Isolation of Bacterial Agents Associated with Otitis Media among Schoolchildren in Dhamar City- Yemen

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DOI: https://doi.org/10.56807/buj.v4i2.306

Abstract

Background: *Otitis Media (OM) is the inflammation of the middle ear which is most common among children and can lead to hearing loss affecting 1.23 billion people in developing countries. The current study aims to isolate and identify the bacterial agent's causative otitis media among schoolchildren at Dhamar City, Yemen.*

Methods: *Cross section study was conducted at Dhamar City in the period from February to May 2020. A total of 100 ear swab samples were collected from children patients backing Al-Hasan, Al-Tholaia, Omar, Hamzah, Al-Shimaa and Al-Thawrah schools, inoculated into blood, chocolate, MacConkey agar, and biochemical tests.*

The results: *The results being drawn from the study show that the most common isolated bacteria were Staphylococcus aureus, flowed by Streptococcus pneumoniae, Alloiococcus spp. and Haemophilus influenzae, Streptococcus pyogenes, Micrococcus spp. and Klebsiella spp. as the recorded rates 37%, 16%, 13%, 13%, 11%, 7% and 3% respectively.*

Conclusion: *Staphylococcus aureus and Streptococcus pneumoniae, were the predominant pathogens of discharging ear. Highest isolation rate of otitis media bacteria, were in age between nine to twelve and highest in female. Early detection and treatment of upper respiratory tract infection before it develops into OM and lead to hearing loss among children is a must. Further study with advanced test to detect bacteria causes OM is recommended.*

Keywords: *Otitis media; bacterial pathogens; Children; Yemen.*

Introduction

Otitis media (OM) is an inflammation of the middle ear cleft, mostly after an acute upper respiratory tract infection **(Hailegiyorgis *et al*., 2018)**. Globally prevalence rates estimates a range between 1% and 46%; it has been estimated that 65–330 million individuals have discharging ears, 60% of whom suffer from significant hearing impairment **(WHO, 2004).**

It is one of the major chronic diseases in low and middle-income countries and the most common reason for which children receive antibiotics **(Acuin, 2004)**. Hearing loss, reduced learning ability, and low scholastic achievement have been indicated due to the chronic and recurrent form of the disease **(Monasta *et al*., 2012)**. Prolonged and recurrent attacks of OM may lead to hearing impairment and late speech development, which influence the child's later performance at school (**Asma *et al*., 2018)**.

The risk factors in OM include socioeconomic status, cultural, seasonal, and age factors, as well as family history of the middle ear disease. Other risk factors include: environmental tobacco smoke, crowded living conditions, daycare attendance, pacifier use, and bottle feeding in a supine position. Hand washing, breastfeeding, and immunizations offer some protection against otitis media **(Lok *et al*., 2012).** The major pathogens bacteria responsible for OM in children are *Streptococcus pneumoniae*, *Haemophilus influenzae* and, to a much lesser extent, *Moraxella catarrhalis*, *Streptococcus pyogenes* and *Staphylococcus aureus* **(Abera & Kibret, 2011)**.

OM accompanied with one or more signs of acute illness or signs and symptoms of middle ear inflammation, such as fever, otalgia, irritability, headache, otorrhea or vomiting **(Cherpillod, 2011)**. Complications often associated with OM include hearing loss, balance and motor problems related to vestibular dysfunction or labyrinthitis, tympanosclerosis, cholesteatoma and mastoiditis **(Klein, 2013)**.

The present study aimed to isolate and identify the bacterial agent's causative otitis media in schoolchildren at Dhamar city, Yemen and to determine the risk factors that may be associated with otitis media in schoolchildren at Dhamar City

Materials and methods:

Study area:

The study was conduct in Dhamar City. Geographically, Dhamar lies between 43.30 to 44.50 latitude, 14-15 longitude and at altitude of 2400 meter above Sea level. The annual mean temperature average in summer is between (28.20 Celsius), while it declines in winter between (18 to -1 below zero Celsius) during the night and early morning. In addition, relative humidity is 49%.

Study design and population:

This is a cross sectional study carried out during February to May 2020. One hundred (100) swab samples were collected from schoolchildren whom complainants are of middle ear infection, at Dhamar City.

Samples collection:

One hundreds of ear swab samples were collected from children in age between 5 to 12 years old, who are suffering from chronic or acute otitis media from different schools at Dhamar province. A sterile swab stick was inserted to pick a middle ear, then immediately replaced in its casing, labeled appropriately and transferred directly to the laboratory for

examination according to **(Al-Mazrou *et al.*, 2014)**. Personal information about patients with otitis media were recorded Such as name, sex, age, symptoms and date.

Handling, Culture and Identification:

Ear swap/discharge specimens were aseptically collected. Patient's ear was washed by normal saline (0.85% NaCl). Discharges samples were collected using sterile cotton swabs. Ear swab samples collected were directly streak on Chocolate agar, Blood agar and MacConky´s agar (Himedia®, India). Then incubated plates of Blood agar and MacConky´s agar aerobically at 37 °C for 24 hr. whereas the plates of Chocolate agar incubated in microaerophilic atmosphere, and identified the by colonies morphology, motility, gram stain and by conventional biochemical characteristics **(Aguilar *et al*., 2009)**.

All positive cultures were identified according to standard microbiology methods, including: Cultural characters, Gram stain, biochemical reactions such as: Coagulase, catalase, oxidase, urease test, citrate media and Kilgler Iron Agar (KIA), indole test, and diagnostic tests such as gas production, bacitracin and optichin.

Statistical analysis:

Statistical analysis was done using SPSS software version 23. Chi-square test was used to compare the proportion of bacterial isolates with patients' age , gender etc. P-value of < 0.05 was

Results

Percentage of otitis media bacteria according to age:

The highest isolation rate of otitis media bacteria, was (54%) in age between nine to twelve, while lowest isolation was (46%) in age between five to eight years old as in table 1.

Table 1. Percentage of otitis media according to age

Isolated Bacteria	5-8		9-12		*P*- value
	No.	%	No.	%	
Alliococcus	5	10.9	8	14.8	0.139
Strep. pneumonia	7	15.2	9	16.7	
Staphylococcus	15	32.6	22	40.7	
Strept. pyogeneus	9	19.6	2	3.7	
H. influenzae	4	8.7	9	16.7	
Micrococcus	5	10.9	2	3.7	
Klebseilla	1	2.2	2	3.7	
Total	**46**	**100**	**54**	**100**	

There is no significant association between otitis media bacterial infection with age.

OM is a common public health problem worldwide and a major cause of hearing impairment among children in developing countries. The disease and its associated problems constitute a hidden disability, putting children at risk of poor school performance, delayed language and speech development, and poor cognition **(Mackenzie and Smith, 2009 ; Smith *et al.*, 1996) .** This study is proposed to isolation of bacterial agents associated with OM

among schoolchildren in Dhamar city, Yemen. The percentage of otitis bacteria according to age are summarized in table 1. The study indicated that majority of OM occurs in age between nine to twelve with (54%). This is resembling with the observed by **Farhad & Khayat, (2011) who** evaluated 120 Children aged 3-12 years 44 patients (36.7%) had OME, mean age was 6.5 years. While there were converse with a study carried out by **(Tesfaye *et al*., 2009)** among children, who observed peak prevalence of otitis media in the age group of under five years with previous studies conducted in Ethiopia, and Nigeria **(Egbe *et al*., 2010; Jido *et al*., 2014)**.

Distribution of otitis media according to the gender:

The distribution of isolated bacteria from children according to the gender, show the highest rate from females (52%) followed by the isolated otitis media from males (48%), as showing in table 2.

Table 2. Distribution of otitis media bacteria according to gender

Isolated Bacteria	Male		Female		Total	P- value
	No.	%	No.	%		
Alliococcus	5	10.4	8	15.4	13	
Strep. Pneumonia	13	27.1	3	5.8	16	
Staphylococcus	19	39.6	18	34.6	37	
Strept. pyogeneus	3	6.3	8	15.4	11	
H. influenza	6	12.5	7	13.5	3	**0.044**
Micrococcus	2	4.2	5	9.6	7	
Klebseilla	0	0,0	3	5.8	3	
Total	**48**		**52**		**100**	

There were statistical significant between of otitis media and gender of childreen.

Distribution of otitis media according to the gender as shown in table 2 indicates the highest rate from females (52%) followed by the isolated otitis media from males (48%), there are high significant association between otitis media with the sex (*P* value 0.044). The current study is opposite to the study by **(Akter *et al*., 2015)** who found it to be slightly more in male (69%) than female (62%) although it was not statistically significant. This study is similar to the result obtained by **farhad *et al*. (2011)** who found that (55%) were male, and (45%) female and **Okolugbo and Ugwu (2009)** who found a prevalence of 36.53% in male and 32.5% in females .This difference may be because of growth difference or overall male predominance for childhood infection **(Maw, 1987)**. According to the study by **Marom *et al*. (2014)** which used insurance claims from a nationwide managed healthcare plan, over half (52%) of children with OM visits were males. In addition, study results were not consistent with the current study results in terms of gender (51.7%) males and (48.3%) females **(Ma, 2015)**.

Percentage of otitis media bacterial infection

From One hundred (100) samples, collected in the current study, *Staphylococcus aureus* is recorded as the highest percentage rate 37%, followed by 16% of *Streptococcus pneumoniae*, then 13% of *Alloiococcus spp*. and *Haemophilus influenzae*, 11% *Streptococcus pyogenes*, 7% of *Micrococcus spp*., finally 3% of *Klebsiella spp*. as the lowest percentage as shown in figure 1.

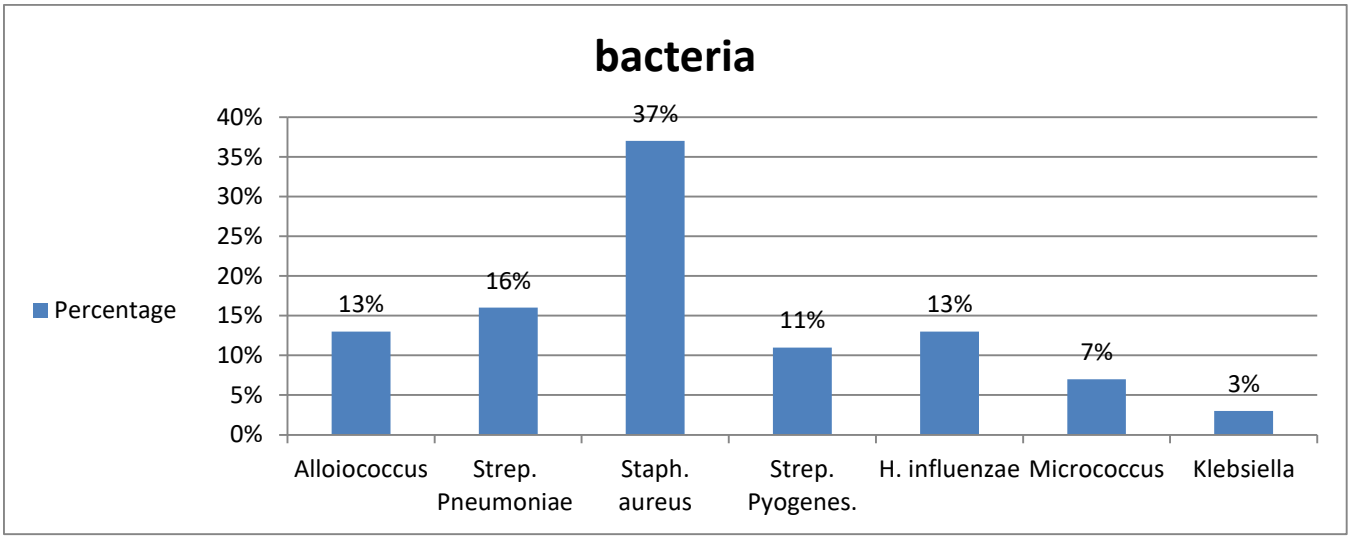

figure 1: Percentage of OM bacterial infection

The present study indicates the prevalence of bacterial agents that causes otitis media among schoolchildren in Dhamar governorate. Out of One hundred swab samples as presented here were *Staphylococcus aureus*. recorded as the highest percentage rate 37%, followed by 16% of *Streptococcus pneumoniae*, then 13% of *Alloiococcus spp*. and *Haemophilus influenzae*, 11% *Streptococcus pyogenes*, 7% of *Micrococcus spp*., finally 3% of *Klebsiella spp*. which is similar to previous studies **(Akter *et al*., 2015; Mohanna & Bahannan, 2016; Ilechukwu *et al*., 2017)**. The predominant bacterial isolates in the present study were *S. aureus* (15.8%) followed by *P. aeruginosa* (10.9%), the comparison of results of current study with obtained studies shows some discrepancy with **Sutton *et al*. (2000)** who recorded the higher prevalence of *H. influenzae*, followed by *S. pneumoniae* and *M. catarrhalis*. The individual percentage rates for *H. influenzae* (11%) is near to **(Sutton *et al*., 2000)**. The results varied among the predominant pathogens, in addition to *S. pneumonia*, *M. catarrhalis*, *S. aureus*, and *S. pyogenes* were highly prevalent **(Saffer *et al*., 1996; Rezende *et al*., 1999)**.

Distribution of otitis media according to place take of samples

The distribution of isolated otitis media from children according to place take of samples show the highest rate of otitis bacteria from Al-tholaia school (28%) followed by the isolated otitis bacteria from Omar school (21%), (20%) from Al-thawrah school, (19%) from Al-shimaa school, while the lowest isolated bacteria belongs

to the samples collected from Hamzah school (12%) as shown in table 4.

Table 4. Distribution of otitis media according to place take of samples

Isolated Bacteria	Al Tholaia school		Omar school		Hamzah school		Al-Shimaa school		Al-Thawrah school		Total	P-value
	No	%	No	%	No	%	No	%	No	%		
Alloiococcus	4	14.3	2	9.5	5	41.7	1	5.3	1	5.0	13	0.000
St. pneumonia	4	14.3	1	4.8	0	0.0	2	10.5	9	45.0	16	
Staphylococcus	8	28.6	12	57.1	0	0.0	11	57.9	6	30.0	37	
Strept. pyogene.	1	3.6	5	23.8	3	25.0	2	10.5	0	0.0	11	
H. influenza	7	25.0	1	4.8	3	25.0	1	5.3	1	5.0	13	
Micrococcus	3	10.7	0	0.0	1	8.3	1	5.3	2	10.0	7	
Klebsiella	1	3.6	0	0.0	0	0.0	1	5.3	1	5.0	3	
Total	**28**		**21**		**12**		**19**		**20**		**100**	

There is a high significant association between otitis and place take of samples.

Distribution of otitis bacteria according to smoker's relative with patients

The distribution of isolated otitis bacteria according to smokers relative with patients, show the highest rate of infection from children whom have relationship with smokers (64%) followed by the isolated otitis bacteria from children whom have not relationship with smokers (36%) as shown in table 5.

Table5. Distribution of otitis bacteria according to life in environmental tobacco smoke smoker's

Isolated Bacteria	Yes		No		Total	*P*- value
	No.	%	No.	%		
Alliococcus	9	14.1	4	11.1	13	0.002
Strep. Pneumonia	14	21.9	2	5.6	16	
Staphylococcus	20	31.3	17	47.2	37	
Strept. Pyogeneus	6	9.4	5	13.9	11	
H. influenzae	7	10.9	6	16.7	13	
Micrococcus	6	9.4	1	2.8	7	
Klebseilla	2	3.1	1	2.8	3	
Total	**64**		**36**		**100**	

There is high significant association between otitis bacteria infection and the patients with smoker relatives.

Cigarette smoke decreases mucociliary clearance by respiratory epithelium, potentially facilitating bacterial colonization **(Wanner, 1985; Stanley, 1986)**. Several research groups have demonstrated increased adherence of bacteria to respiratory epithelial cells of smokers, compared with nonsmokers **(El Ahmer *et al.*, 1999; Fainstein & Musher, 1979)**. Finally,

tobacco smoke induces inflammation, which may result in epithelial injury, predisposing to bacterial colonization **(Willemse *et al*., 2005)**.

Distribution of otitis bacterial infection according to type of infection

The distribution of isolated otitis swab from children according to type of infection show the highest rate from chronic infection (68%) followed by the isolated from acute infection (32%), as shown in table 6

Table 6. Distribution of otitis media according to type of infection

Isolated Bacteria	Acute		Chronic		Total	*P*- value
	No.	%	No.	%		
Alliococcus	4	12.5	9	13.2	13	0.778
Strep. Pneumonia	5	15.6	11	16.2	16	
Staphylococcus	15	46.9	22	32.4	37	
Strept. Pyogeneus	2	6.3	9	13.2	11	
H. influenza	4	12.5	9	13.2	13	
Micrococcus	1	3.1	6	8.8	7	
Klebseilla	1	3.1	2	2.9	3	
Total	**32**		**68**		**100**	

There is no significant association between otitis and the type of infection.

Conclusion and Recommendation:

Staphylococcus aureus and *Streptococcus pneumoniae*, were the predominant pathogens of discharging ear. Highest isolation rate of otitis media bacteria were in age between nine to twelve and highest in female. The distribution of OM in females is higher than males. The highest rate of infection is from children who have relationship with smokers. Early detection and treatment of upper respiratory tract infection before it develops into OM and lead to hearing loss among children is a must. Further study with advanced test to detect bacteria causes OM is recommended.

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