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RISK FACTORS OF ACUTE OTITIS MEDIA IN CHILDREN UNDER FIVE YEARS

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ABSTRACT

Introduction: Otitis media is one of the most prevalent childhood illnesses that can cause hearing loss. Otitis media affects almost two-thirds of children of all ages. This study aimed to investigate the factors that increase the chance of otitis media in preschool children in Erbil, Iraq. **Methods:** A case-control study was carried out among children attending Rapareen Pediatric Teaching Hospital, Brayati and Shady primary health care centers, and the ear, nose, throat department of Rizgary Teaching Hospital. The duration of the study was nine months. **Results:** There was a statistically significant difference between the age groups of cases and controls ($p<0.008$). No significant difference was found in terms of gender and the child's rank in the family. There was a highly significant difference between the two groups in terms of the mother's educational level and occupation status. Compared to controls a higher percentage of cases attended day-care (56% vs. 38%), were bottle fed during the first 6 months of life (54% vs. 40%), were bottle fed in the supine position (54% vs. 30%), were passive smokers (48% vs. 30%), were born pre-term (28% vs. 4%), had craniofacial anomalies (10% vs. 0%) and allergies (50% vs 18%). These findings were statistically significant ($p<0.05$). **Conclusion:** According to the findings of the present study, the highest incidence of acute otitis media was observed in children aged 1-2 years. Significant risk factors for acute otitis media included the mother's employment, daycare attendance, bottle feeding in the first six months of life, particularly in a supine position, latent smoking, premature birth, and craniofacial abnormalities.

KEYWORDS: Otitis media, Daycare attendance, Eustachian tube, Risk factors.

INTRODUCTION

Otitis Media, or inflammation of the middle ear is one of the most prevalent childhood illnesses that can cause hearing loss.[1] This disease is characterized by the presence of middle-ear effusion and the acute onset of signs and symptoms caused by middle-ear inflammation.[2] OM comprises the following: Acute Otitis media (AOM) is defined by signs and symptoms of an acute infection in addition to fluid in the middle ear, or middle ear effusion.[3] Recurrent acute otitis media (ROM) is defined as having at least three episodes of AOM in a period of 6 months, or four or more episodes in 12 months.[3] Otitis media with effusion (OME) is distinguished by the presence of middle ear effusion behind an intact tympanic membrane, but unlike AOM, OME is not associated with symptoms of an acute infection.[4] Chronic otitis media with effusion (COME) is chronic inflammation of the middle ear and mastoid cavity, the main symptom is persistent or recurrent ear discharge through a rupture in the tympanic membrane or a ventilation tube. The middle ear ossicles could be harmed by chronic suppurative OM, which also results in conductive hearing loss.[5]

Otitis media affects almost two-thirds of children of all ages.[1] OM occurs at least three times in 75% of children throughout their first three years of life.[6] It is estimated that 709 million new cases of AOM occur annually, with 51% occurring in infants of five years old.[7] Many OM bouts cure spontaneously within three months; however, the illness recurs in 30% to 40% of children.[8]

AOM can be caused by a variety of factors including lowered immunological defenses, genetics and family history, cochlear devices, bacterial and viral pathogens, allergies and so on. OM is generally known as an inflammatory condition.[8-11] The resultant inflammatory process leads to edema of the eustachian tubes (ETs), which harms ventilation. In this condition, the tympanic membrane is visualized red and bulging. The middle ear

fluid may also contain pus. OM is caused by bacteria, fungi, or viruses and can occur in conjunction with other infections such as respiratory infections.[12] The primary and most common bacterial species causing OM are *Hemophilus influenzae, followed by Streptococcus pneumoniae*, and *Moraxella catarrhalis*.[13] Due to the increased usage of polysaccharide conjugate vaccines (PCVs) against *S. pneumoniae, H. influenzae* has been on the rise as an important cause of AOM.[14,16]

Risk factors of OM include genetic predisposition, age range of 1-4 years, Eustachian tube defect, microbial colonization at the adenoid and tonsils, and upper respiratory tract infection.[17-28]

The genetic portion comprises craniofacial anomalies (Down syndrome and cleft palate). Increased risk of OM may be due to the difference in the anatomy of the ear in children and adults. Children have shorter, wider, and more horizontally-situated ETs. This may allow the pathogen easier access to the middle ear.[17]

Children aged 1-4 years have an increased rates of AOM, children aged one being affected the most.[1] Increased risk of OM involves boys, bottle feeding, low socioeconomic conditions, living in packed environments including day care attendance, passive smoking, and pacifier usage in infants and toddlers.[18-24]

Eustachian tube defect is one of the most common causes of OM. The ET can become clogged as a result of tumors, enlarged adenoids, inflammatory causes, or sinusitis, all of which cause fluid to accumulate in the middle ear.[12] Eustachian tube defect is the failure of the ET in maintaining pressure equalization or mucociliary transport. Complications of untreated ETD include conductive hearing loss, chronic OM, OME (glue ear) and its sequelae, and eardrum retraction.[25]

The microbial colonization of the epithelial lining of Waldeyer's ring lymphatic tissues is a well-known clinical challenge during infancy due to frequent episodes of upper respiratory tract infections (URTIs).[26] Due to the accumulation of pathogens in the adenoids, there may be enlargement of the adenoids. This may result in obstruction of the airway and obliteration of normal functioning of the ET.[27]

Even mild URIs can cause the lymphoid tissues (Adenoid and Other lymphoid follicles) surrounding the ET to enlarge and obstruct the drainage of fluid from the middle ear. URTIs also damage the ciliated epithelium of the ET, which increases the likelihood of bacteria adhering to the wall and predisposes the individual to a superimposed bacterial infection.[28]

This study aimed to investigate the factors that increase the chance of otitis media in preschool children in Erbil, Iraq.

Subjects and Methods

Study setting

The current study was carried out at four selected locations, which are Rapareen Pediatric Teaching Hospital, Brayati and Shady primary health care centers (PHCCs), and the ENT department of Rizgary Teaching Hospital in Erbil city in the Kurdistan region of Iraq.

Study Design and Duration

A case-control study was carried out among children attending the above- mentioned locations. The duration of the study was seven months starting from first of January to the end of July, 2023. including, pilot study, data collection, statistical analysis, and writing the thesis.

Study Sample and Sample size

A convenient sampling method was used to recruit data from children's families attending the four previously mentioned sites. The target sample for the control group was 100 children and for the case group was 100 children. Comparison between variables were made between the control and the case groups.

Inclusion criteria

Case: Any child less than five years old with symptoms and signs of AOM with audiologic findings consistent with the diagnosis of AOM.

Control: Any child less than 5 years old with no symptoms and signs of AOM and normal audiologic examination.

Ethical consideration

This study was approved by the research ethics committee of the executive office of the Arab Board of Health specializations and a formal consent letter from Erbil Directorate of Health was obtained before the initiation of the research. All children's families recruited for this study were informed about the nature and scope of the study and a verbal consent was obtained from each of them before participation and before filling up the questionnaire. All parents were assured regarding the privacy and confidentiality of the collected data.

Data collection

Interviews

Patient data was collected via face-to-face interviews with their parents. The researcher used Arabic and Kurdish languages during the interviews. The aim and objectives of the study was explained to each patient in the language they were most comfortable with it to avoid misunderstandings. The answers were documented on the questionnaire forms. The participant's identity was kept anonymous instead an ID code was used. Otoscopic examinations were performed during the setting of the interview after obtaining a consent from parents.

Questionnaire

A questionnaire was designed by the researcher and thoroughly reviewed by the supervisor to include all the

relevant data required for this study. The questionnaire consisted of three parts.

First part: sociodemographic characteristics of the children were collected such as the age and gender of the child, the child's rank in the family, the family's residency, the educational level of the mother, occupation of the mother, and socioeconomic status of the family.

Second part: the child's presenting complaint was recorded as well as otoscopic examination result.

Third part: the socioeconomic status was determined according to study conducted and designed by Omar W, and Al-Hadithi T to assess the family's socioeconomic status.[29]

Statistical analysis

Statistical Package for Social Sciences (SPSS, version 25) was used to analyze data. The Chi-square test was used to compare between cases and control groups. Fisher's exact test was used when the expected count was less than 5 in more than 20% of the cells of the table. A p-value of <0.05 was considered statistically significant.

RESULTS

Distribution of sociodemographic characteristics among the Cases and The control groups

Table 1 shows the sociodemographic characteristics of the two groups both together and separately. The highest percentage of cases was among zero to less than one year old infants and the lowest number of cases was among age four to less than five years. When comparing the age ranges separately, there was a statistically significant difference between the two groups in the age range 1 up to 2 years and 3 up to 4 years of age. However no significant difference was found in terms of gender and the child's rank in the family. Table 1 also showed that the highest frequency of cases (73.3%) was recorded among children of mothers who were institution graduates and no cases were found among children of mothers who had a degree in higher education i.e.: Master's degree. There was a highly significant difference between the two groups in terms of mother's educational level (p= 0.001). A higher number of cases (57.1%) were found among children whose mothers were working and a lower number of cases (40.9%) were found among children of unemployed mothers and this finding was statistically significant (p=0.023). Regarding the socioeconomic status, 16 (100%) of cases were of low socioeconomic group compared to zero in control group and this was statistically significant.

Table 1: Distribution of sociodemographic characteristics among the cases and the control groups.

Variables		Total (n= 200)	Case (n= 100)	Control (n= 100)	p-value
Age group, years (%)	0-<1	6 (3%)	4 (66.7%)	2 (33.3%)	0.683**
	1-<2	64 (32%)	40 (62.5%)	24 (37.5%)	0.015*
	2-<3	44 (22%)	24 (45.5%)	20 (54.5%)	0.495*
	3-<4	54 (27%)	18 (64.3%)	36 (35.7%)	0.004*
	4-<5	32 (16%)	14 (43.8%)	18 (56.3%)	0.563*
Gender	Male	112 (56%)	58 (51.8%)	54 (48.2%)	0.569*
	Female	88 (44%)	42 (47.7%)	46 (52.3%)	
Child rank	First	88 (44%)	44 (50%)	44 (50%)	0.525*
	Second	80 (40%)	38 (47.5%)	42 (53.5%)	
	Third	22 (11%)	14 (63.6%)	8 (36.4%)	
	Fourth	10 (5%)	4 (40%)	6 (60%)	
Mother's educational level	High school or vocational	36 (18%)	16 (44.4%)	20 (55.6%)	0.001*
	Institute	60 (30%)	44 (73.3%)	16 (26.7%)	
	University graduate	66 (33%)	32 (48.5%)	34 (51.5%)	
	Higher education (MSc)	14 (7%)	0 (0%)	14 (100%)	
	PhD or equivalent	24 (12%)	8 (33.3%)	16 (66.7%)	
Mother's occupation status	Employed	112 (56%)	64 (57.1%)	48 (42.9%)	0.023
	Unemployed	88 (44%)	36 (40.9%)	52 (59.1%)	
Socioeconomic status	Low	16 (8%)	16 (100%)	0 (0%)	0.001*
	Medium	111 (55.5%)	68 (61.3%)	43 (38.7%)	
	High	73 (36.5%)	16 (21.9%)	57 (78.1%)	
Residency	Urban	184 (92%)	92 (92%)	92 (92%)	1.000
	Rural	16 (8%)	8 (8%)	8 (8%)	
*chi-square **Fisher's exact test					

Distribution of clinical presentation among Cases and Controls

Table 2 comprised the clinical symptoms that the child presented with. The most common clinical features among the cases were fever, irritability and loss of appetite which were found in 100% of the cases followed by otalgia (96%), ear pulling (96%), otorrhea (92%), vomiting (90%), diminished hearing (26%), Tinnitus (12%), and lastly vertigo (2%).

Table 2: Distribution of clinical presentation among cases and controls.

Clinical presentation	Total n= 200	Cases n= 100	Control n= 100
Fever	102 (51%)	100 (100%)	2 (2%)
Otalgia	98 (49%)	96 (96%)	2 (2%)
Irritability	100 (50%)	100 (100%)	0 (0%)
Loss of appetite	102 (51%)	100 (100%)	2 (2%)
Ear pulling	96 (48%)	96 (96%)	0 (0%)
Otorrhea	92 (46%)	92 (92%)	0 (0%)
Vomiting	92 (46%)	90 (90%)	2 (2%)
Diminished hearing	26 (13%)	26 (26%)	0 (0%)
Tinnitus	12 (6%)	12 (12%)	0 (0%)
Vertigo	2 (1%)	2 (2%)	0 (0%

Prevalence of risk factors among Cases and Controls

Table 3 shows the prevalence of risk factors among cases and controls. Compared to controls, a higher percentage of cases attended day-care (56% vs. 38%), were bottle fed during the first 6 months of life (54% vs. 40%), were bottle fed in supine position (54% vs. 30%), were passive smokers (48% vs. 30%), were born pre-term (28% vs. 4%), had craniofacial anomalies (10% vs. 0%) and allergies (50% vs 18%). These findings were statistically significant ($p<0.05$). Even though the percentage of pacifier use during the second 6 months of the child's life was higher among cases than controls, but this finding was not statistically significant.

Table 3: Prevalence of risk factors among Cases and Controls.

Risk factors	Total n= 200	Cases n= 100	Control n= 100	p-value
Day care attendance	94 (47%)	56 (56%)	38 (38%)	0.01*
Bottle feeding during the first 6 months of life	94 (47%)	54 (54%)	40 (40%)	0.047*
Supine bottle feeding	84 (42%)	54 (54%)	30 (30%)	0.001*
Pacifier use during the second 6 months of life	84 (42%)	44 (44%)	40 (40%)	0.567*
Passive smoking	78 (39%)	48 (48%)	30 (30%)	0.009*
Pre-term delivery	32 (16%)	28 (28%)	4 (4%)	0.001*
Craniofacial anomalies	10 (5%)	10 (10%)	0 (0%)	0.001*
Allergy	68 (34%)	50 (50%)	18 (18%)	0.001*
*chi-square **Fisher's exact test				

Frequency of signs of otitis media on otoscopic examination

Table 4 showed the frequency of otoscopic features of otitis media among cases. The most frequent finding was bulging tympanic membrane (76%), followed by Red/yellow/cloudy tympanic membrane (74%), presence of air-fluid level (72%), ear canal discharge (84%), and perforated tympanic membrane (24%).

Table 4: Frequency of signs of otitis media on otoscopic examination.

Otoscopic features	(%)
Red/yellow/cloudy tympanic membrane	74%
Bulging tympanic membrane	76%
Air-fluid level	72%
Perforated tympanic membrane	24%
Ear canal discharge	84%

Odds ratio (OR) and risk factors in causing otitis media

Table 5 showed the odds ratio of the studied risk factors in relation to otitis media. Evidently, all the studied risk factors increase the odds of having otitis media but the risk factor that is most effective was being born preterm which increased the odds of having otitis media by more than nine times. The odds of otitis media also increased by almost 2 times when their mother was working.

Table 5: Odds ratio (OR) and risk factors in causing otitis media.

Risk factors	OR	95% CI
Working mother	1.926	1.093-3.393
Day care attendance	2.1	1.181-3.653
Bottle feeding during the first 6 months of life	1.761	1.005-3.086
Supine bottle feeding,	2.739	1.231-2.135
Pacifier use during the second 6 months of life	1.179	0.672-2.068
Passive smoking	2.154	1.205-3.848
Pre-term delivery	9.333	3.134=27.796
Craniofacial anomalies	2.111	1.817-2.452
Allergy	4.556	2.394-8.669

DISCUSSION

For the purposes of this study, a case-control design was used. In this study the highest rate of AOM was among the age group 1 up to 2 years (40%). Our finding is consistent with Alsalam et al.'s study conducted in Mosul in 2013, in which they observed the highest frequency (26%) of AOM in this age group. However, our result is significantly higher than their study.[30] An older study conducted in Iraq by Serhan N, in 2007 found that among 250 cases of AOM the percentage of children up to 24 months formed (48.4%).[31] A more recent study conducted in Iran by Hardani et al. showed no significant association between age and AOM in preschools at any age ranges.[23] The lowest frequency of AOM of the current study was reported in the age range 4 up to 5 years (18%). Alsalam et al. also reported the lowest frequency among this age group (12%).[30]

In the current study, the percentage of boys was 58%. However, there was no significant association between gender and AOM. This is comparable with Alsalam et al. and Serhan's studies,[30,31] in which the percentage of boys was reported to be 56.7% and 51.6% respectively. Moreover, similar to our study, both studies found no significant association between gender and AOM. While in a study that was conducted in 2017-2019 period in Kerbala, Iraq by Athbi et al.[32] a significant association between gender and AOM was found ($p<0.01$). Their finding was in contrast to our study as the percentage of AOM was higher among girls (64%) compared to boys (36%). Furthermore, in contrast to our study Hardani et al. reported a lower percentage of boys with AOM (47.2%) than girls (52.8%) but their finding was also statistically insignificant.[23]

In our study, the mother's education level was a highly significant factor associated with AOM. The frequency of AOM was lower among children whose mothers are university graduates or have higher degrees compared to those whose mothers aren't university graduates. This is consistent with a study conducted in Indonesia by Wijayanti et al. in which they reported that the frequency of AOM is more in children whose mothers are of lower educational levels compared to higher levels.[22]

Another significant factor associated with AOM is the mother's employment status. The prevalence of AOM was significantly higher among children of employed mothers (57.1%) compared to unemployed mothers (40.9%). Alsalam et al. reported no significant association between children of working mothers and child children of non-working mothers.[30] Similar to our study, Hardani et al. found a highly significant association between mother's working status and AOM, in which they reported a higher frequency of AOM among children of employed mothers compared to unemployed mothers.[23] This is probably may the fact that employed mother have no enough time for taking care of her child and most of them they send their child to a day care center, which is a risk factor for AOM in which they get more attacks of URTIs, which is in turn another risk factor for AOM.

In this study, socioeconomic status showed a highly significant association with AOM. All the children who came from low socioeconomic status families were diagnosed with AOM. More than half of those who came from middle socioeconomic status families were diagnosed with AOM, while only 21% of those who were from high socioeconomic status families were diagnosed with AOM. Pawathil and Rajamma reported 58% of cases came from middle class families and their result showed 2.16 times higher chance of children from middle-class families to develop AOM.[33]

In this study the most common clinical presentation was fever (100%), irritability (100%) and loss of appetite (100%) followed by otalgia (96%) and ear pulling (96%), then otorrhea (92%) and vomiting (90%). Diminished hearing (26%), Tinnitus (12%) and vertigo (2%) were less common clinical presentations. This lower percentage of the last three symptoms was probably due to the fact that small children could not explain these

symptoms accurately. These findings are comparable to Alsalam et al.'s study to some extent.[30]

Among the risk factors, daycare attendance was significantly associated with AOM (p-value= 0.01). Fifty-six percent of AOM cases were attending daycare compared to 38% of control. Our study also showed that attending daycare increased the risk of AOM by more than 2 times. Alsalam et al.[30] also reported a significant association between daycare attendance and AOM (p-value=0.005). They also reported that daycare attendance increased the risk of AOM by more than 3 times. Our result is significantly higher than Pawathil and Rajamma's study in which only 38% of their AOM cases were attending daycare compared to 24% of children in the control group.[33] They also reported an increased risk of AOM by almost 2 times in children attending daycare. Gultekin et al. in a study of 1740 children conducted in Turkey, reported that there was a significant association between AOM and daycare attendances.[17]

Another significant risk factor that we found was bottle feeding during the first 6 months of life. We found that bottle feeding increased the risk of AOM by almost 2 times. Fifty-four percent of our cases were bottle fed during the first 6 months of life compared to 40% of controls. In accordance with our study Alsalam et al.[59] reported increased risk of AOM by more than two times in children who were bottle fed and 17% of their cases were bottle fed compared to 6.6% of controls. Pawathil and Rajamma reported an increased risk AOM of almost 2 and a half times in bottle fed children.[33]

Along with that supine bottle feeding was also a highly significant risk factor of AOM in our study, the risk of AOM increased by almost 3 times in children when bottle fed in supine position. This is consistent with Alsalam et al.'s study,[30] in which they reported an increased risk of AOM by more than 3 times in children who were bottle fed in supine position. Pawathil and Rajamma found a significantly higher percentage of supine bottle feeding among AOM cases (66%) compared to the control group (14%).[33] This could be due to the leaking of milk into the ear canal causing AOM.

Using a pacifier in the second 6 months of life was statistically insignificant risk factor of AOM. This is in contrast to Alsalam et al.'s study in which pacifier use was significantly associated with AOM (p-value= 0.001) and it increased the risk of AOM by more than 3 times.[30] Hardani et al. also reported a significant association between pacifier use and AOM (p-value<0.001).[23]

Children who were passive smokers had an increased risk of AOM by more than 1 time and there was a significant association between AOM and passive smoking in our study (p-value= 0.002). Alsalam et al. reported a similar finding in which the risk of AOM increased by more than two times and there was a significant association between passive smoking and AOM (p-value=0.0001).[30] Sophia et al. also reported a significant association between AOM and passive smoking.[8] Pawathil and Rajamma reported that 50% of cases were exposed to smoking at home compared to 24% of controls.[33] In contrast to our study, Hardani et al. reported no significant association between passive smoking and AOM.[23] Passive smoking may lead to AOM because smoking can cause upper respiratory tract infection which can in return transpire into AOM.

Furthermore, in our study, children who were born preterm had an increased risk of AOM by more than 9 times and there was a highly significant association between being born preterm and AOM (p-value<0.001). This is also in accordance with but significantly higher than Alsalam et al.'s result in which being born preterm increased the risk of AOM by more than 2 times only and there was a significant association between them (p-value= 0.006).[30]

In the current study, all the cases (10 cases) with craniofacial anomalies were diagnosed with AOM hence, there was a highly significant association between AOM and craniofacial anomalies. We also found that craniofacial anomalies increase the risk of AOM by more than 2 times. In contrast to our study, Alsalam et al. reported no significant association between craniofacial anomalies and AOM.[30]

The current study also showed a statically significant association between allergy and AOM. Gultekin et al.'s studies[17] also showed a significant association between AOM and history of Allergies. Also, Alsalam et al. and Hardani et al.'s studies,[23,30] found a significant association between children who have had allergies and AOM. This association could be attributed to inflammatory swelling of the nasal mucosa and eustachian tube orifice absorption of bacterial contaminated nasopharyngeal secretions.[34]

CONCLUSIONS

- The highest frequency of AOM was found in 1-2 years old children.
- Fever, irritability and loss of appetite were found in 100% of the cases of AOM, while diminished hearing, tinnitus, and vertigo were least found in AOM in 26%, 12%, and 2% of cases respectively.
- The higher percentage of cases attended day-care, were bottle fed during the first 6 months of life, were bottle fed in supine position, were passive smokers, were born pre-term, had craniofacial anomalies and allergies (p<0.05).
- Bulging tympanic membrane was found in 76% of cases on autoscopic examination, followed by Red/yellow/cloudy tympanic membrane in 74% of cases, presence of air-fluid level in 72% of cases, ear canal discharge in 84% of cases, and perforated tympanic membrane in 24% of cases.

Recommendations

- It is necessary to educate parents about modifiable risk factors of AOM in order to prevent them as much as possible.
- It is also important to increase physician knowledge and awareness about risk factors of AOM.
- Increase physician practice and information to make them to be familiar with symptoms of AOM in both small and older children as well as their practice in diagnosis of AOM by autoscopic examination and also effective management of the disease.
- Further studies are important to be done which should concentrate on the incidence of otitis media and also risk factors in older children and comparing it to that of children less than five years.
- It's highly advised to vaccinate all preschool children with pneumococcal conjugate vaccines and Influenza vaccines, to decrease the risk of developing AOM in their delicate years.

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