm long in adults, however, it is much shorter, wider, and horizontal in children[9].

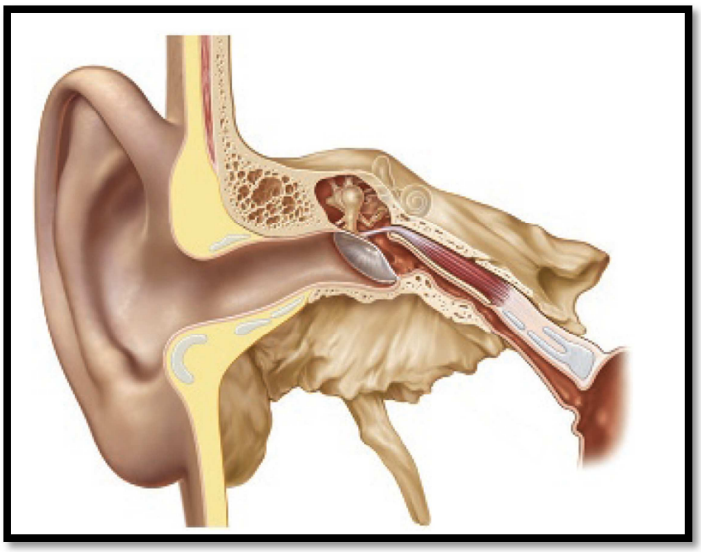


Figure 1: Middle ear cleft and Eustachian tube

The anteromedial section of the tube comprises of cartilage and connective tissue, whereas the lateral third is made of bone.

Respiratory epithelium, comprising goblet cells, basal cells, and ciliated and non-ciliated cells, lines the ET lumen. The area adjacent to the pharyngeal aperture and along the inferior portion of the tube has the largest number of ciliated and goblet cells[10].

The eustachian tube is generally closed, but it opens when the tensor and levator palatini contract, unless a congenital condition such as cleft palate is present. [9,10,11]

Tensor veli palatini while contracting, seen in swallowing or yawning, regulates the middle ear pressure. As a result, the ET can open, allowing passive air exchange between the nasopharynx and middle ear.[10]

Based on the pressure differential between the middle ear and the atmosphere, intermittent airflow occurs about every 1-2 minutes, lasting around 0.2 seconds in both directions[9].

As eustachian tube is shorter, wider and more horizontal in children, infection from nasal cavity spreads easily into the middle ear through the short eustachian tube and hinders middle ear ventilation.

CHRONIC SUPPURATIVE OTITIS MEDIA.

Chronic suppurative otitis media, defined as persistent inflammation of the mastoid cavity and middle ear, presenting as recurrent ear discharge via a perforated tympanic membrane. [12]

Childhood episodes of acute otitis media or otitis media with effusion are frequently precursors of COM. Anatomical, physiological, and environmental variables, together with modified host defense mechanisms, increase the susceptibility to infection. [12,13]

The infective agents could be either viral or bacterial or both. Frequent episodes of URTI lead to altered function of the Eustachian Tube, carrying the infection to the middle ear.

The negative middle ear pressure facilitates the movement of micro-organisms through the eustachian tube. [12]

Shorter and horizontal eustachian tube also helps in carrying the infections more easily in children. The infection may also occur through the perforation or through the grommet. [13]

The risk factors contributing to the chronic otitis media include genetic predisposition and defective or lowered immunity. Environmental factors like low socioeconomic status, poor physical and surroundings' hygiene, and chronic malnutrition also contribute to lessening the immunity. [12]

COM in children can be either with cholesteatoma or without cholesteatoma.

COM without cholesteatoma or otherwise called mucosal disease presents with tympanic membrane changes like perforation of the TM, tympanosclerosis, thinning or atrophy of the drum, ossicular erosion or fixation.

Mucosal COM can be inactive or active. Inactive COM is called so, when there is permanent perforation of the tympanic membrane but there is no inflammation of the mucosa of middle ear and mastoid. [12]

During active COM, there is a persistent inflammatory response involving lymphocytes, plasma cells, and histiocytes in middle ear and mastoid mucosa, as well as variable degrees of oedema, submucosal fibrosis, and hypervascularity. There is also increase in number of goblet cells and basal cell hyperplasia in the middle ear epithelium.

Active COM erodes the ossicular chain. Typically, the afflicted ossicles have areas of hyperemia with capillary growth and significant granulation tissue. Osteoclast action is responsible for bone resorption or destruction. Numerous proteins and chemicals involved in bone remodeling, including receptor activator NF-kB (RANK) and RANK ligand (RANKL), are expressed in COM and have the ability to activate osteoclasts. on the other hand, osteoprotegerin functions as an antagonist to RANKL. An important anti-inflammatory cytokine, IL-10 prevents the generation of TNF-α, IL-1, IL-6, and IL-8 in addition to suppressing macrophages and neutrophils' generation of oxygen radicals.[12]

It was also found that hypoxia signaling pathways were upregulated in invitro studies done on mice, which showed both hypoxia and hypoxia inducible factor (HIF).

HIF signaling is controlled at two levels: transcriptionally through interactions with nuclear factor kappa-light chain-enhancer of activated B cells (NF-kB), and translationally through cytokines, which are glycoproteins produced by epithelial and inflammatory cells.[14]

Examples of these glycoproteins are interleukin-1 (IL-1β) and tumor necrosis factor alpha (TNFA), which trigger the acute phase of the inflammatory response and releases additional cytokines.[15]

Both TNF-α and IL-1β work in tandem to activate neutrophils, promote fibroblast proliferation, and stimulate prostaglandin and leukotrienes. In addition to this, NF-kB can also be induced by other factors as well, such as bacterial lipopolysaccharides, viral pathogens, and growth factors.[15]

In another human study, it was reported that hypoxia signaling pathways and VEGF were significantly upregulated in patients with COME, which is a precursor of COM.[12]

Multiple animal models of otitis media have demonstrated increased hypoxia signaling within the bulla. These models include genetic mouse models of COME such as Fbxo11Jf/+, MecomJbo/+, Tgif−/−, Nischarin edsn/edsn, and EdaTa. Additionally, experiments inducing otitis media by cauterizing the Eustachian tube in rats or by injecting non-typeable Haemophilus influenzae in intrabullar region in mice, as well as the introduction of gastric content into rabbits, have all shown heightened hypoxia signaling. These diverse animal models provide valuable insights into the mechanisms underlying otitis media and highlight the significance of hypoxia signaling in its pathogenesis.[16]

This emphasizes how hypoxia and inflammation are commonly associated independent of the OM's onset cause, the length of the inflammation, the effusion's phenotype, or species-specific variations.

Hypoxia promotes angiogenesis, vascular permeability, and neutrophil recruitment by activating VEGF. It also drives inflammation through the activation of NF-kB, IL-1β, and TNF-α [17]

The initiation and subsequent chronicity of OM are strongly correlated with the recruitment of inflammatory cells, including neutrophils, mast cells, lymphocytes, plasma cells, and monocytes/macrophages.[14]

TNF-α and IL-8, among other cytokines, also cause the middle ear to upregulate the mucin genes, and the changed viscosity hinders mucociliary clearance. Nitric oxide enhances the formation of mucin, and both TNF-alpha and IL-8 can raise the enzyme inducible nitric oxide synthase (iNOS) in the middle ear mucosa.[12]

The most common organisms responsible for the disease are Pseudomonas aeruginosa and staphylococcus aureus. Klebsiella, Proteus, Escherichia coli, Bacteroides fragilis, Prevotella, Candida, and Aspergillus were among the other aerobic isolates often found. As per the latest studies in Indian population.[18]

Iron is the most essential element required by the body. Nearly all living cells need iron for a variety of metabolic processes, such as the metabolism of proteins, lipids, carbohydrates, and amino acids, as well as cell division. [1,19]

Iron deficiency anemia is most commonly seen during the rapid growth years. There is an increased demand during the first years of life and when the demand is not

met, it leads to deficiency. Other causes which can lead to deficiency include inadequate iron intake through diet, or due to pathological blood loss.[20]

Iron present in diet is in Ferric (Fe^{+3}) form. once it reaches the stomach, it is converted to Ferrous (Fe^{+2}) form by the action of Hydrochloric acid. Gastric secretions dissolve the iron, so that it can form soluble complexes with ascorbic acid which helps in better absorption. [20,21]

The enzyme Ferric reductase, which is present in brush border of duodenum, converts the ferric (Fe^{+3}) to ferrous (Fe^{+2}) form. These ferrous ions are then absorbed into enterocytes via Divalent Metal Transporter 1 (DMT1).[20,21]

The heme is also absorbed into the enterocytes by transporter protein. In the enterocytes, the ferrous ions are separated from the porphyrin by Heme oxygenase, which is transported out of enterocytes to enter the blood with the help of ferroprotein.[21,22]

In the blood, it binds with transferrin in the ferric form. Some of the ferrous ions in the enterocytes bind with apoferritin protein to form ferritin which is the storage form of the iron. [20,22]

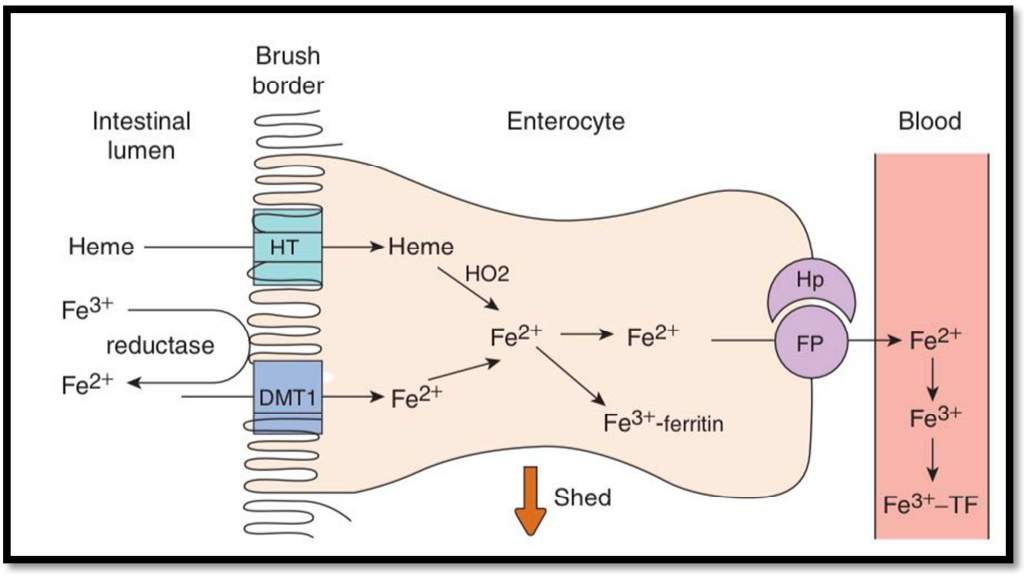


Figure2: Transport of Iron in Blood

(TIBC) is an indirect measure of iron stores. Greater the total iron binding capacity, less is the stored iron value and the readiness of the iron ions to attach to the transferrin.

Hepcidin, originating from the liver, serves as the principal hormone governing systemic iron metabolism. It exerts its regulatory function on ferroportin, the exclusive exporter of cellular iron situated at the enterocytes' basolateral membrane. The pivotal role of hepcidin lies in its ability to modulate iron secretion into the circulation by the intestinal epithelium.This regulation occurs through the binding of hepcidin to ferroportin, which initiates a cascade leading to the internalization, ubiquitination, and subsequent breakdown of ferroportin. Through this intricate mechanism, hepcidin ensures the maintenance of iron balance within the body, preventing both excessive iron accumulation and deficiency. [20,21,22]

To determine the iron deficiency anemia, four parameters are measured. Serum iron levels, serum ferritin levels, percentage of transferrin saturation and total iron binding capacity.

IRON AND IMMUNITY.

In innate immunity, iron is crucial. It is a significant part of the enzymes that produce peroxide and nitrous oxide, which are essential for the healthy enzymatic operation of immune cells. It also plays a role in the development of cell-mediated immunity and the control of cytokine synthesis and activity.[23]

Iron regulates the activity of transcription factors and enzymes, which in turn produces antimicrobial effectors including hydroxyl (OH) and nitric oxide (NO) radicals. This fine-tunes the function of myeloid cells in innate immunity. Iron is a crucial growth component in the adaptive immune system that promotes the clonal expansion of certain subsets of lymphocytes.[24]

Deficiency in the iron levels may lead to

a) Decreased myeloperoxidase (MPO) activity and reduced neutrophil function.
b) Impaired bactericidal activity
c) Thymic atrophy-associated reduction in T-lymphocyte counts
d) Improper T lymphocyte-induced proliferative response
e) Reduced activity of natural killer cells
f) Reduced lymphocyte production of interleukin 2
g) Decreased synthesis of the inhibitor of macrophage migration[25]

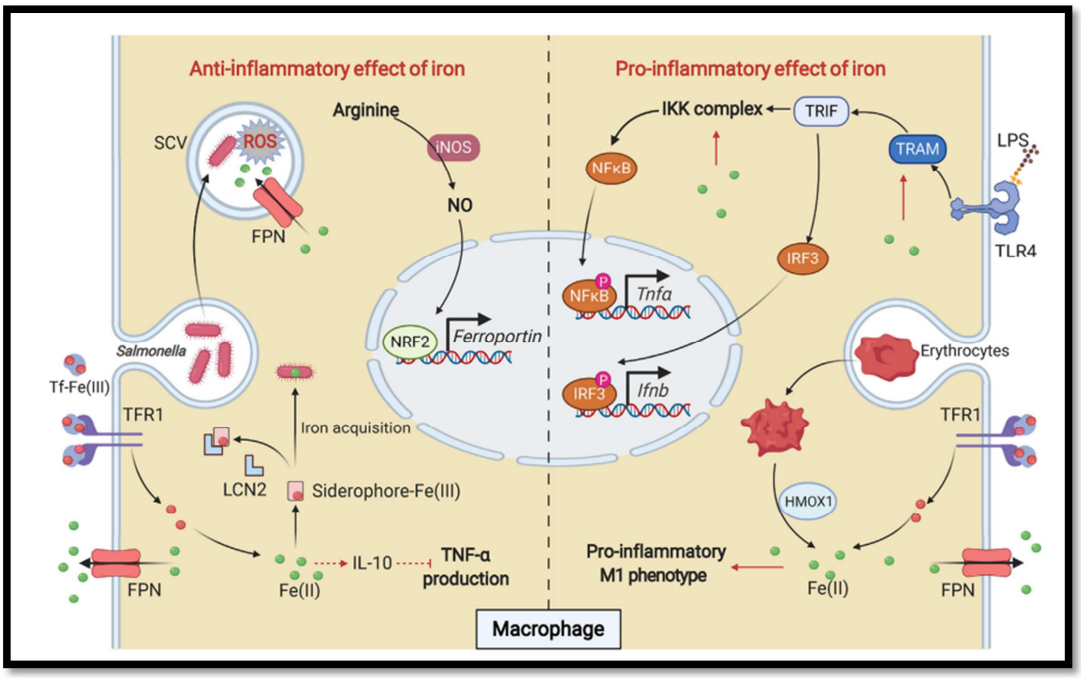


Figure3: Inflammatory action of Iron

Nuclear factor kappa B (NFKB) activation and Toll-like receptor 4 (TLR4) lack of expression are the causes of the decreased cytokine release. Since the absence of the HFE gene is typically linked to the overexpression of ferroportin-1, which raises iron efflux and causes iron depletion in macrophages, the decreased production of cytokines may be directly related to iron deficiency.[24,26]

TLR4 binds to LPS in macrophages and dendritic cells, and when LPS and TLR4 interact, cytokine gene and protein expression is increased, frequently through NFKB activation. Lower expression levels of Toll-like receptor 4 (TLR4) in rodents result in a decline in splenic natural killer (NK) cell cytotoxicity, accompanied by a reduction in the plasma concentrations of IL-12, IL-23, and IL-17. This decrease in TLR4 expression potentially heightens the susceptibility to infections by compromising the immune response, specifically the function of NK cells and the production of key cytokines involved in immune regulation.[25,26,27]

METHODS AND METHODOLOGY

Study design: A hospital based one-year comparative study.

Study period: September 2022- August 2023

Sample Size: 40

Sample size formula:

The minimum sample size formula based on mean and standard deviation is

$$n = \frac{(z_\alpha + z_\beta)^2 (s_1^2 + s_2^2)}{(\bar{X}_1 - \bar{X}_2)^2}$$

where zα is linked with the level of significance and zβ is linked with the power of the test. For 5% level of the significance zα =1.96 and zβ =0.84 for 8o% power of the test.

The parameter considered in the calculation is serum iron level. is the mean of the first group (75.02) and is the mean of the second group (115.24).

s1 is the standard deviation of the first group (26.14) and s2 is the standard deviation of the second group (35.25).

With these values the sample size obtained is 9.

To make the study more confirmative the sample size will be raised to 20.

There will be two groups with 20 cases in each group.

Study population: Patients aged between 5-18 years who presented to the OPD with complaints of ear discharge, who were ready to get serum iron profiling done along with complete blood picture.

Sampling Procedure: After getting informed consent from the parent/guardian, thorough history and clinical examination was done. All patients who had a history of ear discharge for more than 6 weeks were considered for the study. The serum iron profiling consisting of Serum Fe levels, serum ferritin levels, TIBC and transferrin saturation in percentage was done. Complete blood picture including peripheral smear was ordered to know the total hemoglobin levels and morphological status of the blood cell indices.

Inclusion criteria:

Individuals between the ages of five and eighteen

All cases of CSOM with more than 6 weeks history of ear discharge.

Patients who are willing to give written and informed consent to undergo serum iron profiling and complete blood picture.

Exclusion criteria:

- Children under 5 years of age.
- Children who are on iron supplementation.
- Children who have a history of chronic malnutrition.
- Children who have craniofacial abnormalities, allergic rhinitis, and other hematological disorders.
- Children whose parents/guardians did not give consent to the study.

Study method: After confirming the diagnosis by clinical history and thorough ear examination, serum iron profiling and complete blood picture was done. The levels of hemoglobin, serum Fe, serum ferritin, TIBC, Serum transferrin saturation was recorded in both the groups and results were compared.

Data Analysis: All the samples were analysed using **SPSS** software.

Chi square test was used for analysis of age, gender and side of the disease

Unpaired t test was used for analysis of Haemoglobin, Serum Iron levels, Serum Ferritin levels, serum transferrin percentage and TIBC levels.

RESULTS

A total of 40 samples were analyzed. 20 cases of CSOM and 20 cases of non CSOM were considered. All patients who presented to the OPD of Department of Otorhinolaryngology and Head & Neck surgery, at Jawaharlal Nehru Medical College, KAHER.

All results are studied and described under following headings:

Age and Sex Distribution:

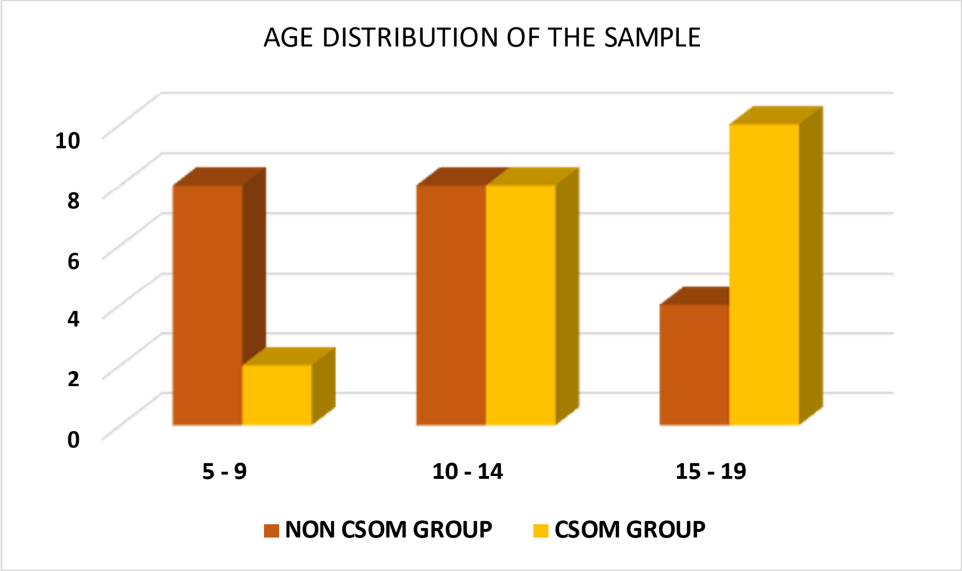
Out of a total of 20 cases of CSOM, the distribution of data by age group looked like this:

Two patients were identified in the age range of 5-9 years, eight cases were observed within the age bracket of 10-14 years, and the remaining ten cases were reported among individuals aged 15-19 years. This distribution provides insight into the prevalence of CSOM across various age demographics, indicating a notable representation of cases in the adolescent age range, followed by those in the late childhood and early teenage years.

In 20 non CSOM cases, 8 patients were within the age bracket of 5-9 years, 8 were within the age bracket of

10-14, and 4 in the age group of 15-19 years.

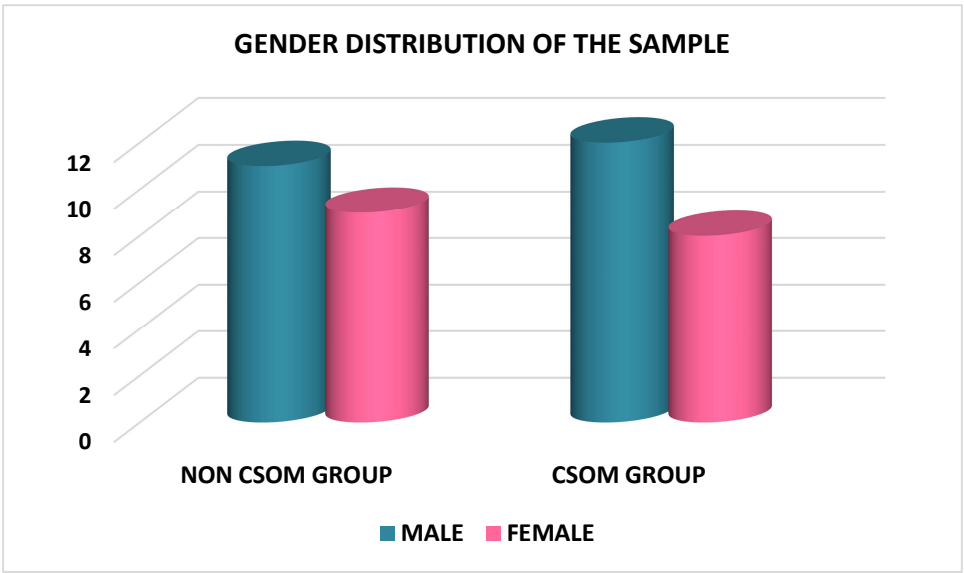
GRAPH 1:



Out of 20 CSOM cases 9 (45%) cases showed right sided CSOM, 6 (30%) cases showed left sided CSOM and 5 (25%) showed bilateral CSOM.

The CSOM cases had more males than females. out of 20 CSOM cases 12 were males and 8 were females. Likewise, in Non CSOM group, there were 11 males and 9 females.

GRAPH 2:



In all the patients, Hemoglobin was measured, and the results were as following:

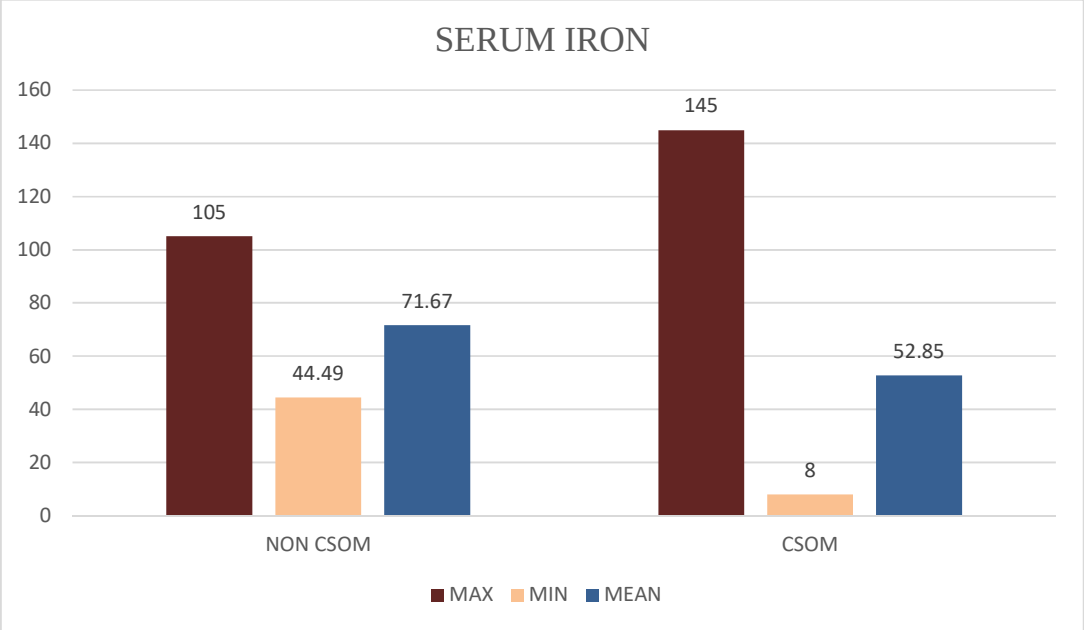
The mean Hb in Non CSOM group was 12.01 ± 1.73. The mean Hb in CSOM group was 12.51 ± 1.60.

The minimum serum iron levels noted in the CSOM group was 8 mcg/dl and maximum were 145 mcg/dl with mean levels of 52.85 ± 32.26.

TABLE 1: S.IRON LEVELS OF THE SAMPLE

S. IRON (mcg/dl)							
NON CSOM				CSOM			
MEAN	S.D.	MIN	MAX	MEAN	S.D.	MIN	MAX
71.67	18.94	44.49	105	52.85	32.26	8	145

GRAPH 3:



In the non CSOM group the minimum levels were 44.49 mcg/dl maximum was 105 mcg/dl with mean levels at 71.67 ± 18.94.

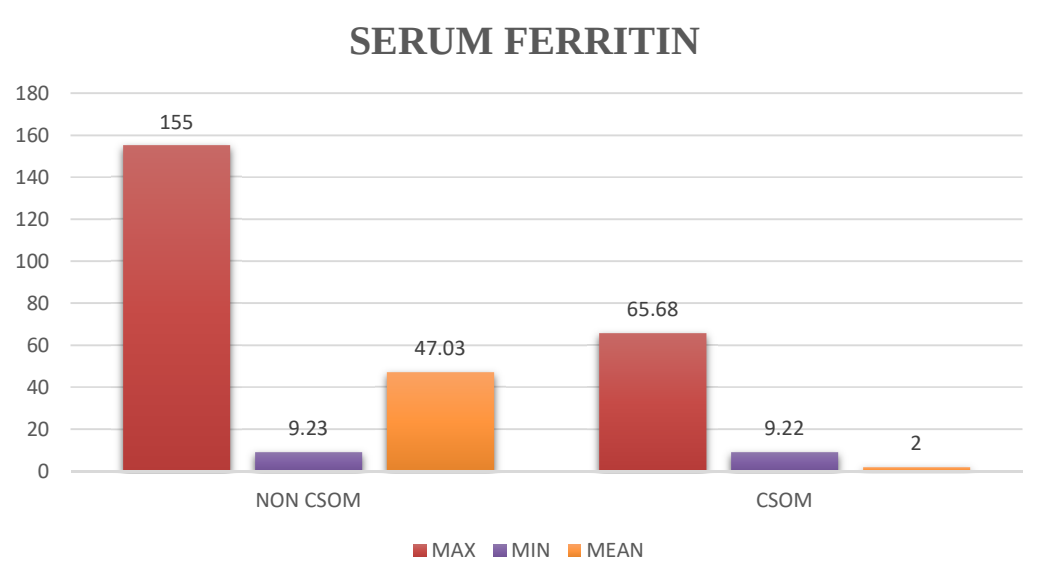
The serum ferritin levels were also compared in the study in CSOM group and Non CSOM group which are as follows:

TABLE 2: S. FERRITIN LEVELS OF THE SAMPLE

S. FERRITIN (**ng/ml**)							
NON CSOM				**CSOM**			
MEAN	**S.D.**	**MIN**	**MAX**	**MEAN**	**S.D.**	**MIN**	**MAX**
47.03	35.18	9.23	155	28.72	14.96	9.22	65.68

The minimum S. Ferritin value seen in Non CSOM group was 9.23ng/ml and the maximum level was 155. The mean value was 47.03 with a standard deviation of 35.18.

GRAPH 4:



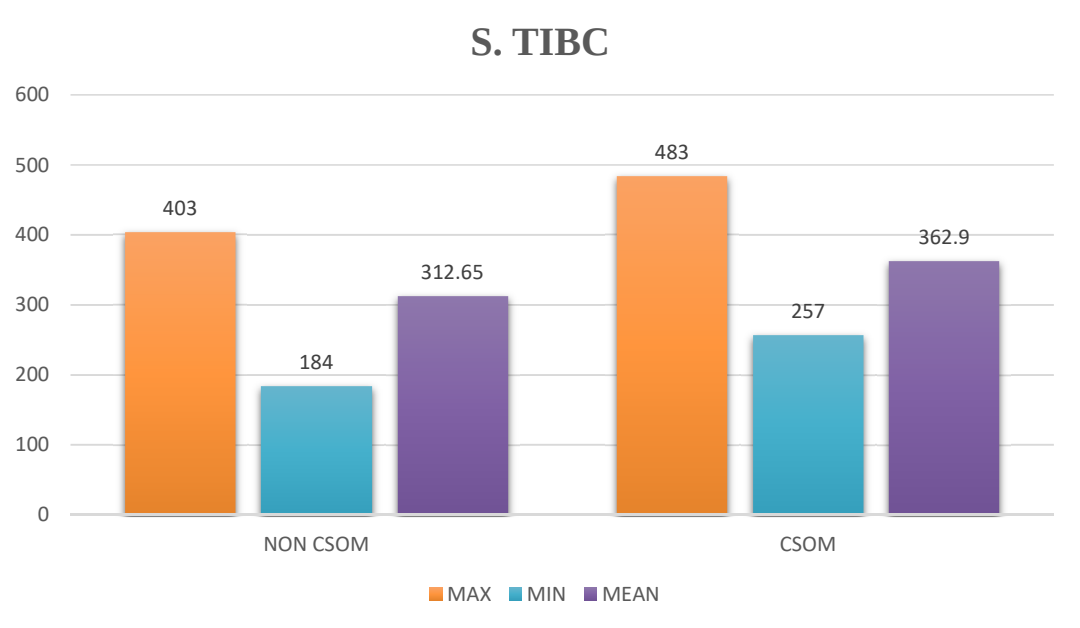
The minimum S.Ferritin value in CSOM group was 9.22ng/ml and the maximum value noted was 65.68ng/ml. The mean value calculated was 28.72ng/ml with a standard deviation of 14.96.

Another parameter that was studied was TIBC. The mean value in Non CSOM group was 312.65 ± 64.52 and in CSOM group was 362.90± 69.76. TIBC was increased in the CSOM group with significant p value p= 0.02.

TABLE 3: S. TIBC LEVELS OF THE SAMPLE

TIBC (mcg/dl)							
NON CSOM				CSOM			
MEAN	S.D.	MIN	MAX	MEAN	S.D.	MIN	MAX
312.65	64.52	184	403	362.90	69.76	257	483

GRAPH 5:

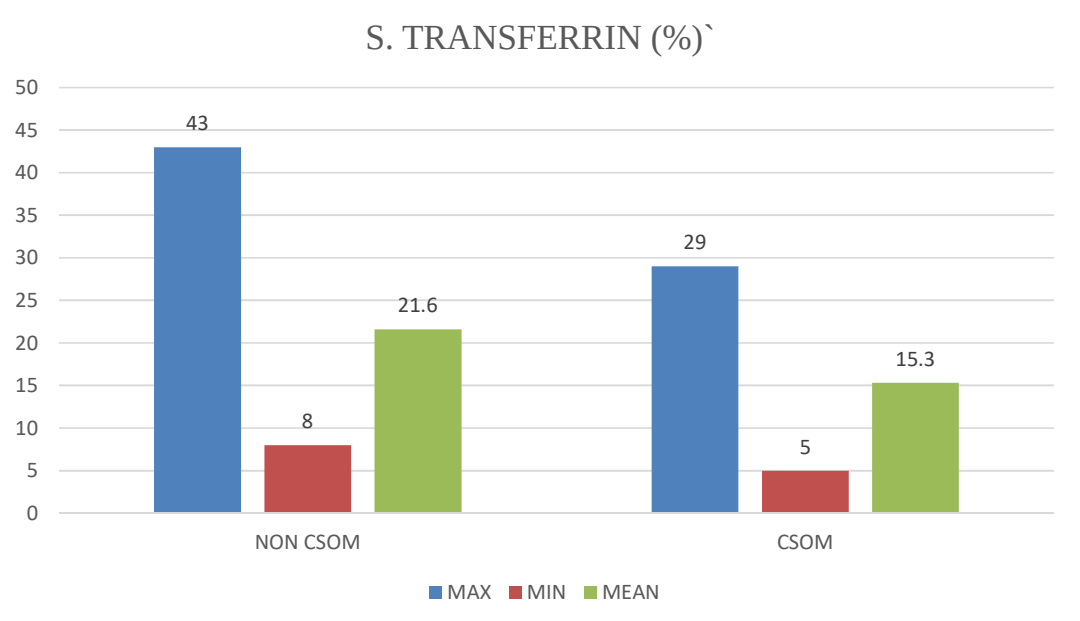


The serum transferrin levels were measured in both groups, which showed values as follows: The mean value in Non CSOM group was 21.60±11.13 and the mean value in CSOM group was 15.30±7.07.

TABLE 4: S. TRANSFERRIN LEVELS OF THE SAMPLE

S. TRANSFERRIN (%)							
Non CSOM				CSOM			
MEAN	S.D.	MIN	MAX	MEAN	S.D.	MIN	MAX
21.60	11.13	8	43	15.30	7.07	5	29

GRAPH 6:



In our study, S. Fe, S. Ferritin and Transferrin % levels are decreased and TIBC was increased in CSOM group compared to that of Non CSOM group.

DISCUSSION

In India, two prevalent issues affecting children are chronic suppurative otitis media (CSOM) and iron deficiency anemia. CSOM is a complex condition influenced by multiple factors, including decreased immunity. Hence, it's essential to examine iron's role in immunity and its potential impact on infection rates. An adequate supply of iron is required for adequate immune system maturation, with its deficiency impairing the body's ability to mount effective defenses. It plays a vital role in various immune functions, such as growth and maturation of immune cells. Therefore, understanding the relationship between iron and immunity is vital for grasping its implications for infections like CSOM among children in India.

Examining the link between CSOM and iron deficiency anemia is the primary goal of the current analysis.

In our study, a total of 40 patients were considered, out of which 20 were Non CSOM patients and 20 were CSOM patients and the results were comparable.

In CSOM patients, out of 20 patients, 12 were males and 8 were females. 9 patients showed Left side CSOM, 6 patients showed Right sided CSOM, and 5 patients had Bilateral disease. The incidence was higher in males than females.

Study done by Jain et al[28] found a similar incidence, where males were more affected than females.

The age of the patients was between 5-18years. They were divided into three age groups 5-9 years, 10-14 years, and 15-18 years. 2 patients were within the age bracket of 5-9 years in CSOM group, 8 patients were within the age bracket of 10-14 years and 1o patients were within the age bracket of 15-18 years.

It most commonly was seen in children above 14 years of age.

The average Hb in our CSOM group was 12.51± 1.60 and the average Hb in Non CSOM group was 12.01±1.73. The Hb values did not differ much between the two groups.

The mean S. Iron level in CSOM group was 52.85 ± 32.26. The mean S. Iron levels in the non CSOM group were 71.67± 18.94. The serum iron levels were decreased in CSOM group. The p value was significant with p = 0.03. A similar study was done by Lina lasminingrum et al, [29] in which they found that the mean serum Iron levels were 75.02± 26.14 g/dl in case group and control group 115.24 ± 35.25 g/dL.

In another study done by Akcan FA et al,[30] they evaluated iron deficiency anemia in relation to otitis media with effusion. In their study, the serum ferritin levels were decreased with values of 18.20±8.91 in the study group and 36.97±27.01 in control group. In our study, the mean ferritin levels were 28.72±14.96 in CSOM group and 47.03±35.18 in non CSOM group. The ferritin values were decreased in both studies with significant p value (<0.05). In the same study, the mean serum iron levels were also evaluated and found to be decreased in the study group. The study group showed mean serum iron levels of 59.74±29.27 whereas in the control group it was 68.29±28.14.

M. A. Elemraid et al.,[31] conducted a case-control study to evaluate for the nutritional factors associated with CSOM in Yemeni children. They found that S. Ferritin, sTfr had no association with CSOM.

S. Ferritin levels are directly linked with inflammatory cytokines. Decrease in S. Ferritin results in increase in IL-6 which is involved in pathogenesis of CSOM. A

study was conducted by Roxan Serban et al [16] in which they concluded that decrease in S. Ferritin levels resulted in increase in IL-1α, IL-6, IL-10.[16]

A retrospective study carried out in Israel uncovered significant associations between acute otitis media (AOM) and anemia among children. Specifically, it found that 72% of children with a history of more than 12 episodes of AOM were moderately anemic, whereas only 5% of non-anemic children experienced AOM. Notably, administering iron supplements and antibiotics to anemic children resulted in a substantial reduction in the frequency of AOM, with 95.6% experiencing relief. Meanwhile, in the United States, research comparing two groups of term infants during their second six months of life found that those consuming cow's milk showed lower mean serum ferritin and corpuscular volume levels by the age of 12 months.

In our study we also evaluated the values of TIBC and S. Transferrin saturation. In IDA, the TIBC levels are always increased, and transferrin saturation percentages are always decreased. The mean values were comparable to a similar study done by Lina lasminingrum et al[29], where in the TIBC levels were increased in the study group. Transferrin saturation is also similar to TIBC levels. Transferrin saturation is the measure of iron that is bound. It is advised that iron profiling be done routinely in children with CSOM so as to treat the IDA.

Although our study proved the relation between the IDA and CSOM, it has its limitations with respect to sample size . Our sample size was 40. Future studies are needed to actually establish and prove the relation of deficiency of Iron and CSOM.

SUMMARY

The present study of "A one-year comparative study to evaluate the association of iron deficiency anemia in children with CSOM and without CSOM" which was done in the department of otorhinolaryngology and Head and Neck Surgery, Jawaharlal Nehru Medical College and KLEs Dr Prabhakar Kore Hospital from September 2022 to August 2023. The aim of the study was to determine the association between iron deficiency anemia and CSOM in children aged between 5-18 years.

40 patients were taken into consideration. 20 patients with CSOM and 20 patients without CSOM. All the patients were investigated for iron deficiency anemia by doing Serum iron profiling and Hemoglobin.

The study showed male preponderance in developing CSOM. of all the parameters evaluated for Iron deficiency anemia, Haemoglobin levels did not show any variation between the two groups.

CSOM group had lower levels of Serum Iron, Serum Ferritin and Serum Transferrin percentages compared to the children who did not have CSOM. Simultaneously, the TIBC decreased in CSOM group than that of Non CSOM group.

We noticed that in our study most cases were between 15-18 years where the requirement of iron is higher for development of immunity as well as for physical development. Prevention of IDA in children has a bigger role in CSOM also.

As the study showed that there is association between the iron deficiency anemia and CSOM, we conclude that IDA is a possible predisposing factor for CSOM. As our sample size is smaller, we would like to recommend to bigger multicentric study with larger sample size for confirming our findings.

CONCLUSION

Various factors are attributed to causing CSOM. Decreased immunity and the reasons responsible for it are one of the most common and important factors to be studied especially in Indian demographic as IDA is most commonly seen in children. CSOM was seen more in males than females in our study. The S. Fe, S. Ferritin, Transferrin saturation levels were decreased in patients with CSOM and TIBC was increased in CSOM group. Based on our study, we suggest that the high index of suspicion shown should be maintained for IDA in patients of CSOM and whenever deemed necessary , they should be subjected to iron profiling and treatment of IDA at early stage to prevent the occurrence of this malady.

BIBLIOGRAPHY

1. Walter T, Olivares M, Pizarro F, Muñoz C. Iron, anemia, and Infection. Nutrition Reviews. 2009 Apr 27;55(4):111–24. doi:10.1111/j.1753-4887. 1997.tb06462.x
2. Kumar V, Choudhry VP. Iron deficiency and Infection. The Indian Journal of Pediatrics. 2010 Jun 29;77(7):789–93. doi:10.1007/s12098-010-0120-3
3. Mittal R, Lisi CV, Gerring R, Mittal J, Mathee K, Narasimhan G, et al. Current concepts in the pathogenesis and treatment of chronic suppurative otitis media. Journal of Medical Microbiology. 2015 Oct 1;64(10):1103–16. doi:10.1099/jmm.0.000155
4. Santoshi Kumari M, Madhavi J, Bala Krishna N, Raja Meghanadh K, Jyothy A. Prevalence and associated risk factors of otitis media and its subtypes in South Indian population. Egyptian Journal of Ear, Nose, Throat and Allied Sciences. 2016 Jul;17(2):57–62. doi: 10.1016/j.ejenta.2016.04.001
5. Licameli GR. The eustachian tube. Otolaryngologic Clinics of North America. 2002 Aug;35(4):803–9. doi:10.1016/s0030-6665(02)00047-6
6. Luers JC, Hüttenbrink K. Surgical anatomy and pathology of the Middle Ear. Journal of Anatomy. 2015 Oct 19;228(2):338–53. doi:10.1111/joa.12389
7. Dinç AE, Damar M, Uğur MB, Öz II, Eliçora SŞ, Bişkin S, et al. Do the angle and length of the eustachian tube influence the development of chronic otitis media? The Laryngoscope. 2015 Mar 16;125(9):2187–92. doi:10.1002/lary.25231
8. Pal GK, Pal P. Textbook of practical physiology. Hydrerabad, India: Orient Longman; 2016.

9. Chakkal H, Parmar S, Sood A. Prevalence of chronic suppurative otitis media in schoolgoing children. Indian Journal of Otology. 2018;24(4):223. doi: 10.4103/indianjotol.indianjotol_152_17
10. Hentzer E. Histologic studies of the normal mucosa in the middle ear, mastoid cavities and eustachian tube. Annals of Otology, Rhinology & Laryngology. 1970 Aug;79(4):825–33. doi:10.1177/000348947007900414
11. Mu Q, Chen L, Gao X, Shen S, Sheng W, Min J, et al. The role of iron homeostasis in remodeling immune function and regulating inflammatory disease. Science Bulletin. 2021 Sept;66(17):1806–16. doi: 10.1016/j.scib.2021.02.010
12. Watkinson JC, Clarke RW. Scott-Brown's otorhinolaryngology and head and neck surgery. volume 2, Paediatrics, the ear, and skull base surgery. Milton: Chapman and Hall/CRC; 2018.
13. Bhutta MF, Lambie J, Hobson L, Williams D, Tyrer HE, Nicholson G, et al. Transcript analysis reveals a hypoxic inflammatory environment in human chronic otitis media with effusion. Frontiers in Genetics. 2020 Feb 21;10. doi:10.3389/fgene.2019.01327
14. Serban R, Filip C, Radulescu L, Badescu M, Badescu M, Diaconescu B, et al. IL-1α, IL-6 and IL-8 serum values in patients with chronic suppurative otitis media. Experimental and Therapeutic Medicine. 2021 Aug 27;22(5). doi:10.3892/etm.2021.10660
15. Ganz T, Nemeth E. Iron homeostasis in host defence and inflammation. Nature Reviews Immunology. 2015 Jul 10;15(8):500–10. doi:10.1038/nri3863
16. Nairz M, Weiss G. Iron in infection and immunity. Molecular Aspects of Medicine. 2020 Oct; 75:100864. doi: 10.1016/j.mam.2020.100864

17. Hassan TH, Badr MA, Karam NA, Zkaria M, El Saadany HF, Abdel Rahman DM, et al. Impact of iron deficiency anemia on the function of the immune system in children. Medicine. 2016 Nov;95(47). doi:10.1097/md.0000000000005395
18. Kumar S, Gupta P, Varshney S, Mohanty A, Jha M. Chronic suppurative otitis media: A microbiological review of 20 years. Indian Journal of Otology. 2020;26(2):59. doi: 10.4103/indianjotol.indianjotol_141_19
19. Cummings CW, Flint PW. Cummings otolaryngology: Head and Neck Surgery. Philadelphia, PA: Elsevier Saunders; 2015. Page 2095-2097
20. Jonker FAM, te Poel E, Bates I, Boele van Hensbroek M. Anaemia, iron deficiency and susceptibility to infection in children in sub-saharan Africa, guideline dilemmas. British Journal of Haematology. 2017 Apr 11;177(6):878–83. doi:10.1111/bjh.14593
21. Subramaniam G, Girish M. Iron deficiency anemia in children. The Indian Journal of Pediatrics. 2015 Feb 1;82(6):558–64. doi:10.1007/s12098-014-1643-9
22. Wang L, Miao Y, Ma Z, Jiang W, Zhou J, Lv J, et al. Association of Serum Iron and hepcidin levels with stroke from 1990 to 2022: A systematic review and meta-analysis. Journal of Functional Foods. 2023 May; 104:105549. doi: 10.1016/j.jff.2023.105549
23. Marques O, Weiss G, Muckenthaler MU. The role of iron in chronic inflammatory diseases: From mechanisms to treatment options in anemia of inflammation. Blood. 2022 Nov 10;140(19):2011–23. doi:10.1182/blood.2021013472
24. Sipahi T, Akar N, Egin Y, Cin Ş. Serum interleukin-2 and interleukin-6 levels in iron deficiency anemia. Pediatric Hematology and Oncology. 1998 Jan;15(1):69–73. doi:10.3109/08880019809009510

25. Kuvibidila SR, Baliga SB, Chandra LC, French CL. The role of iron in immunity and inflammation: Implications for the response to infection. Diet, Immunity and Inflammation. 2013;193–220. doi:10.1533/9780857095749.2.193

26. Gupta SK, Bansal D, Malhi P, Das R. Developmental profile in children with iron deficiency anemia and its changes after therapeutic iron supplementation. The Indian Journal of Pediatrics. 2010 Mar 19;77(4):375–9. doi:10.1007/s12098-010-0046-9

27. Verhoeff M, van der Veen EL, Rovers MM, Sanders EAM, Schilder AGM. Chronic suppurative otitis media: A Review. International Journal of Pediatric Otorhinolaryngology. 2006 Jan;70(1):1–12. doi: 10.1016/j.ijporl.2005.08.021

28. A. Jain, N. Arora, R. Meher, J.C. Passey, R. Bansal, Intracranial complications of CSOM in pediatric patients: a persisting problem in developing countries, Int. J. Pediatr. Otorhinolaryngol. 100 (2017) 128–131, https://doi.org/10.1016/j. ijporl.2017.06.038.

29. lasminingrum L, Purwanto B, Sudiro M, Mutmainnah A. The Association of Iron Deficiency Anemia on chronic suppurative otitis media in children: A case-control study. Annals of Medicine and Surgery. 2021 Dec; 72:103105. doi:10.1016/j.amsu.2021.103105

30. Akcan FA, Dundar Y, Akcan HB, Cebeci D, Sungur MA, Unlu I. The association between Iron Deficiency and otitis media with effusion. The Journal of International Advanced Otology. 2019 May 3;15(1):18–21. doi:10.5152/iao.2018.5394

31. Elemraid MA, Mackenzie IJ, Fraser WD, Harper G, Faragher B, Atef Z, et al. A case–control study of nutritional factors associated with chronic suppurative otitis media in Yemeni children. European Journal of Clinical Nutrition. 2011 May 4;65(8):895–902. doi:10.1038/ejcn.2011.58

ANNEXURE I- INFORMED CONSENT FORM

"A one-year comparative study to evaluate the efficiency of iron deficiency anemia in children with CSOM and without CSOM"

Name of Student/Principal Investigator:

Name of Guide/Co Investigators:

Objective: To know the association between iron deficiency anemia and chronic otitis media in children

Explanation of procedure: After taking informed consent from the patient, demographic details of all the patients will be recorded, predesigned proforma and thorough clinical history will be obtained. All patients will be examined including general physical examination, careful examination of ear nose and throat, complete blood picture serum iron profile (serum iron levels, total iron binding capacity, serum ferritin levels) will be obtained

Withdrawal from participation in the study: Participation in this study is voluntary. You will be free to decide whether to participate in this study or continue participation once enrolled. In case you decide to withdraw your participation, you are free to do so. However, please convey the decision to the principal investigator.

Possible benefits from participating in the study: You will/will not have nor get any benefits by participating in this study. The data gathered will help the population at large.

Possible risks from participating in the study: There are no risks involved in participating in this study.

Privacy and confidentiality: The information collected from you will be coded, to prevent any person from identifying you. Your identity will never be revealed. The data collected from you will be kept confidential and only processed or aggregated data will be used for publication.

Financial incentives: You will not receive any payment for participating in this study.

Authorization for publication of aggregated data: Results obtained after processing of the aggregated data will be published for scientific purposes and or presented to scientific groups. However, your identity will never be revealed.

Questions: In case of any questions with regard to this study, you are free to contact: BE0121010 If you have any question or complaints with regard to your right as study participant you may contact Dr Harsha Hegde, Chairperson, Ethical committee of JNMC, 0831-2473777 Extension 4052.

Legal rights: By signing this consent form, we are not waving any of your legal rights.

CONSENT STATEMENT

I am making a voluntary decision to participate in the study "**A one-year comparative study to evaluate the efficiency of iron deficiency anemia in children with CSOM and without CSOM"**. My signature below indicates that I have decided to participate and I have read the information provided above or the information provided above has been read to me in the language that I understand best. I was given the opportunity to ask questions and that they have been answered to my satisfaction.

Name of the participant:

Signature or left thumb impression of the participant:

Name of the witness:

Signature or left thumb impression of the witness:

Name of the investigator:

Signature of the investigator:

ANNEXURE II - PROFORMA FOR DATA COLLECTION

"A ONE YEAR COMPARATIVE STUDY TO EVALUATE THE ASSOCIATION OF IRON DEFICIENCY ANEMIA IN CHILDREN WITH CSOM AND WITHOUT CSOM"

Date: I.P. No:

Name: Occupation:

Age: Phone No:

Sex:

Address:

CLINICAL PROFILE:

Chief Complaint:

History of Present Illness:

Past History:

Personal History:

Family History:

I) General Physical Examination -

Blood Pressure:

Pulse:

Respiratory Rate:

Pallor

Icterus

Clubbing

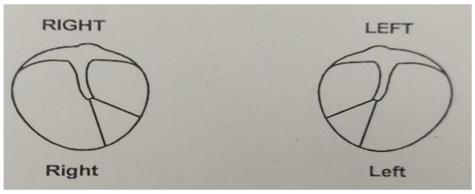
Cyanosis

Lymphadenopathy

Oedema

II) ENT Examination

1. **EAR EXAMINATION:**

	Right	Left
Pinna		
Pre auricular area		
Post auricular area		
Tragal Tenderness		
Mastoid Tenderness		
External auditory canal		
Tympanic membrane		

TUNING FORK TESTS:

Rinne's test: 256 Hz

512 Hz

1024 Hz

Weber's test:

Absolute Bone Conduction test

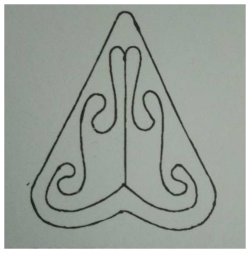
2. NOSE EXAMINATION:

External appearance

- Root
- Bridge
- Dorsum
- Alae
- Tip
- Columella

Cold spatula test

Anterior Rhinoscopy



Posterior Rhinoscopy

Paranasal Sinus Examination

	Right	Left
Frontal Sinus tenderness		
Ethmoidal Sinuses tenderness		
Maxillary Sinus tenderness		

3. THROAT EXAMINATION:

Oral cavity:

- Lips
- Labial and buccal mucosa
- Gingivolabial and gingivobuccal sulci
- Gingiva
- Teeth
- Hard palate
- Floor of mouth
- Anterior 2/3rd of tongue
- Retromolar trigone

Oropharynx:

- Soft palate
- Uvula
- Anterior pillar
- Tonsils
- Posterior pillar
- Posterior and lateral pharyngeal wall

Indirect Laryngoscopy

4. NECK EXAMINATION:

DIAGNOSIS

COMPLETE BLOOD PICTURE:

Haemoglobin:

Haematocrit

Leucocyte Count:

Platelet Count:

SERUM IRON PROFILING:

SERUM IRON:

TOTAL IRON BINDING CAPACITY:

SERUM TRANSFERRIN LEVELS:

SERUM FERRITIN LEVELS:

ANNEXURE III- PHOTOGRAPHS

PHOTOGRAPH 1: PHOTOGRAPH OF COMPLETE BLOOD PICTURE

Date: 20/03/2023

Test Description	Value	Unit	Reference Range
Sample : 23065711 / Whole Blood EDTA			
LAB NO:	3462		
BLOOD GROUP (ABO Gp & Rh typing)			
HAEMOGRAM			
Sysmex XN 350			
BLOOD Group	"A"		
Rh (D)	Positive		
HAEMOGLOBIN	12.20	g/dl	12 - 15
HAEMATOCRIT(Hct)/PCV	36.8	%	35-45
MCV	**101.0**	fl	80.7-95.5
MCH (Computed)	**33.4**	pg	27-32
MCHC (Computed)	33.1	g/dl	31.5-34.5
Red cell Distribution Width (R D W)	12.2	%	11.6-14
RED CELL COUNT	**3.64**	10^6/µL	3.8 - 4.8
RETICULOCYTE COUNT	0.50	%	0.5-2.5
WBC TOTAL COUNT	9.79	10^3/µL	4- 10
PLATELET COUNT	335	10^3/µL	150-450
DIFFERENTIAL WHITE CELL COUNT			
NEUTROPHILS	53	%	35-65
LYMPHOCYTES	42	%	33-53
EOSINOPHILS	1	%	1-6
MONOCYTES	4	%	2-10
ABSOLUTE EOSINOPHIL COUNT	0.10	10^3/µL	0.02 - 0.5
PERIPHERAL SMEAR			

PHOTOGRAPH 2: PHOTOGRAPH OF SERUM FERRITIN

Date: 20/03/2023

Test Description	Value	Unit	Reference Range
Sample : 23064258 / SERUM			
Ferritin * *(C.L.I.A)*	**10.82**	ng/mL	13.00 - 150.00

Report Notes : FERRITIN
INTERPRETATION : The whole clinical situation is to be evaluated by considering the entire diagnostic paramater
1. Ferritin is decreased in very early in iron deficiency
2. During pregnancy & in patients undergoing dialysis.
3. Ferritin is increased in People receiving regular blood transfusion or iron replacement therapy
4. Patients with haemomochromatosis and hemosiderosis chronic conditions like chronic infection, inflammatory diseases, malignances and viral hepatitis or toxic liver injury.
5. In patients with chronic disorders together with iron deficiency ferritin levels are often normal.

PHOTOGRAPH 3: PHOTOGRAPH OF IRON PROFILE

Date: 20/03/2023

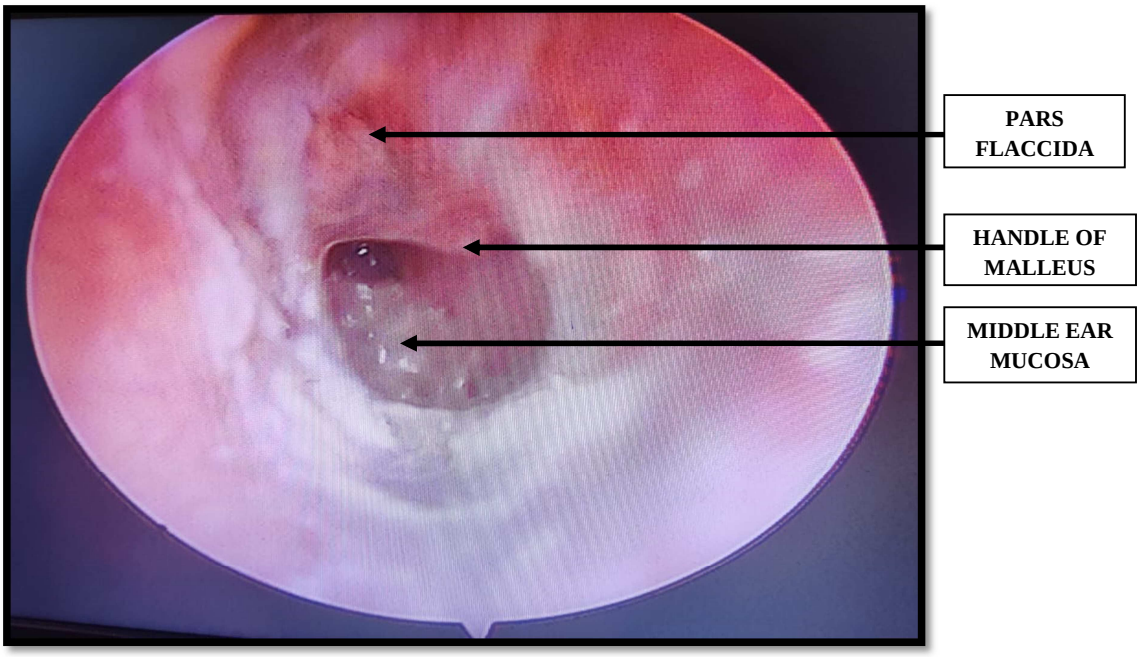
Test Description	Value	Unit	Reference Range
Sample : 23064258 / SERUM			
IRON & TIBC			
IRON (Sr.) *(Ferene)*	100	µg/dl	33 - 193
TIBC *(Ferene)*	345	µg/dl	135 - 392
TRANSFERRIN SATURATION	29	%	12 - 45

Report Notes : FERRITIN
INTERPRETATION : The whole clinical situation is to be evaluated by considering the entire diagnostic paramater
1. Ferritin is decreased in very early in iron deficiency
2. During pregnancy & in patients undergoing dialysis.
3. Ferritin is increased in People receiving regular blood transfusion or iron replacement therapy
4. Patients with haemomochromatosis and hemosiderosis chronic conditions like chronic infection, inflammatory diseases, malignances and viral hepatitis or toxic liver injury.
5. In patients with chronic disorders together with iron deficiency ferritin levels are often normal.

End Of Report

PHOTOGRAPH 4: YELLOW VIAL CONTAINING TRISODIUM CITRATE, CITRIC ACID AND DEXTROSE- COLLECTING FOR IRON STUDIES

PHOTOGRAPH 5: PHOTOGRAPHS SHOWING LARGE CENTRAL PERFORATION OF LEFT EAR IN FIVE YEAR OLD PATIENT



ANNEXURE IV- KEY TO MASTERCHART

AGE	IN YEARS
SEX	MALE AND FEMALE
DISEASE STATUS	CSOM/NON CSOM
HAEMOGLOBIN	IN g/dL
S.IRON	IN mcg/dL
TIBC	IN mcg/dL
S. TRANSFERRIN	IN PERCENTAGE
S.FERRITIN	IN ng/ml

ANNEXURE V- MASTERCHART

MASTER CHART OF CHILDREN WITHOUT CSOM									
S.N.	IP/OP No.	NAME	**AGE**	**SEX**	**HAEMOG LOBIN**	**S. IRON (mcg/dl)**	**TIBC (mcg/dl)**	**S.TRANS FERRIN (%)**	**S.FERR ITIN(ng/ml)**
1	6807026	ANANYA KURUBGATTI	5	FEMALE	11.3	58	266	8	15.23
2	7072080	SIDDHANTH BETAGERI	9	MALE	8	79	265	11	12.66
3	1188578	RITHANYA SATHEESH	5	FEMALE	12.3	88	184	18	45
4	6833170	AMRUTHA NAIK	10	FEMALE	13.7	99	238	39	36.91
5	1197493	NIRANJAN SHRIRAMUDU	16	MALE	14.4	54	296	43	65.33
6	1189505	MANOJ MEKALI	9	MALE	10.6	82	400	29	155
7	1207756	AADITH HUBBALLI	8	MALE	12.3	87	304	25	45.62
8	6048009	BHOOMI PAWALE	6	FEMALE	12.1	79	331	29	47.31
9	1197384	SAI DAYANAND USKE	5	MALE	12.3	48	373	24	35.64
10	1198893	PARASHURAM BALEKUNDRI	18	MALE	14.4	44.49	342	15	26.6

11	1165229	POONAM PATIL	12	FEMALE	12.4	45	306	11	28.13
12	1175205	GOPAL PATIL	12	MALE	10.7	67	403	19	117
13	1206161	SHRILAXMI BHADRASHETTI	18	FEMALE	10.8	100	345	10	21.45
14	1200223	VITHAL CHANDRAGIRI	15	MALE	8.1	73	288	12	29.45
15	6038442	AKSHATHA NAVANI	11	FEMALE	13.1	105	243	20	40.83
16	6999887	PREETHAM	10	MALE	13.1	56	318	11	9.23
17	1188572	ISHWARI DHANKANTE	11	FEMALE	13.1	56	212	19	53
18	1188595	VAISHNAVI JILLANNAVAR	5	FEMALE	12.3	87	386	34	36.21
19	7112648	PRAJWAL HATTIAMNI	13	MALE	13.3	59	402	13	75.8
20	7094923	SHIVRAJ DANGER	12	MALE	11.8	67	351	42	44.23

MASTER CHART OF CHILDREN WITH CSOM										
S.N.	IP/OP NO.	NAME	**AGE**	**SEX**	**CSOM/NON CSOM**	**HAEMO GLOBIN**	**S. IRON (mcg/dl)**	**TIBC (mcg/dl)**	**S.TRANS FERRIN (%)**	**S.FERR ITIN(ng/ml)**
1	10006431	SAMIKSHA	12	FEMALE	LEFT CSOM	13.2	20	453	13	35.44
2	1205374	DARSHAN GHASTI	15	MALE	LEFT CSOM	15.6	14	428	15	35.7
3	7085432	KRISHNA NAIK	8	MALE	B/L CSOM	12.9	32	404	18	29.48
4	6602459	LAXMI HANAMANNAVAR	16	FEMALE	LEFT CSOM	12.6	72	325	25	17.6
5	7148401	GANESH BHAKANE	15	MALE	LEFT CSOM	13.4	80	303	11	17.06
6	7116879	AMRUTA HINGALE	11	FEMALE	RIGHT CSOM	11.8	55	257	11	54.15
7	1184433	SUJAL KAMBLE	17	MALE	LEFT CSOM	14.9	45	316	16	65.68
8	6993105	VAIBHAVI SALUNKE	15	FEMALE	RIGHT CSOM	12.6	67	331	7	11.92
9	1190090	KRUTHIKA MELGADE	18	FEMALE	LEFT CSOM	9.7	64	373	13	16.72
10	1193580	CHAITRA PUJARI	12	FEMALE	B/L CSOM	11.1	145	284	13.01	34.17
11	7025454	HANAMANT JAMAKHANDI	17	MALE	B/L CSOM	15.4	27	445	25	32.45
12	6249508	SAGAR PATIL	16	MALE	LEFT CSOM	12.5	33	310	8	19.66
13	6925385	NIDHA MOMIN	13	FEMALE	LEFT CSOM	12.2	26	413	29	10.82
14	6925260	AJAYREDDY BHAGAVAT	8	MALE	B/L CSOM	12.1	8	398	11	35.74
15	4977712	PRAJVAL DURADUNDI	16	MALE	RIGHT CSOM	11.8	65	483	25	46.5
16	1002156	SURAJ RAJU	14	MALE	RIGHT CSOM	12.3	35	470	15	35.71

17	1176631	ZIYAN SINDGIKAZ	14	MALE	B/L CSOM	14	52	362	9	22.8
18	7155226	MAYANK HIRANNAVAR	11	MALE	LEFT CSOM	10.8	53	267	11	15.2
19	7106914	RENUKA ASHIROTTI	18	FEMALE	RIGHT CSOM	11.1	102	329	5	9.22
20	7107582	SOURABH KOCHERI	14	MALE	RIGHT CSOM	10.2	62	307	26	28.3