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Study Some Factors Predisposing the Prevalence of Otitis Media in the Diyala Governorate.

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ABSTRACT

Otitis media is a prevalent condition affecting individuals of all ages, often accompanied by symptoms such as ear pain, fluid accumulation, and possible hearing loss. Bacterial infections are among the leading causes, with *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Klebsiella pneumoniae* frequently implicated. This study aimed to identify the bacterial agents responsible for otitis media among patients attending hospitals in Diyala Governorate. A total of 172 ear swab samples were collected between September 1, 2024, and January 1, 2025. Bacterial identification was carried out using biochemical tests and the VITEK 2 system. The findings revealed *Pseudomonas aeruginosa* as the most prevalent isolate (36%), followed by *Staphylococcus aureus* and *Klebsiella pneumoniae* (11% each). Other less frequent isolates included *Escherichia coli*, *Proteus mirabilis*, and *Staphylococcus epidermidis*. Infection was more common among males, individuals aged 16–30, those with lower educational levels, urban residents, and smokers. These results emphasize the necessity of enhanced public health awareness, accurate microbial diagnostics, and responsible antibiotic use to improve treatment outcomes and combat antimicrobial resistance.

Keywords: otitis media, bacterial species, affecting factors, ear swab.

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دراسة بعض العوامل المسببة لانتشار التهاب الأذن الوسطى في محافظة ديالى

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الملخص

يُعد التهاب الأذن الوسطى من المشكلات الشائعة التي تصيب الأفراد من مختلف الأعمار، ويصاحبه أعراض مثل الألم، تراكم السوائل، وأحيانًا فقدان السمع. تُعتبر العدوى البكتيرية أحد أبرز أسباب هذا المرض، وتلعب أنواع معينة من البكتيريا مثل *Pseudomonas aeruginosa* و*Staphylococcus aureus* و*Klebsiella pneumoniae* دورًا رئيسيًا في حدوثه. تهدف هذه الدراسة إلى التعرف على الأنواع البكتيرية المرتبطة بحالات التهاب الأذن الوسطى بين مراجعي مستشفيات محافظة ديالى. تم جمع 172 عينة مسحة أذنية خلال الفترة الممتدة من 1 أيلول 2024 وحتى 1 كانون الثاني 2025. جرى تشخيص العينات باستخدام الفحوصات الكيميائية الحيوية ونظام VITEK 2. أظهرت النتائج أن *Pseudomonas aeruginosa* كانت الأكثر شيوعًا (36%)، تلتها *Staphylococcus aureus* و *Klebsiella pneumoniae* (11% لكل منهما). كما سُجلت نسب أقل لأنواع أخرى مثل *Escherichia coli* و*Proteus mirabilis*. وُجد أن الذكور والشباب (16–30 سنة) كانوا أكثر عرضة للإصابة، إلى جانب السكان غير المتعلمين وسكان المناطق الحضرية والمدخنين. تؤكد هذه النتائج أهمية توجيه الجهود الصحية نحو التوعية، والتشخيص الدقيق، والمراقبة المستمرة لمقاومة المضادات الحيوية لتحسين سُبل العلاج.

INTRODUCTION

Otitis media is an infection of the middle ear cavity that various microorganisms, including bacteria, viruses, or fungi, can trigger. [(1)]. Studies show that 60–80% of children suffer from recurrent ear infections during their early years. In infants, ear infections typically occur shortly after a cold. However, an ear infection in an adult may signal a more serious issue. A sudden discharge of green or yellow fluid from the ear could indicate a ruptured eardrum. [(2)]. Patients with an effusion in chronic otitis media are at higher risk of hearing loss. Studies have reported that approximately 141 million individuals with otitis media (2.1%) experience mild hearing loss, with a higher prevalence in males than females. [(3)]. Bacterial infection refers to bacteria that cause diseases when they enter the body or are present in areas where they are not typically found. For example, when bacteria disrupt the skin, they can cause multiple infections that may spread to the bloodstream, leading to a condition called "septicemia," which can be fatal. Some of the most common bacterial species responsible for middle ear infections include *Staphylococcus spp., Pseudomonas aeruginosa, Proteus spp., Streptococcus spp., Klebsiella pneumoniae*, and *Escherichia coli* [(4)]. The middle ear is vulnerable to infections from the respiratory tract, including bacteria and viruses. Additionally, the presence of the tympanic membrane makes it easier for opportunistic pathogens to access and cause middle ear infections. [(5)]. Several factors contribute to the development of otitis media, including colds, influenza, allergies, asthma, age, gender, socioeconomic status, poor hygiene, and breastfeeding. [(6)]. The study aimed to isolate and identify the bacteria causing otitis media and to examine the influence of factors such as gender, age, geographic location, educational level, smoking and type of infection on the prevalence of the disease.

METHOD AND MATERIALS

Sample Collection:

The study included 172 samples collected from individuals attending the ENT consultation units at Baqubah General Hospital and Jalawla General Hospital in Diyala Governorate, across all ages and both genders, for the period from the beginning of September 2024 until January 2025. The samples

were collected by rotating a sterile cotton swab in the middle ear, then placing the swab in a transport medium before transferring it to the laboratory [7].

Isolation and Identification:

Swabs taken from patients were cultured on blood agar, MacConkey agar, mannitol salt agar, cetrimide agar and eosin methylene blue agar (EMB), and the plates were incubated in an aerobic environment at 37°C for 18-24 hours. Bacterial growth was monitored, and colony shape, size, height, and hemolysis type were assessed, along with any changes in medium color. This is a preliminary diagnosis based on the bacteria's phenotypic characteristics. The diagnosis was finally confirmed using the VITEK 2 Compact system. [8].

Statistical Analysis:

The statistical analysis of the collected data was performed using SPSS version 26 (IBM Corp., Armonk, NY, USA). Descriptive statistics were calculated to determine the frequency and percentage of bacterial isolates and demographic characteristics. The Chi-square test (χ^2) was used to assess the association between otitis media and various predisposing factors, including gender, age, residency, educational level, type of infection, and smoking status. A p-value < 0.05 was considered statistically significant.

RESULTS AND DISCUSSION

Culture Samples

Samples were cultured on blood agar, MacConkey agar, and differential media, including cetrimide agar, mannitol salt agar, and eosin methylene blue agar (EMB). The results of the study revealed that 149 (86.60%) samples showed microbial growth, while 23 (13.40%) did not, as shown in Table 1. This discrepancy is because the pathogen (viruses, anaerobic bacteria, etc.) is diagnosed by other methods that require special culture media and growth conditions, as the media used do not meet the growth requirements, or the patient took antibiotics for a period of 1–3 days before sample collection [9].

Table 1: Microbial growth rate.

Culture result	NO	Percentage (%)
Positive growth	149	86.60%
Negative growth	23	13.40%
Total	172	100%

Percentages of bacterial species isolated from patients with otitis media

The study results, as presented in Figure 1, revealed that *Pseudomonas aeruginosa* was the leading cause of otitis media in Diyala, accounting for 62 isolates (36% of the 149 positive samples). This was followed by *Staphylococcus aureus* (11%) and *Klebsiella pneumoniae* (11%). *Staphylococcus epidermidis* came next with 4.6%, and both *Proteus mirabilis* and *Escherichia coli* had 3.4% each. Enterococcus faecalis and Acinetobacter baumannii accounted for 1.1% and 0.85%, respectively. Fungi were detected in 15.10% of the cases.

The dominance of P. aeruginosa aligns with findings from regional and international studies. [10, 11], aeruginosa is the most prevalent pathogen in patients with otitis media. This supports the organism's known pathogenic potential and resistance mechanisms, particularly in hospital settings and chronic infections.

However, the detection of fungi in 15.10% of the cases is notably higher than global averages, which typically range from 5% to 10% in similar otitis media studies. This discrepancy could be attributed to multiple regional factors, including the local environment (humidity, sanitation), overuse or misuse of antibiotics leading to fungal overgrowth, and delayed medical intervention. These findings underscore the need to incorporate fungal diagnostics into routine otitis media screening, especially in regions with similar conditions.

Such comparisons highlight the epidemiological variability of otitis media pathogens across regions and emphasize the need for local surveillance to inform antibiotic stewardship policies. The high prevalence of P. aeruginosa, known for its multidrug resistance, further supports the urgency for targeted antimicrobial guidelines and ongoing monitoring of resistance trends.

This study presents novel data specific to Diyala Governorate, where comprehensive bacterial and fungal profiling of otitis media cases has not

previously been documented using both biochemical methods and the VITEK 2 system. Unlike prior reports, which focused either on bacterial identification or demographic factors alone, this study uniquely integrates microbial identification with sociodemographic risk factor analysis, providing a multifaceted understanding of disease dynamics in a regional context.

The documentation of a notably high fungal prevalence (15.10%) in otitis media cases in Diyala adds a new dimension to existing literature, particularly in Middle Eastern populations where fungal etiology is underreported. Furthermore, by correlating infection patterns with education, smoking, and urban residency, the research offers critical epidemiological insights that are valuable for local health authorities aiming to tailor interventions.

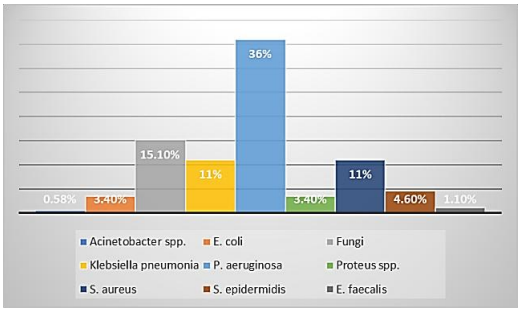

Fig. 1: Percentages of bacterial species isolated from patients with otitis media.

Pseudomonas aeruginosa, Staphylococcus *aureus and Klebsiella pneumoniae* were the most prevalent isolates, followed by *Staphylococcus epidermidis*. This dominance may be due to the unique resistance mechanisms these bacteria possess against commonly prescribed antibiotics, their production of extracellular enzymes, and their ability to enter the middle ear through the tympanic membrane. [10].

Relationship of some predisposing factors with otitis media infection

Relationship of patient gender to bacterial growth

The results of the current study indicated that the percentage of bacterial diversity associated with otitis media was higher in males than in females, with a non-significant difference ($P > 0.05$). The infection rate was 99 (57%) of male samples and 73 (42.4%) of female samples, as shown in Table 2.

Table 2: Percentages of samples infected with otitis media distributed according to gender.

N.	Gender	Positive bacterial growth		Negative bacterial growth		Total	Percentage %
		No	%	No	%		
1	Male	68	39.5	31	18	99	57
2	Female	55	32	18	10.5	73	42.4
	Total	123	71.5	49	28.5	172	100
	Chi-square	0.914					
	$P > 0.05$	0.339					

The results of the current study are consistent with those of many other studies. [12-14]. The ratio of males to females was as follows: (53.57%_46.43%), (57.4%_42.6%), and (54.91%_45.09%). The higher incidence of infection among males than females is due to their greater susceptibility to risk factors from outdoor activities and swimming in contaminated pools and ponds. In addition, the smoking rate among males is higher than that of females. This paragraph is added to the title of the relationship between smoking and bacterial growth. [15].

Relationship between age and bacterial growth

The results of the current study indicated that the infection was more common in the age groups 16-30 at a rate of 70 (40.7%) and the age groups 1-15 at a rate of 50 (29.1%), followed by the age groups 31-45 at a rate of 32 (18.6%), with a non-significant difference ($P > 0.05$). Finally, the age groups 46-60

and 61+ have percentages of 12 (7%) and 8 (4.7%), respectively, as shown in Table 3.

Table 3 shows the percentages of samples infected with otitis media, distributed by age group.

No.	age groups	Positive bacterial growth		Negative bacterial growth		Total	Percentage %
		No	%	No	%		
1	1-15	33	19.2	17	9.9	50	29.1
2	16-30	49	28.5	21	12.2	70	40.7
3	31-45	27	15.7	5	2.9	32	18.6
4	46-60	6	3.5	6	3.5	12	7
5	> 61	8	4.7	0	0	8	4.7
	Total	123	71.5	49	28.5	172	100
	Chi-square	9.33					
	P > 0.05	0.053					

The results of the current study are consistent with a study by [16] In Mosul, the study found that the majority of infections occurred in the 16-30 age group, representing 42% of the total. They differ from the results of a study by [17] In Baghdad, the 40-49 age group had the highest incidence rate, accounting for 30.4% of the total. The study results indicated that the age group 16-30 is the most vulnerable to infection. This is because this age group is made up of young adults who engage in more activities that expose them to many external factors, such as smoke, crowding, poor living conditions and pollutants, as well as social groups with low economic income.[18].

The relationship between patient residence and bacterial growth

The results of the current study indicated that the incidence of otitis media in urban areas is higher than in rural areas, with a non-significant difference (P > 0.05). The incidence rate was 102 (59.3%) samples from urban areas and 70 (40.7%) samples from infected people residing in rural areas, as shown in Table 4.

Table 4: Percentages of samples infected with otitis media distributed according to the area of residence.

No.	Residence area	Positive bacterial growth		Negative bacterial growth		Total	Percentage %
		No	%	No	%		
1	Urban area	74	43	28	16.3	102	59.3
2	Rural area	49	28.5	21	12.2	70	40.7
	Total	123	71.5	49	28.5	172	100
	Chi-square	0.132					
	P > 0.05	0.716					

The results of the current study are consistent with those of a previous study. [16] conducted in Mosul, where the percentage of urban areas was 69% compared to 31% for rural areas. They are also consistent with a study. [11], where the percentages of patients in urban and rural areas were 69.5% and 30.9%, respectively. This is because most patients who visit the consultation center are city residents interested in medical treatment and living near the hospital, unlike those living in rural areas.

Relationship between the patient's educational level and bacterial growth

The results of the current study indicated that the incidence of otitis media among educated people was significantly lower than among uneducated people (P < 0.05). The incidence rate was 69 (40.1%) among educated people and 103 (59.5%) among non-educated people, as shown in Table 5.

Table 5: Percentages of samples infected with otitis media, distributed by educational level.

No.	Level of education	Positive bacterial growth	Negative bacterial growth	Total	Percentage

		No	%	No	%		%
1	Educated	43	25	26	15.1	69	40.1
2	uneducated	80	46.5	23	13.4	103	59.9
	Total	123	71.5	49	28.5	172	100
	Chi-square	4.78					
	$P < 0.05$	0.02					

The results of the current study were consistent with those of previous studies. (13, 16, 19). The ratio of uneducated to educated individuals was as follows: 55%_45%, 59.1%_40.9%, and 51.76%_48.24%, respectively. An educated individual differs from an uneducated one in many ways, most notably in health. It is well known that an educated person pays special attention to their health, maintaining it in various ways, such as practicing personal hygiene, maintaining ear hygiene, and avoiding the indiscriminate use of antibiotics.

Relationship between infection type and bacterial growth

The results of the current study indicated that chronic otitis media was the most common among infected patients, followed by acute otitis media and, finally, purulent otitis media, with no significant difference ($P > 0.05$). The incidence rate of chronic otitis media was 97% (56.4%), followed by acute otitis media at 60% (34.9%) and purulent otitis media at 15% (8.7%), as shown in Table 6.

Table 6 shows the percentages of samples infected with otitis media, distributed by infection type.

No.	type of infection	Positive bacterial growth		Negative bacterial growth		Total	Percentage %
		No	%	No	%		
1	Purulent	8	4.7	7	4.1	15	8.7
2	Acute	48	27.9	12	7	60	34.9
3	Chronic	67	39	30	17.4	97	56.4
	Total	123	71.5	49	28.5	172	100
	Chi-square	4.83					
	$P > 0.05$	0.089					

While the results of the current study did not agree with the results of the study [20] conducted in Hillah, where it was found that the highest rate of acute otitis media (AOM) was 76.7% and chronic suppurative otitis media (CSOM) was 23.3%. It was shown that chronic otitis media is more common due to bacterial infections, as bacteria are transmitted from the ear and upper respiratory tract through the Eustachian tube. Eustachian tube blockage and fluid accumulation create a suitable environment for bacterial growth and the recurrence of chronic otitis media. [21].

The relationship between smoking and bacterial growth

The results of the current study indicated that the incidence of otitis media is higher among smokers, followed by non-smokers and finally passive smokers, with a non-significant difference ($P > 0.05$). The incidence rate was 75 (43.6%) among smokers, 52 (30.2%) among non-smokers, and 45 (26.2%) among passive smokers, as shown in Table 7.

Table 7: Percentages of samples infected with otitis media distributed according to smoking pattern.

No.	Smoking	Positive bacterial growth		Negative bacterial growth		Total	Percentage %
		No	%	No	%		

1	Non-smoker	34	19.8	18	10.5	52	30.2
2	passive smoking	33	19.2	12	7	45	26.2
3	Smoker	56	32.6	19	11	75	43.6
	Total	123	71.5	49	28.5	172	100
	Chi-square	1.39					
	$P > 0.05$	0.497					

The results of the current study are consistent with the researcher's study. [22] In India, researchers discovered that smokers had the highest infection rates at 72 (80%). Smoking increases the risk of otitis media by impairing mucociliary clearance, which transports mucus out of the respiratory system; by decreasing cilia movement; or by excessive mucus secretion, which obstructs the drainage of fluids from the middle ear, increasing the likelihood of infection. [23].

CONCLUSION

The study results indicated that *Pseudomonas aeruginosa* is the most common bacterial species causing middle ear infections in Diyala province. Males were more susceptible to infection than females, and the age group of 16-30 had the highest infection rate. Chronic otitis media is the most common type of infection. The uneducated, those living in urban areas and smokers were also most susceptible to infection.

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