MIDDLE EAR EFFUSION IN CHILDREN WITH CEREBRAL PALSY: A CASE-CONTROL STUDY AT THE KENYATTA NATIONAL HOSPITAL.

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DECLARATION

I, the undersigned hereby declare that this dissertation is my original work and has not been presented for the award of degree in any other university. Where I have used another person's work, I have carefully acknowledged and referenced.

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DEDICATION

I dedicate this work to my family for their support during the study period and the mothers who take care of children with cerebral palsy for their resilience and dedication in caring for these vulnerable children.

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LIST OF ABBREVIATIONS

A.O.M - Acute Otitis Media

AAOHNS – American Academy of Otolaryngologists Head and Neck Surgeons

ABEP- Auditory brainstem evoked potentials.

AHRQ- Agency for Healthcare Research and Quality

ASHA - American Speech -Language Hearing Association

dB- decibel.

E.N.T – Ear Nose and Throat

EAC- External Auditory Canal

HL- Hearing loss

HZ- Hertz

KNH – Kenyatta National Hospital

MEE- Middle Ear Effusion

OME - Otitis Media with effusion

PTA- Pure tone audiometry

R.S.V. – Respiratory Syncytial Virus

RCT – Randomized control trials

S.P.S.S - Statistical Package for Social Sciences

TM- Tympanic membrane

U.R.T.I - Upper Respiratory Tract Infection

USA- United States of America

VEP- Visual Evoked Potentials

ABSTRACT

Background: Otitis Media with Effusion remains an important cause of preventable hearing loss in children. This condition negatively affects a child's speech and language development. Children with developmental difficulties are vulnerable to the adverse outcomes of chronic otitis media with effusion, which can worsen the already existing developmental delays.

Main Objective: To determine whether children with cerebral palsy are at a higher risk of developing middle ear effusion than those without cerebral palsy at the Kenyatta National Hospital.

Study Design and Setting: This was a case-control study on middle ear effusion in children with cerebral palsy versus those without at the Kenyatta National hospital clinics from July 2020 to February 2021.

Methodology: One hundred and twenty-four children aged between six months and seven years were recruited into the study comprising sixty-two cases and sixty-two controls. History and physical examination including pneumatic otoscopy was done followed by tympanometric evaluation of the middle ear.

Data Analysis and Presentation: Prevalence of middle ear effusion between case and controls was analyzed and presented as percentages with odds ratio and p-values calculated for significance. Pearson chi-square test was used to analyse the relationship between specific risk factors and development of middle ear effusion in children with cerebral palsy. A P value of <0.05 for a 95% confidence interval was considered significant.

Results: There were 74 (59.67%) males and 50(40.37%) females with a mean age of 21 months +/- 15.1 months. Middle ear effusion was found in 14(22.6%) of the cases and 7(11.3%) of the controls. The difference was however not statistically significant (p=0.094).Very low birth weight and duration of exclusive breast-feeding for less than six months were significantly associated with middle ear effusion among the cases (p=0.014 OR 10.16 95% CI 1.051-2.805; p=0.011 OR 3.19 95% CI 1.230-6.320) respectively. Majority of the patients had tympanogram type A 62(50.0%) followed by As 20 (16.7%), with type B being seen in 14(10.0%) of the study population.

Conclusion: Children with cerebral palsy were two times more likely to develop middle ear effusion compared to controls although this was not statistically significant.

1.0 INTRODUCTION

Otitis media with effusion (OME) is the presence of fluid in the middle ear without symptomatology of acute ear infection [1, 2]. This condition is common in early childhood [3]. This is because about 90% of children have OME before school age [4] and develop four episodes of OME every year[5].

American Academy of Pediatrics has identified a group of children who are at increased risk of developmental difficulties once they develop chronic effusion. This group includes children with sensory, physical, cognitive or behavioral factors such as cerebral palsy and blindness. Other conditions included in this group include autism spectrum of disorders and other pervasive developmental disorders, syndromic and non-syndromic cleft palate[6].

Studies and guidelines for management of chronic effusion in these specific groups of children in Africa are quite scarce. The burden of middle ear disease in cerebral palsy patients is not known in most African countries. In addition, these children tend to have chronic middle ear effusion compared to other children[6]. Whether cerebral palsy predisposes affected children to development of middle ear effusion is not very clear from literature.

Cerebral palsy is likely to remain a common problem with increasing incidence due to increase in survival of children with perinatal complications. These children present with certain developmental complications that are quite complex to manage. Worldwide incidence is 2 to 2.5 for every 1000 live births and 5 for every 1000 live births in developing countries[7].

Although cerebral palsy has been documented as a risk factor for development of middle ear effusion, very few studies have been done to determine whether the condition confers a high risk of developing middle ear effusion.

2.0 LITERATURE REVIEW

2.1 Cerebral Palsy

Cerebral palsy is a neurodevelopmental disorder primarily affecting motor development. It is often described as non-progressive, fluctuating motor impairment syndromes due to lesions or injury to the brain usually in the early stages of its development- antenatal, perinatal or early postnatal period. The malfunctioning of motor domains in cerebral palsy are usually associated with disturbances of sensation, perception, vision, hearing, cognition, swallowing, communication and behavior, convulsive disorders and secondary locomotive problems.[7]

The four subtypes of cerebral palsy include spastic, ataxic, mixed and athetoid forms. Spastic form occurs frequently at 65%. Spastic palsy presents with exaggerated hypertonic movements due to injury to pyramidal tracts. Clinical presentation can be in the form of spastic monoplegia, spastic hemiplegia, spastic diplegia or spastic quadriplegia depending on the extent of the insult.[8]

2.1.1 Pathophysiology and Diagnosis of Cerebral Palsy

Intraventricular hemorrhage (IVH) and periventricular leukomalacia (PVL) are the main pathogenic mechanisms. Corticospinal tracts usually course through the periventricular region and are affected in both PVL and IVH. In addition, the association fibers of the visual, auditory and somesthesic functions are involved interfering with development of sensory perception skills and eventually psycholinguistic skills. Periventricular leukomalacia tend to give rise to uniform diplegic spasticity or quadriplegic types of CP.[9] Bulbar involvement can lead to difficult swallowing with risk of aspiration that could lead to middle ear infection and its sequela middle ear effusion.[10]

Cerebral palsy is diagnosed based on clinical examination or parental history of motor development like sitting, standing and walking. Evaluation of posture with examination of deep tendon reflexes and muscle power can be done. This needs repeated examinations to exclude transient neurological deficits that can occur especially in children born prematurely.[10]

2.1.2 Cerebral Palsy and Otitis Media with Effusion

Accurate diagnosis of OME with identification of children who are most susceptible to developmental sequalae is vital. This expedites treatment and follow up. Although most of the effusion has natural resolution within 3 months, about 30% to 40% of children will have recurrence and another 5% to 10% develop chronic disease.[1] This percentage is specifically higher in children harboring permanent host risk factors like cerebral palsy. These children tend to have a high degree of dysfuctioning Eustachian tube predisposing them to chronic effusion. In addition, the associated comorbidities like convulsive disorders, reflux and aspiration further predisposes them to a higher risk of developing middle ear infections.

Long term OME is associated with not only hearing loss but also vestibular problems, poor school performance, behavioral problems such as attention deficit disorder, delayed gross motor skills, otalgia, recurrent acute otitis media (AOM) and poor quality of life.[11] It is also important to note that OME may cause structural damage to the tympanic membrane including but not limited to retraction pockets, adhesive otitis media and cholesteatoma that may require surgical interventions.[12]

2.2 Applied Anatomy of the Middle Ear

The middle ear cleft has a thin layer of mucus overlying an epithelium made up of several types of secretory, ciliated and non-ciliated cells. The cilia forms a conveyer belt that beats towards the pharyngotympanic tube and nasopharynx clearing the ear cavity of mucus and maintaining the sterility of the tympanic cavity by impeding the flow of bacteria from the postnasal space into the middle ear.

In the mechanism of pharyngotympanic tube action, contraction of the tensor veli palatini muscle is almost isometric and it depends on hypomochlia, which have an influence on the muscular force vectors. The muscular contractions of the tensor veli palatini provides for the opening of the Eustachian tube, which is limited to Rudinger safety canal.

There are fibromuscular interconnections between the medial pterygoid muscle and tensor veli palatini on both sides of the Weber- Liel Fascia. This makes the two muscles to work as a functional unit during Eustachian tube opening.[13]

In cerebral palsy, it is thought that the contraction of the peritubal muscles is uncoordinated or absent impairing the opening of the Eustachian tube with increased incidence of middle ear effusion.[14]

2.3 Applied Physiology of the Middle Ear

The middle ear has an important role in offsetting the reduction in acoustic energy that would occur if the low resistance ear canal air directly contacted the high-resistance cochlea's fluid. When transformation of sound from a low-impedance medium e.g. air to one of high impedance e.g. water occurs, there is considerable attenuation of its energy.

In the absence of the tympanic cavity, only 0.1% of the acoustic wave energy, would be able to reach the fluid of the cochlea and 99.9% would be attenuated.[15]

Fluid in the middle ear frequently interferes with this precochlear sound amplification by damping the movement of the tympanic membrane and ossicles and hence reducing the lever action of the ossicles as well as the hydraulic amplification of tympanic membrane and stapes footplate. Precochlear amplification system is needed to provide physiologic hearing. Proper impedance matching is interfered with, when there is effusion in the tympanic cavity, which increases the rate of acoustic energy decay and eventual low hearing.

2.4 Otitis Media with Effusion

2.4.1 Aetiology

The cause of effusion has largely been attributed to a malfunctioning eustachian tube. The tube has three key roles: (i) Pressure equilibration between the middle ear cleft and the atmosphere (ii) middle ear drainage and (iii) a mechanical barrier against infection. Malfunctioning of the tube can be due to physical blockage as a result of edema secondary to allergies, respiratory tract infection and injury or host anatomic and neurological defects. Middle ear gas absorption averages at 1ml/24h.

One of the theory proposed by Politzer (hydrops ex vacuo) postulates that formation of fluid into the middle ear cavity is due to continuous negative middle ear pressure. Several studies have demonstrated similar bacteriologic pattern in acute otitis media and OME. In fact, new evidence now describes inflammation as an important pathophysiologic factor in middle ear effusion. Bluestone et al, demonstrated reflux up the pharyngotympanic tube in children prone to middle ear infections[3] when he found pepsin in 60% of children with OME.[16] Similarly O' Relly et al in specimens collected from the ears of 64 patients showed presence of pepsin further lending credence to the possibility of aspiration into the nasopharynx.[17]

Mediators of inflammation released because of immune attack on pathogenic epitopes have been implicated in induction and up regulation of mucin genes. The mucous fluid provide ample medium for the proliferation of bacteria. Yilmaz et al has demonstrated significant changes in middle ear oxygen tension in patients with OME.[18]

Commonly encountered bacteria in order of frequency include *Streptococcus pneumoniae*, *Haemophilus influenzae* and *Moraxella Catarrhalis.* These pathogens are also associated with upper and lower respiratory infections. They account for 85% of acute ear infections. Additional organisms include *Streptococcus aureus*, gram-negative enteric bacteria and anaerobes. *Pseudomonas Aeruginosa* has been shown to predominate in chronic effusion.[19]

2.4.2 Risk Factors

Environmental factors like bottle feeding while supine, day care attendance, allergies, more than 4 siblings, smoking, lower socio-economic status and parental history of OME have all been implicated.[20] Predominance of bilateral OME with higher hearing loss has been established in atopic children. Age has been defined as an important risk factor.

The pharyngotympanic tube in children has a more flat projection in relation to the ground. This changes to about 45 degrees angle later on in life. Different studies of children in Denmark reveals type B or type C tympanograms in 24 % of children by the age of 1 year. Type B tracing was common in pediatric population aged 2-4 yrs with a declining trend in children older than 6 years.

Dysfunction of the pharyngotympanic tube tend to occur in patients who have cerebral palsy and patients with Down's syndrome. Decreased mucocilliary clearance and higher viscosity of mucus in conditions like cystic fibrosis has been thought to account for a higher prevalence of middle ear effusion in these patients.[21]

Cerebral palsy children tend to have other comorbid medical conditions like convulsive disorders, aspiration and gastro-esophageal reflux disease. In addition to this, those with convulsive disorders are place on anticonvulsant medication with their attendant side effects. These are some of the factors that pre-dispose these children to development of effusion.

2.4.3 Diagnosis of Otitis Media with Effusion

Otitis media with effusion usually follows acute ear infection during its resolution. In almost half of the patients, the symptoms of middle ear effusion are not obvious. Parents may note reduced hearing in children when they do not respond well to commands. On otoscopy, some of the findings include thin and translucent membrane, air bubbles or air-fluid levels, spoke sign, bulging of the tympanic membrane, reduced mobility on pneumatic otoscopy and retraction pockets in chronic eustachian tube dysfunction.[22] The American Academy of Otolaryngologists, Head and Neck Surgeons guidelines recommend pneumatic otoscopy to assess for otitis media with effusion in a child with ear pain or reduced hearing.

Reduced tympanic membrane mobility can be used to assess the presence of fluid in the middle ear.[22] In a systemic review of nine methods for evaluating OME[7], pneumatic otoscopy had a sensitivity of 94% and specificity of 80%. In the event pneumatic otoscopy is unable to give a clear diagnosis, tympanometry is used to aid diagnosis.

Tympanometric evaluation can aid in the assessment of tympanic membrane mobility and pharyngotympanic tube function by measuring the amount of acoustic energy reflected back from the tympanic membrane.[23]

Upon production of acoustic energy, the transmission to the external auditory canal and subsequent reflection of sound is measured by an internal microphone as pressure is varied. Graph tracing can be produced with a type A tympanogram tracing indicating normal result with peak pressure between +/- 100 dapa and a compliance of 0.3-1.5ml.

On the other hand, AD tracing (upper) indicates a pliable tympanic membrane with peak pressure between +/- 100 dapa and compliance of more than 1.5ml while an As tracing (lower) indicates abnormal stiffness of the tympanic membrane with peak between +/- 100 dapa and compliance less than 0.3ml. Type A' is associated with negative middle ear pressure above -100. Presence of well-defined peak on the graph tracing is associated with less incidence of OME.[24]
Type B tracing is flat and provides a reasonably reliable diagnosis of OME, with no identifiable peak.
Type C1, C2 and C3 tracing usually indicate a possibility of effusion with a peak and negative middle ear pressure (below -100 dapa). In interpretation of type B results, the normal external auditory canal volume, which is 0.3 to 0.9 in normal children, should be borne in mind[24]

2.4.4 Management of Otitis Media with Effusion

The use of steroids in the treatment of OME showed little benefit in either the resolution of the effusion or hearing level improvement.[25] Addition of antibiotics failed to show improvement in outcomes compared to control patients who did not antibiotics or those who received antibiotics alone.[26]

Recommendation for tympanostomy tube insertion from the AAO –HNSF advocate for insertion of tympanostomy tubes in children with bilateral chronic OME or those at risk of adverse developmental outcomes. This is especially so, if they have persisting type B tympanogram for more than three months.[26]

2.5 CEREBRAL PALSY AND MIDDLE EAR EFFUSION

Prevalence of OME worldwide differs based on study population and region of study. Studies on otitis media with effusion in children with cerebral palsy are quite scarce. The few that are available have mostly dwelt on hearing impairment and comorbidities in CP patients.

A study on middle ear evaluation in cerebral palsy patients in Benin City Nigeria found a prevalence of middle ear effusion and dysfunction of pharyngotympanic tube at 68.8% and 25.9% compared to the control group that had prevalence of 57.6% and 14.3% respectively ($p< 0.001$). The study found a prevalence of middle ear pathology of 78.6% in children with cerebral palsy and 40.2% in the control group. In evaluation of otitis media with effusion, tympanogram tracings type B, C1 and C2 were used to diagnose OME.[27]

Mohammed evaluated the audiological profile of children with cerebral palsy in a hospital in Mumbai India. The study's aim was to determine the frequency of hearing disability in cerebral palsy and possible causes. The study involved 117 children between 2-10 years of age in both gender. Audiometry, tympanometry, autoacoustic emissions and auditory brain stem response hearing tests were employed. Dysfunction of the eustachian tube with serous and secretory otitis media with resultant impairment in conductive hearing was observed in 52 children representing 45% of the study population.[28]

A study by Hanan on auditory impairment in 30 children with various types of cerebral palsy found abnormal tympanometry in the form of secretory otitis media or eustachian tube dysfunction in 52% of spastic quadriplegic patients. In this study, other types of cerebral palsy had normal tympanometric findings. The study also found sensorineural hearing loss in 40% of the children highlighting the need for close follow up and management of conductive hearing loss in these children.[29]

Another study on hearing loss in children with cerebral palsy by Weir et al in Jan 2018 evaluated the prevalence, degree and type of hearing impairment. A total of 940 patients were studied and out of this 367 (39%) had hearing loss.

In evaluation of hearing loss in 1629 individual ears, 782 (48%) had sensorineural hearing loss, 410 (25%) had mixed hearing loss and 374 (23%) had hearing loss that could not be specified. The specific causes of hearing loss were not evaluated.[30]

A study by Mugwaneza on evaluation of risk factors for middle ear effusion in 57 children at the Kenyatta National hospital Ear Nose and Throat clinic found prevalence of 47% in patients between 48 months to 63 months. Upper respiratory tract infections, adenoid hypertrophy, exposure to passive smoke, bottle feeding and allergic rhinitis were some of the risk factors that occurred at high frequency. An attempt to evaluate cerebral palsy, Down syndrome and cleft palate as risk factors for OME was not successful due to insufficient numbers.[31]

In East Africa, a study done in Uganda by Bisso on prevalence and risk factors of middle effusion showed a prevalence of otitis media with effusion at 14.1%. This study had a narrow age range of children between 4-6 years attending nursery school in Kampala city. Female children were found to have a statistically significant higher prevalence than their male counterparts. Socio-economic status was found to have little significance as a risk factor in those who had OME. Other risk factors were not evaluated. The study found hearing impairment in 78.7 % of the children with OME. Children with neurological disorders were not evaluated because the numbers were too small to make any statistical inference.[32]

A study on epidemiology of middle ear effusion in Nigeria assessing risk factors and disease burden found a low prevalence of less than 1 percent. The study was carried out in children aged 0-12 years. Peak incidence was found in children aged 1-4 yrs (22.5%), with the least incidence in the age group below one year. The study found an association between exposure to household smoke, lower level of mother's education, more than four siblings in the same household and occurrence of OME.[33]

3.0 STUDY JUSTIFICATION

Children with cerebral palsy have been postulated to have a higher chance of developing middle ear effusion due to their muscular disorders and other cor-mobidities like convulsive disorders. These children are more susceptible to complications of middle ear effusion, which include hearing loss, cognitive decline and vestibular disorders among others. These complications tend to worsen the already existing neurophysiological deficits. There is a possibility that middle ear effusion is underdiagnosed and undertreated in these children in our set up, yet this condition can be easily diagnosed and treated. Data from this study might help to sensitize healthcare providers on the need for screening and early identification and treatment of middle ear effusion in these children

3.1 Research Question

Does cerebral palsy predispose children to development of middle ear effusion?

3.2 Broad Objective

To determine whether cerebral palsy is associated with development of middle ear effusion at Kenyatta National hospital.

3.3 Specific objectives

i. To determine the prevalence of OME in children with cerebral palsy versus control group.
ii. To describe the social-demographic characteristics of children with cerebral palsy and those without.
iii. To describe the tympanometric characteristics in children with cerebral palsy versus control group.
iv. To determine the association between specific risk factors in children with cerebral palsy with middle ear effusion.

4.0 METHODOLOGY

4.1 Study design

This was a case-control hospital based study.

4.2 Study Area

The study was carried out at the following clinics at the Kenyatta National Hospital: E.N.T, Pediatric neurology, Occupational, Physiotherapy, Orthopedic, Dental and Well baby clinic.

4.3 Study Population

The study population comprised children with cerebral palsy and controls between the ages of 6 months to 15 years who had met the inclusion criteria.

4.4. Inclusion Criteria

i) Children aged between 6 months to 15 years.

ii) Children with cerebral palsy who have already been diagnosed by a pediatric neurologist.

iii) Children whose parents/guardians have consented to the study.

4.5 Exclusion Criteria

i) Children with anatomic defects that precludes proper examination of the ear.

ii) Children with other neurological and craniofacial disorders.

4.6 Controls

Controls comprised children without any of the aforementioned exclusion criteria for the cases. They were matched for age and sex with the cases.

4.7 Sampling and Sample Size

Convenient sampling was used to recruit both cases and controls until the desired sample size was achieved.

4.8 Sample Size Calculation

The main aim of this study was to assess the role of cerebral palsy in the pathogenesis of OME by comparing the prevalence of middle ear effusion between patients with cerebral palsy and those without. There is no Kenyan data on this subject but a study in Benin City in Nigeria showed that the prevalence of OME in children with cerebral palsy and those without were 68.8% and 25.9%, respectively (37). Using this prevalence as the basis, the sample size was calculated using Kirk and Sterne (2003) formula below: [34]

$$N = \frac{u\sqrt{p1\,(1-p_1) + p_2\,(1-p_2)} + v\sqrt{(p_1 + p_2)\,1-(p1+p2)/2}}{(p1 - p2)^2}^2$$

Where $p_1 = 0.688$; $p_2 = 0.259$; N = minimum number of children in each group; μ = one-sided percentage point of the normal distribution corresponding to 100% less the power (95%) in this case 1.28 and; ν = percentage point of the normal distribution corresponding to the significance level of 5% (i.e. 1.96).

This formula gives a minimum number of 32 children in each group. Each month, an average of 10 children with cerebral palsy were seen at the Kenyatta National Hospital according to hospital records. Sixty-two cases and sixty-two controls were enrolled into the study during the study period.

4.9 Recruitment procedures

Cases

Cases were drawn from specialty clinics at the Kenyatta National hospital (Neurology, physiotherapy, occupational therapy). Upon meeting the inclusion criteria, they were taken through the process of informed consent, which involved a detailed explanation of the purpose of the study, its voluntary nature, benefits and confidentiality of the data collected.

Those who agreed to be part of the study had their children undergo a focused history taking, otoscopy and tympanogram evaluation.

Controls

Matched controls based on gender and age groups were approached and the study explained to them. They were recruited from well-baby clinic, dental clinic and fracture clinic. Informed consent was sought after a detailed explanation of the intent, benefit and risks of the study had been done. Those whose parents/guardians agreed to participate in the study had a focused history, otoscopy and tympanogram as for the cases. This was explained to them during the interview. They were informed of their examination findings and tympanogram results and referred for further care if abnormal.

4.10. Data collection Procedures

Patients who met inclusion criteria were recruited into the study by convenient sampling. An informed consent was a prerequisite before recruitment. Controls were matched for age and sex until the required sample size was achieved.

Otological history included additional risk factors for OME that these children could have been exposed to in their home environment.

Physical examination assessed for any abnormality of the external auditory canal and the middle ear.

Standard and Pneumatic otoscopy were used to examine the EAC and the tympanic membrane respectfully. Features suggestive of middle ear effusion like air bubbles, air-fluid levels, dull membrane with diminished mobility, bulging membrane without signs of acute inflammation, retraction pockets with prominent handle of the malleus were recorded in a data collection sheet. All the participants were subjected to tympanometric studies of the middle ear. Type B tympanogram was used to corroborate otoscopic findings of OME. Reduced/absent mobility of the tympanic membrane with significant negative middle ear pressure (type C1, C2 or C3 tympanogram) was also considered as middle ear effusion.

Tympanometric evaluation was done by a qualified audiologist at the audiology clinic of the Kenyatta National hospital. The machine model used was a calibrated interacoustics impedance audiometer AT 235 Serial number 745338.

A Probe with a tone frequency of 226 Hertz (HZ) and a tone intensity of 8 sdb SPL +/- 1.5 dl, a compliance interval of 0.1 to 0.6 ml and a pressure range between + 300 to - 330 dapa was used.

4.11 Study Tools

The following tools were used in the study:

i. Data collection sheet
ii. Standard otoscope
iii. Pneumatic otoscope
iv. Impedance Audiometer.

4.12 Data Collection

A structured questionnaire was used together information on history, physical examination and tympanometry results.

4.13 Data Management and Analysis

Data collection was done using a data collection sheet and entered into excel spreadsheet for cleaning before being analysed in a computer database by use of SPSS version 23. The prevalence of middle ear effusion between cases and controls was calculated and presented as percentages and student t-test was used to compare the two. A P-value of <0.05 was considered statistically significant.

The socio-demographic characteristics of cases and control was analysed and presented as frequencies and proportions for categorical data and as means and standard deviations for continuous data. The tympanometric characteristics in children with cerebral palsy versus control group was analysed with use of student t-test. Associated risk factors that could further predispose these children to middle ear effusion was analysed with use of Pearson Chi-square tests, and significant factors subjected to multivariate analysis with use of logistic regression. P values and 95% confidence interval was calculated and reported where applicable. P values <0.05 was considered statistically significant.

4.14 Ethical Considerations

Permission to undertake this study was sought from Kenyatta National Hospital and University of Nairobi Ethics and Research Committee prior to commencement of the study. A letter of approval was obtained from the department of Surgery and permission to commence the study was sought from the Kenyatta National Hospital Administration.

Informed consent was obtained from the caregivers after explaining to them the objective and methodology of the study.

The principal investigator undertook the discussion on informed consent and ensured that caregivers had understood the decisions that were making. Covid 19 protocols in terms of masking, social distancing, avoidance of crowds and hand sanitizing were adhered to.

The caregivers were free to opt out of the study and their children continued receiving care with no discrimination whatsoever.

All patients' information was held in confidentiality and only used for the purpose for which the study was intended. Children diagnosed with middle ear effusion were informed of the findings and referred to the department of Ear, Nose and Throat clinic at the Kenyatta National Hospital for further management. The study did not involve any invasive procedures and tympanometric evaluation was paid for by the principal investigator.

The results of this study shall be distributed to the hospital, presented in medical conferences, and published in medical journals and public media where necessary for the benefit of the medical profession and the lay public.

There was no conflict of interest in this study.

4.15 Quality Control

The study collection tool was tested for accuracy of data collection before commencement of the study and appropriate changes made. The impedance Audiometer was recalibrated before commencement of the study.

Only the principal investigator did the examination and history taking. A qualified audiologist from the audiology clinic at the Kenyatta National hospital did the impedance audiometric testing.

5.0 RESULTS

The main objective of the study was to study the point prevalence of middle ear effusion between children with cerebral palsy and those without. Specific risk factors for middle ear effusion and tympanometric characteristics of the study participants were also evaluated.

5.1 Social-Demographic characteristics of study population.

A total of 124 participants were enrolled into the study. Among these, 62 had cerebral palsy while 62 did not. Those with cerebral palsy were 37 males and 25 females who were matched for age and sex with the control group giving a total sex distribution of 74 (59.7%) for males and 50 (40.3%) for females with a male to female ratio of 1.5:1.

Table 1- Sex distribution between cases and controls

Variable	Class		Total
	Cases	Controls	
Sex			
Male	37(50.0)	37(50.0)	74(59.7%)
Female	25(50.0)	25(50.0)	50(40.3%)
Total	62(100.0)	62(100.0)	124(100.0)

This is illustrated in the pie chart as shown below:

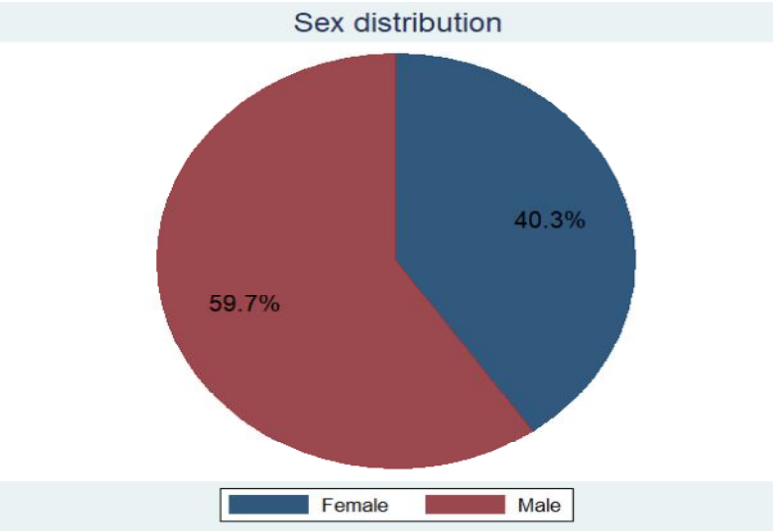

Figure 1- Gender distribution of the study participants

Majority of study participants had their ages ranging between 13 to 36 months with a mean age of 22 months for the cases and 20.4 months for the controls and total mean of 21 months +/- 15.1 months (range 6 months- 96 months)

Table 2- Age distribution between cases and controls

Variable	Class		Total
	Cases	Controls	
Age (months)			
0 – 1	0(0.0)	0(0.0)	0(0.0)
1 – 12	18 (46.2)	18 (53.3)	36(32.5)
13 – 36	35 (53.8)	35 (46.2)	70(54.2)
37 – 72	8 (57.1)	8 (42.9)	16(11.7)
73 – 144	1 (50.0)	1 (50.0)	2(1.7)
145-180	0(0.0)	0(0.0)	0(0.0)
Total	62(100.0)	62(100.0)	124(100.0)
Mean age (months)	22	20.4	21.0 +/- 15.1

The figure below illustrates the age distribution of the study participants:

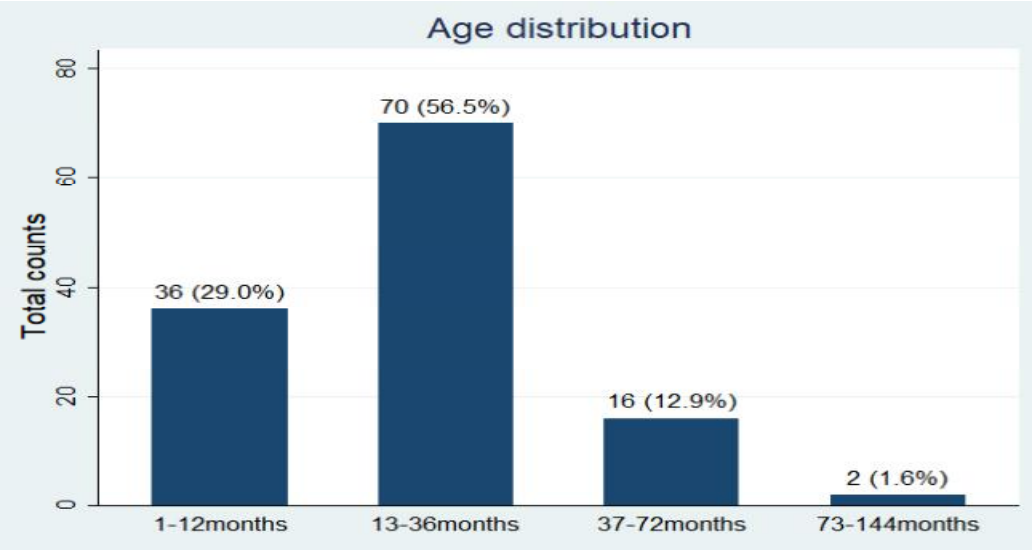

Figure 2- Age distribution of the study participants.

(*Age groups courtesy of the National Institute of child Health and Human Development)*

Key socio-demographic parameters studied showed that most of the mothers had some form of education with secondary education being the most common. The mean birth weight for the cases and controls was 3.05kg and 3.08kg respectively and a total mean of 3.06 +/- 0.52kg. Controls had a higher number of siblings with a mean of 2.7 compared to 1.9 among the cases. Both groups had similar exposure to household smoke as illustrated in the table below:

Table 3- Socio-demographic characteristics distribution

Variable	**Class**		**Total**
	Cases	**Controls**	
Mother education level			
No school	1 (100.0)	0(0.0)	1(0.8)
Primary not completed	2 (50.0)	2 (50.0)	4(3.2)
Primary completed	8 (34.8)	11 (65.2)	19(18.5)
Secondary	26 (55.3)	23 (44.7)	49(37.9)
College	21 (47.7)	23 (52.3)	44(35.5)
University	4 (57.1)	3 (42.9)	7(5.6)
Birth weight			
<1.5	2 (100.0)	0(0.0)	2(1.6)
1.5 – 2.499	7 (50.0)	8 (50.0)	14(11.3)
2.5 – 4.0	51 (49.6)	54 (51.4)	105(84.7)
>4.0	3 (100.0)	0(0.0)	3(2.4)
Mean Birth weight	3.05	3.08	3.07
No. of siblings			
1	28 (73.7)	10 (26.3)	38(30.6)
2	16 (48.5)	19 (51.5)	35(28.2)
3	15 (46.9)	19 (53.1)	34(27.4)
4	3 (25.0)	9 (75.0)	12(9.7)
5	0(0.0)	5 (100.0)	5(4.0)
Mean no. of siblings	1.9	2.7	2.3
Smoke exposure			
Yes	32 (53.3)	28 (46.7)	60(48.4)
No	30 (50.0)	34 (50.0)	64(51.6)

The bar graphs below represent the distribution birth weight among the study participants.

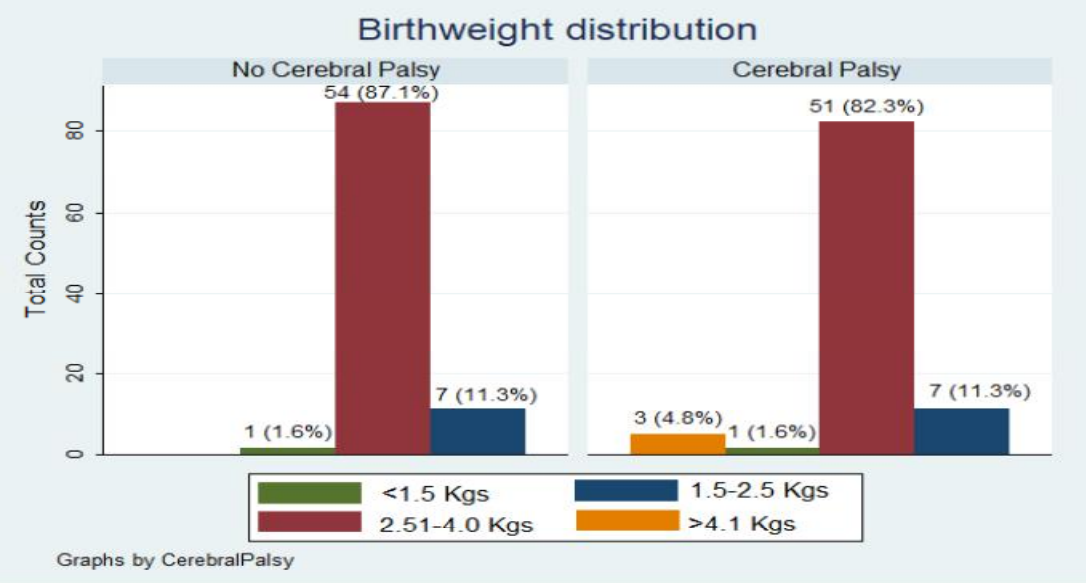

Figure 3- Distribution of birth weight in cases and controls.

5.2 Prevalence of Middle ear Effusion between cases and controls

There were 14 (22.6%) cases with middle ear effusion in children with cerebral palsy and 7(11.3%) cases in children without cerebral palsy. The difference was not statistically significant (*p=0.094*). This is illustrated in the table below:

Table 4- Prevalence of middle ear effusion between cases and controls

		Study participants		TOTAL	
	VARIABLE	**CASES**	**CONTROLS**		***Pvalue 0.094***
Middle Ear Effusion	Yes	14	7	21	
	No	48	55	103	
		62	62		
	Prevalence	22.6%	11.3%		
	Overall prevalence			16.9%	

5.3 Tympanometric findings between the cases and controls

The table below illustrates the various tympanometric graphs that were obtained. Type A tracing was common both in cases and control while the least common tracing was type C3. Type B tracing was more common among the cases than controls:

Table 5- Tympanometric tracings between cases and controls

Variable	Cases	Controls	Total	Percentages	Diagnosis
A	26	36	62	50.0	Normal
A’	4	4	8	6.7	Negative pressure above -100
AD	3	2	5	4.1	Elevated peak compliance
As	12	8	20	16.7	Depressed peak compliance
B	10	4	14	10.0	Middle ear Effusion
C1	3	3	6	5.8	Negative pressure -100 to -150
C2	4	2	6	5.0	Negative pressure -151 to -200
C3	1	2	3	2.5	Negative pressure <- 200

Table 6-Tympanometric findings in children with cerebral palsy

Variable	Right Ear N=62(%)	Left Ear N=62(%)	Diagnosis
A	26 (41.9)	28 (45.2)	Normal
A’	4 (6.5)	2 (3.2)	Normal
As	12 (19.4)	12 (19.4)	Reduced compliance
Ad	3 (4.8)	0 (0.0)	Increased compliance
B	9 (14.5)	10 (16.1)	Middle Ear Effusion (MEE)
C1	3 (4.8)	5 (8.1)	Eustachian tube dysfunction
C2	4 (6.5)	2 (3.2)	Eustachian tube dysfunction
C3	1 (1.6)	3 (4.8)	Eustachian tube dysfunction
Total	62(100.0)	62(100.0)	

Middle ear compliance was greater among the controls than cases with left middle ear compliance being statistically significant. In addition, there were more negative middle ear pressure readings among the cases than controls as illustrated in the table below.

Table 7- Ear specific Middle ear compliance, Middle ear pressures and Gradients

Tympanogram variable	**Population**	**Mean**	**Std**	**CI**	***P value (t test)***
Right middle ear compliance	Cases	0.38	0.47	0.26 – 0.49	*0.21*
	Controls	0.44	0.37	0.34 - 0.54	
Left middle ear compliance	Cases	0.29	0.19	0.24 – 0.34	*0.04*
	Controls	0.36	0.20	0.30 – 0.41	
Right Middle ear pressure	Cases	-34.6	93.5	-58.3 – -10.84	*0.14*
	Controls	-16.2	94.6	-41.11 – 8.66	
Left middle ear pressure	Cases	-22.3	11.4	-45.2 – 0.52	*0.08*
	Controls	-1.1	10.2	-21.3 – 19.2	
Right ear gradient	Cases	0.27	0.52	0.14 – 0.36	*0.38*
	Controls	0.29	0.30	0.21 – 0.37	
Left ear gradient	Cases	0.23	0.05	0.13- 0.34	*0.50*
	Controls	0.24	0.02	0.19 – 0.28	

5.4 Identified risk factors associated with middle ear Effusion.

When the various factors associated with middle ear effusion were analysed further, it was found that low birth weight and duration of exclusive breastfeeding below six months had statistically significant relationship with prevalence of middle ear effusion among the cases and controls as illustrated in the table below:

Table 8- Association between identified risk factors and Middle Ear effusion (MEE) in cases and controls.

Variable	**Middle Ear Effusion**			
	Yes	**No**	**Total**	
Age (months)				
0 – 1	0(0.0)	0(0.0)	0	P = 0.501 OR-0.8 CI- 0.542- 1.891
1 – 12	9(14.3)	27(75.7)	36	
13 – 36	10(14.3)	60(85.7)	70	
37 – 72	2(12.5)	14(87.5)	16	
73 – 144	0(0.0)	2(100.0)	2	
Mean age	21 months SD 15.10 Range 6 – 96			
Gender				P=0.141 OR-2.4 CI-0.812-7.341
Male	16(21.6)	58(78.4)	74	
Female	5(10.0)	45(90.0)	50	
Mother's education level				P=0.295 OR-1.3 CI-0.997-3.451
No school	0(0.0)	1(100.0)	1	
Primary not completed	2(50.0)	2(50.0)	4	
Primary	2(8.7)	21(91.3)	23	
Secondary	10(20.4)	39(79.6)	49	
College	33(50.0)	33(50.0)	66	
University	1(14.3)	6(85.7)	7	
Birth weight (Kgs)				**P=0.014** **OR-6.2** **CI-4.211-9.723**
<1.5	**2(100.0)**	**0(0.0)**	**2**	
1.5-2.49	2(15.4)	11(84.6)	13	
2.5 – 4.0	17(16.0)	89(84.0)	106	
>4.0	0(0.0)	3(100.0)	3	
Mean birth weight	3.06kgs SD 0.52 Range 1.5-5			
No. of siblings				P=0.481 OR-1.4 C1- 0.663-3.231
1	29(76.3)	9(23.7)	38	
2	30(85.7)	5(14.3)	35	
3	29(85.3)	5(14.7)	34	
4	11(91.7)	19(8.3)	12	
5	4(80.0)	1(20.0)	5	
Smoke exposure				P=1.001 OR- 1.0 CI-0.557-2.341
Yes	10(16.7)	50(83.3)	60	
No	11(17.2)	53(82.8)	64	
Length of exclusive breast feeding				**P=0.007** **OR- 4.56** **C1-1.451-9.451**
<6 months	**9(34.6)**	**17(65.4)**	**26**	
>6 months	12(12.2)	86(87.8)	98	

When these risk factors were subjected to bivariate analysis in cases only, we found that low birth weight and length of exclusive breastfeeding of less than six months were still significantly associated with middle ear effusion as shown in the table below:

Table 9- Association between identified risk factors and middle ear effusion in cases

Variable	**Middle Ear Effusion**			
	Yes	**No**	**Total**	
Age (months)				
0 – 1	0(0.0)	0(0.0)	0	P=0.356 OR- 0.98 CI- 0.789-7.451
1 – 12	4(22.2)	14(77.8)	18	
13 – 36	8(22.9)	27(77.1)	35	
37 – 72	2(25.0)	6(75.0)	8	
73 – 144	0(0.0)	1(100.0)	1	
Mean age	22 SD 15.18 Range 6 – 84			
Gender				P=0.129 OR- 2.78 C1-0.981-5.231
Male	11(29.7)	26(70.3)	37	
Female	3(12.0)	22(88.0)	25	
Mother's education level				P=0.720 OR- 0.78 CI-0.891-4.521
No school	0(0.0)	1(100.0)	1	
Primary not completed	1(50.0)	1(50.0)	2	
Primary	1(12.5)	7(87.5)	8	
Secondary	7(26.9)	19(73.1)	26	
Diploma	5(23.8)	16(76.2)	21	
Bachelor	0(0.0)	4(100.0)	4	
Birth weight (Kgs)				**P=0.014 OR-10.16 C1-1.051-2.805**
<1.5	**2(100.0)**	**0(0.0)**	**2**	
1.5-2.5	1(20.0)	4(80.0)	5	
2.6 – 4.0	12(30.8)	39(69.2)	39	
>4.0	0(0.0)	3(100.0)	3	
Mean birth weight	3.05 SD 0.52 Range 1.5 – 5			
No. of siblings				P=0.480 OR-0.87 C1- 0.765-7.771
1	7(25.0)	21(75.0)	28	
2	2(12.5)	14(87.5)	16	
3	5(33.3)	10(66.7)	15	
4	0(0.0)	3(100.0)	3	
5	0(0.0)	0(0.0)	0	
Smoke exposure				P=0.891 OR-0.74 C1-0.456-10.561
Yes	7(21.9)	25(78.1)	32	
No	7(23.3)	23(76.7)	30	
Length of exclusive breast feeding				**0.011 OR-3.19 CI-1.230-6.321**
<6 months	**6(50.0)**	**6(50.0)**	**12**	
>6 months	8(16.0)	42(84.0)	50	

On further bivariate analysis between identified risk factors and middle ear effusion in the control group, there was no statistically significant risk factor identified as shown below:

Table 10- Association between identified risk factors and middle ear effusion in controls:

Variable	Middle Ear Effusion			P values
	Yes	No	Total	
Age (months)				
0 – 1	0(0.0)	0(0.0)	0	P=0.089 OR-1.74 CI- 0.889-2.891
1 – 12	5(27.8)	13(72.2)	18	
13 – 36	2(5.7)	33(94.3)	35	
37 – 72	0(0.0)	8(100.0)	8	
73 – 144	0(0.0)	1(100.0)	1	
Mean age	21.45 SD 15.15 Range 6 – 96			
Sex				P=0.691 OR- 0.89 CI-0.771-3.211
Male	5(14.7)	32(85.3)	34	
Female	2(8.0)	23(82.0)	25	
Mother's education level				P=0.489 OR-0.87 CI- 0.952-2.421
No school	0(0.0)	0(0.0)	0	
Primary not completed	1(50.0)	1(50.0)	2	
Primary	1(6.7)	14(93.3)	15	
Secondary	3(13.0)	20(87.0)	23	
Diploma	2(10.5)	17(89.5)	19	
Bachelor	0(0.0)	39(100.0)	3	
Birth weight (Kgs)				P=0.587 OR-0.94 CI- 0.342-3.332
<2.5	1(14.3)	6(85.7)	7	
2.5 – 4.0	6(11.1)	49(88.9)	54	
>4.0	0(0.0)	0(0.0)	0	
Mean birth weight	3.08 SD 0.53 Range 1.5 – 4			
No. of siblings				P=0.225 OR-1.12 C1-0.771-4.521
1	2(20.0)	8(80.0)	10	
2	3(15.8)	16(84.2)	19	
3	0(0.0)	19(100.0)	19	
4	1(11.1)	8(88.9)	9	
5	1(20.0)	4(80.0)	5	
Smoke exposure				P=0.610 OR- 0.77 CI-0.787-2.342
Yes	3(10.7)	25(89.3)	28	
No	4(11.8)	30(88.2)	34	
Length of exclusive breast feeding				P=0.184 OR-0.99 CI- 0.887-3.123
<6 months	3(21.4)	11(79.6)	14	
>6 months	4(8.3)	44(91.7)	48	

6.0 DISCUSSION, CONCLUSION & RECOMMENDATIONS

6.1 Discussion

A total of 124 study participants were recruited for this study. The age range of the subjects was from 6 months to seven years with a mean age of 21 months among the cases and 20.4 months among controls. Majority of the patients in both cases and controls were therefore less than five years. Male gender predominated both the cases and controls at 37 (52.1%) and 34(47.9%) respectively. Tella BA et al[35] found higher incidence of cerebral palsy among male children compared to females. The reasons for this are not clear.

The point prevalence of middle ear effusion was to found to be higher in children with cerebral palsy compared to controls at 14(22.6%) and 7(11.3%) respectively. In this study, there was no statistical significance *(p=0.094).* This finding differs with Akpalaba et al study that found a prevalence of 68.8% *(p<0.001)* of middle ear effusion in children with cerebral palsy.[27] Mohammed et al study conducted in India found a prevalence of 45% *(p<0.05)* for both middle ear effusion and eustachian tube dysfunction, while Hanan et al found a prevalence of 52% *(p<0.05)* for middle ear effusion.[28,29] The higher prevalence in these children could be associated with neurological challenges with increased risk of regurgitation while feeding, convulsive disorders and sedating side effects of treatment. Furthermore, these children experience a wide range of hygiene challenges.

Akpalaba in his study on tympanometric evaluation in cerebral palsy patients in Benin City Nigeria found a prevalence of middle ear effusion at 68.8% in children with cerebral palsy.[27] In his methodology however; he used tympanograms type B, C1 and C2 to diagnose middle ear effusion, which explains the high prevalence. In addition Pneumatic otoscopy was not done. Our study had more strict criteria in that a type B tracing was required for diagnosis of MEE and any other tracing combined with abnormal pneumatic otoscopic findings.

The study by Mohammed evaluated 117 children with cerebral palsy and found a prevalence of middle ear effusion and eustachian tube dysfunction at 45%.[28] The study was done in children aged 2-10 years. In his study, he did not separate middle ear effusion from pure eustachian tube dysfunction and therefore the percentage attributable to middle ear effusion was not given.

Hanan on the under hand studied 30 children with spastic quadriplegic cerebral palsy and found a prevalence of 52% for middle ear effusion.[29] Our study in contrast looked at all forms of cerebral palsy since information on different categories of cerebral palsy was not provided.

Majority of our participants had a type A tympanogram 62(50.0%) tracing followed by type As 20(16.7%). This pattern was observed in both cases and controls. Type As tracing is associated with reduced peak compliance. Some of the causes could be foreign body resistance in the external auditory canal during testing e.g wax or a thick poorly compliant tympanic membrane due to previous middle ear infections. Akpalaba et al found type A tympanogram as the commonest tracing in both cases and controls at 21.4% and 59.8% respectively.[27] Type C 1 tracing was the second most common tracing at 47.3% among the cases and 12.1% in the control group. More patients with cerebral palsy had negative middle ear pressure compared to controls, a finding which was also noted in our study. This finding could point towards increased eustachian tube dysfunction in cerebral palsy patients from their neurological status.[15]

Our study evaluated different risk factors associated with middle ear effusion. We found a statistically significant association between very low birth weight and length of exclusive breastfeeding for less than six months and middle ear effusion in children with cerebral palsy (*p-values 0.014 OR 10.16 C1 1.051-2.805; and p= 0.011 OR 3.19 CI 1.230-6.320*) respectively.

A study by Renata found breastfeeding to be a protective factor against middle ear effusion in children less than one year.[36] In this study we found that children who were exclusively breastfed in their first six months of life were 4.5 times less likely to develop MEE in both cases and controls. Among the cases, those who were breastfed exclusively for six months were three times less likely to develop middle ear effusion. Breastfeeding has been shown to strengthen childhood immunity and protects against the negative effects of bottle-feeding which may explain this finding. Psychological trauma could lead to reduced lactation periods among mothers taking care of these children.

A study by Manji found 3.77 times increased risk of developing acute otitis media and middle ear effusion in children with low birth weight.[37] Prematurity has been associated with increased eustachian tube dysfunction and early childhood admission to nursery with frequent hospitalizations could explain this finding. Prematurity is also a risk factor for cerebral palsy.

Other factors studied included age, mother's level of education, number of siblings per household and exposure to smoke. All these factors have been associated with middle ear effusion in different studies in literature.[2,3,6,20,31] .Akpalaba's study looked at predictors of middle ear pathology in children with cerebral palsy which included age, sex and degree of disability but found no statistically significant association. Studies on risk factors however require long prospective follow up to better establish the role of these factors on pathogenesis of middle ear effusion.

6.2 Conclusion

In conclusion, this study has found that children with cerebral palsy are two times more likely to develop middle ear effusion compared to those without although the 95% confidence interval was not statistically significant. Reduced middle ear compliance and negative middle ear pressures in children with cerebral palsy points towards eustachian tube dysfunction. We found statistically significant association between middle ear effusion, very low birth weight and duration of exclusive breast-feeding for less than six months in children with cerebral palsy.

6.3 Study limitations

Recall bias by parents/guardians during history taking could affect the accuracy of data collection.

6.4 Recommendations

We recommend that children with cerebral palsy born with low birth weight should be monitored closely for middle ear effusion for prompt diagnosis and intervention. Children with cerebral palsy who have less than six months of exclusive breastfeeding should also be monitored closely for middle ear effusion. Further large prospective studies should be carried out in multiple centers in children with cerebral palsy to better define the prevalence of middle ear effusion and associated risk factors.

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TIMELINES

The study period from proposal writing to completion is as stipulated:

	2019				**2020**												2021		
	Sep	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**March**
Proposal Development	■	■																	
Presentation to the department		■																	
Corrections to the department			■	■															
Submission to KNH-ERC					■	■	■	■	■	■									
Data collection											■	■	■	■	■	■	■	■	
Data Analysis																			■
Final Presentation																			■

BUDGET

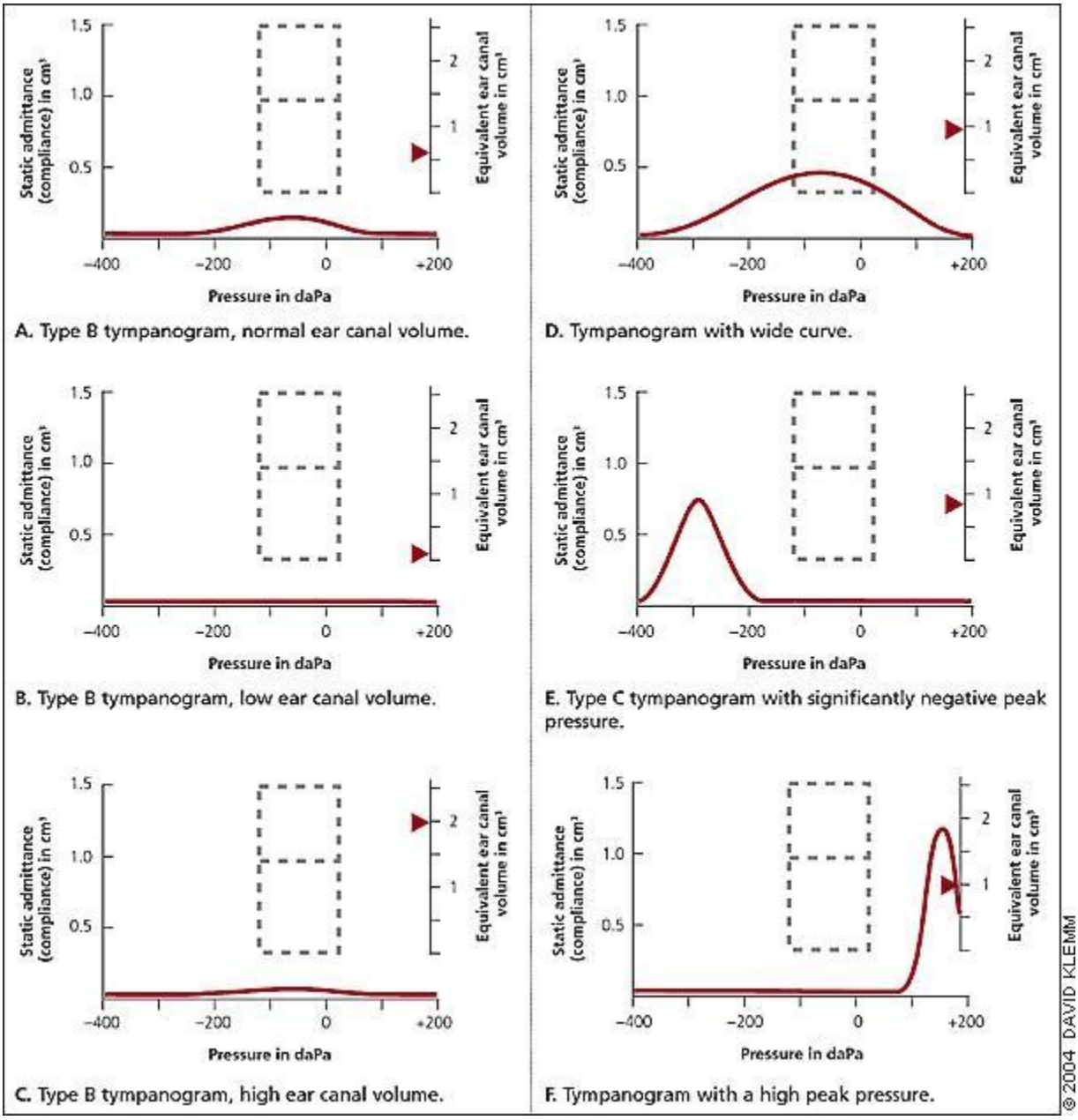
The estimated budget for the whole study is tabulated as follows:

Item	**Cost**
Stationery	**24850**
Pneumatic otoscope	**15000**
Statistician fee	**35000**
Tympanograms	**96000**
Publishing fee	**10000**
Miscellaneous	**20, 085**
Total Cost	**200,935**

APPENDICES

Appendix 1: Tympanograms Charts

Courtesy of American academy of family physicians



Appendix II: General Information and Consent

PARTICIPANT INFORMATION AND CONSENT FORM FOR ENROLLMENT IN THE STUDY

Title of Study: Otitis media with effusion in children with cerebral palsy at the Kenyatta National Hospital. A case-control study.

Principal Investigator\and institutional affiliation: DR OVAMBA DANIEL, POSTGRADUATE STUDENT, UNIVERSITY OF NAIROBI

Introduction:

I would like to inform you about my study on fluid in the middle ear cavity in children. This consent form is aimed at giving you the information you need to enable you make an informed decision. You will be allowed to ask any questions regarding the study. Where you do not understand the benefits and risks of the study, kindly seek clarification. Upon answering your questions and concerns to your satisfaction, you may decide to be included in the study or not. You shall be required to sign a consent form that you have agreed to voluntarily participate in this study. Note that your decision to participate in this study should be voluntary and you may withdraw from the study if you wish to do so without having to give reasons for your withdrawal.

Refusal to participate in the research will not affect the services your child is entitled to in this health facility or other facilities. We will give you a copy of this form for your records.

May I continue? YES / NO

This study has approval by The Kenyatta National Hospital-University of Nairobi Ethics and Research Committee protocol No……..

WHAT IS THIS STUDY ABOUT?

The researcher listed above is examining your child for the presence of fluid in the middle ear. Parents/ guardians in this research study will be asked questions about specific risk factors that their children may have been exposed to in their home environment. Participant will undergo assessment of their middle ear using a special machine called impedance audiometer. There will be approximately 120 participants divided into 60 children with cerebral palsy and 60 without cerebral palsy. We are asking for your consent to consider participating in this study.

WHAT WILL HAPPEN IF YOU DECIDE TO BE IN THIS RESEARCH STUDY?

If you agree to participate in this study, the following things will happen: You will be interviewed by the investigator in a private area where you feel comfortable answering questions. The interview will last approximately 15 minutes. The interview will cover risk factors associated with OME that your child could have been exposed to. Your child ears will be examined for any abnormality which shall be recorded down.

Your child will proceed to have a probe inserted into his/her ears where sound will be produced and measurements about the middle ear status obtained. We will ask for a telephone number where we can contact you if necessary. If you agree to provide your contact information, it will be used only by people working for this study and will never be shared with others. The reasons why we may need to contact you include: clarification on answers provided in the questionnaire.

ARE THERE ANY RISKS, HARMS DISCOMFORTS ASSOCIATED WITH THIS STUDY?

Medical research has the potential to introduce psychological, social, emotional and physical risks. Effort should always be put in place to minimize the risks. One potential risk of being in the study is loss of privacy. We will keep everything you tell us as confidential as possible. We will use a code number to identify your child in a password-protected computer database and will keep all your child's paper records in a locked file cabinet.

However, no system of protecting your child's confidentiality can be secure, so it is still possible that someone could find out your child was in this study and could find out information about you. In addition, answering questions in the interview may be uncomfortable for you. If there are any questions you do not want to answer, you can skip them. You have the right to refuse the interview or any questions asked during the interview.

There will be no bruise or swelling during examination of your child and tympanometry. In case of an injury, contact the study staff right away at the number provided at the end of this document. The study staff will treat you for minor conditions or refer you when necessary.

ARE THERE ANY BENEFITS BEING IN THIS STUDY?

We will refer your child to a hospital for care and support where necessary. In addition, the information you provide will help us better understand the relationship cerebral palsy and fluid in the middle ear. This might help us to develop better screening strategies for children like yours.

WILL BEING IN THIS STUDY COST YOU ANYTHING?

There are no costs to be incurred.

WILL YOU GET REFUND FOR ANY MONEY SPENT AS PART OF THIS STUDY?

There are no refunds as there are no costs.

WHAT IF YOU HAVE QUESTIONS IN FUTURE?

If you have further questions or concerns about participating in this study, please call or send a text message to the study staff at the number provided at the bottom of this page.

For more information about your rights as a research participant, you may contact the Secretary/Chairperson, Kenyatta National Hospital-University of Nairobi Ethics and Research Committee Telephone No. (254-020) 2726300-9. Ext. 44355 email uonknh_erc@uonbi.ac.ke.

The study staff will pay you back for your charges to these numbers if the call is for study-related communication.

WHAT ARE YOUR OTHER CHOICES?

Your decision to participate in research is voluntary. You are free to decline participation in the study and you can withdraw from the study at any time without injustice or loss of any benefits.

CONSENT FORM (STATEMENT OF CONSENT)

Participant's statement I have read this consent form or had the information read to me. I have had the chance to discuss this research study with a study counselor. I have had my questions answered in a language that I understand. The risks and benefits have been explained to me. I understand that my participation in this study is voluntary and that I may choose to withdraw any time. I freely agree to participate in this research study. I understand that all efforts will be made to keep information regarding my child's personal identity confidential.

By signing this consent form, I have not given up any of the legal rights that I have as a participant in a research study.

I agree to participate in this research study:	**Yes**	**No**
I agree to provide contact information for follow-up:	Yes	No

Participant printed name: _____

Participant signature / Thumb stamp _____Date _____

Researcher's statement

I, the undersigned, have fully explained the relevant details of this research study to the participant named above and believe that the participant has understood and has willingly and freely given his/her consent.

Researcher's Name: Dr Ovamba Daniel **Date**: _____

Signature_____

Role in the study: _____

For more information contact,

Dr Catherine Irungu. Consultant ENT Surgeon. Lecturer, University of Nairobi, 0722-385710.

Dr Musa Kipingor. Consultant ENT. KNH. 0722-749196

Ms Serah Ndegwa. Consultant Audiologist. University of Nairobi. 0721-310657

Witness Printed Name (*If witness is necessary)*

Name_____**Contact information** _____

Signature /Thumb stamp:_____**Date**; _____

Appendix III: Kiambatisho; Fomu ya Maelezo Kuhusu Idhini ya Wateja

Kitangulizi

Mimi ni daktari Ovamba Daniel anayesomea masoma ya juu ya kitengo cha upasuaji wa masikio, mapua, koo, kichwa na shingo katika chuo kikuu cha Nairobi. Ningependa kuomba idhini yako ya kushiriki katika utafiti wenye lengo la kujua kuwepo kwa mchanganyiko wa sikio la kati katika mtoto wako.

Jinsi ya kushiriki

Baada ya wewe kupeana idhini ya kushiriki katika utafiti huu, nitachunguza masikio ya mtoto wako, kisha utajibu maswali kadhaa nitakayokuuliza. Mtoto wako atafanyiwa uchunguzi zaidi wa kuthathmini kuwepo kwa mchanganyiko wa sikio la kati kwa kutumia chombo kinachoitwa *impedence audiometer*. Hakuna gharama yoyote zaidi utakayolipishwa na hakuna madhara yoyote ya kushiriki katika utafiti huu.

Una haki ya kuondoa mtoto wako kutoka kwa utafiti huu wakati wowote bila adhabu yoyote. Utapewa habari kuhusu uchunguzi utakaofanywa na umuhimu wa matokea yatakayopatikana.

Jinsi gani kushiriki kwako kunaweza kuleta madhara?

Utafiti huu hautakudhuru kwa njia yoyote; taarifa yote kuhusu mgonjwa wako itakuwa ni siri, utambulizo wa mtoto wako pia utakuwa kwa siri.

Je tutafanyia nini matokeo ya utafiti huu?

Maarifa tutakayopata yatasaidia kuboresha huduma inayopewa watoto walio na ugonjwa wa utindio wa ubongo.

Kuna uwezekano wa kuchapishwa kwa matokeo ya utafiti huu katika majarida ya kisayansi au kuwakilishwa katika mikutano ya kisayansi na umma kwa jumla bila kuwataja wahusika.

Je umeridhika?

Iwapo umeridhishwa na maelezo uliyoyasoma na kufafanuliwa, tafadhali weka sahihi yako kwenye fomu ya idhini inayofuata:

(ii) Sehemu ya pili – Idhini ya mgonjwa

Mimi (Jina)…..... kwa hiari yangu, nimekubali mtoto wangu kushiriki katika utafiti huu ambao unafanywa na Daktari Ovamba Daniel. Nimeelezewa manufaa na madhara ya utafiti huu kwa undani na nimeridhika.

Jina la Mzazi/Mlezi……

Sahihi……...

Tarehe……..

Nambari ya utafiti……..

Appendix IV: Data Collection Questionnaire

Code No……..

Date of birth……

Sex……..

Cerebral Palsy (Case)…… No Cerebral Palsy (control)……: Tick appropriately.

Selected risk factors for OME.

1. Gestational age……...
2. Birth weight……
3. Breastfeeding history……..Y/N. If yes duration…….
4. Number of siblings……...
5. Mother's education level……..
6. Exposure to smoke…….Y/N. If yes, passive cigarrete smoke .....or Household wood smoke……..

Otoscopic findings:

Site	Left Ear	Right ear
External ear		
EAC		
Tympanic membrane	Colour- Mobility- Ai-fluid level- Retractions- Other-	Colour- Mobility- Air fluid level- Retractions- Other-

Type of tympanogram

Ear	A	A'	As	AD	B	C1	C2	C3	Pressure	Gradient	Compliance
Right											
Left											

Appendix V: Study Registration Certificate

KNH/R&P/FORM/01

KENYATTA NATIONAL HOSPITAL
P.O. Box 20723-00202 Nairobi

Tel.: 2726300/2726450/2726565
Research & Programs: Ext. 44705
Fax: 2725272
Email: knhresearch@gmail.com

Study Registration Certificate

1. Name of the Principal Investigator/Researcher
   DR OVAMBA DANIEL
2. Email address: dovamba9@gmail.com Tel No. 0726773878
3. Contact person (if different from PI) -
4. Email address: - Tel No. -
5. Study Title
   MIDDLE EFFUSION IN CHILDREN WITH CEREBRAL PALSY.
6. Department where the study will be conducted E.N.T, physiotherapy, fracture clinic, Occupational therapy, well baby clinic, dental clinic, Pediatric & neurology clinic
   (Please attach copy of Abstract)
7. Endorsed by Research Coordinator of the KNH Department where the study will be conducted.
   Name: ..... Signature ..... Date .....
8. Endorsed by KNH Head of Department where study will be conducted.
   Name: DR J.K. KAMAU Signature ..... Date 8/09/20
9. KNH-UoN Ethics Research Committee approved study number _____
   (Please attach copy of ERC approval)
10. I DR OVAMBA DANIEL commit to submit a report of my study findings to the Department where the study will be conducted and to the Department of Medical Research.
    Signature ..... Date 07/09/2020
11. Study Registration number (Dept/Number/Year) EHL /12 /2020
    (To be completed by Medical Research Department)
12. Research and Program Stamp _____
13. Studies conducted at Kenyatta National Hospital **must** be registered with the Department of Medical Research and investigators **must commit** to share results with the hospital.

KENYATTA NATIONAL HOSPITAL * P.O. Box 20723 - 00202 * NRD. * ENT Department * 08 SEP 2020

KENYATTA NATIONAL HOSPITAL * Research & Programs * 09 SEP 2020

Version 2: August 2014

Appendix VI: ETHICS APPROVAL LETTER

UNIVERSITY OF NAIROBI
COLLEGE OF HEALTH SCIENCES
P O BOX 19676 Code 00202
Telegrams: varsity
Tel:(254-020) 2726300 Ext 44355

KNH-UON ERC
Email: uonknh_erc@uonbi.ac.ke
Website: http://www.erc.uonbi.ac.ke
Facebook: https://www.facebook.com/uonknh.erc
Twitter: @UONKNH_ERC https://twitter.com/UONKNH_ERC

KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/173

9th June 2020

Dr. Daniel Ovamba
Reg. No.H58/87909/ 2016
Dept. of Surgery
School of Medicine
College of Health Sciences
University of Nairobi

Dear Dr. Ovamba

RESEARCH PROPOSAL – MIDDLE EAR EFFUSION IN CHILDREN WITH CEREBRAL PALSY: A CASE-CONTROL STUDY AT THE KENYATTA NATIONAL HOSPITAL (P2/01/2020)

This is to inform you that the KNH- UoN Ethics & Research Committee (KNH- UoN ERC) has reviewed and approved your above research proposal. The approval period is 9th June 2020 – 8th June 2021.

This approval is subject to compliance with the following requirements:

a. Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b. All changes (amendments, deviations, violations etc.) are submitted for review and approval by KNH-UoN ERC before implementation.
c. Death and life threatening problems and serious adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH-UoN ERC within 72 hours of notification.
d. Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH- UoN ERC within 72 hours.
e. Clearance for export of biological specimens must be obtained from KNH- UoN ERC for each batch of shipment.
f. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
g. Submission of an *executive summary* report within 90 days upon completion of the study. This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/ or plagiarism.