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## Investigation of Microbial Contamination of Primary Schools in Baghdad City

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### Abstract

A microbial contamination of several primary schools (official and private) in Baghdad city was conducted. Sampling was performed in each school from desk, door handle, and hand of students.

Out of 113 swabs (classes desk, door holder, and students hands) obtained from ten primary schools, growth was observed in 91 samples (80.5%) (for official school 84.6% and 71.4 for private school).

The results of recent study revealed that the official schools showed higher contamination levels (130 CFU) than private ones (90 CFU).

Results revealed that a total of 12 morphologically different bacterial species were isolated from 62 bacterial isolates, among which gram negative bacteria 40 isolates (64.5%) were higher than gram-positive bacteria 22 isolates (35.4%).

According to the microscopic examination, biochemical tests and API system, the results showed that *staphylococcus epidermidis* was the most frequently isolated bacterial species with recovery rate 10 (16.1%), followed by *staphylococcus aureus* 8 (12.9%), *Escherichia spp7* (11.2%), *Escherichia coli7* (11.2%), *Enterobacter sakazaki* 5 (8%), *Enterobacter cloacae* 5 (8%), *Bacillus spp* 5 (8%), *Pseudomonas aeruginosa* 4 (6.45%), *Klebsiella spp* 4 (6.45%), *Klebsiella pneumoniae* 3 (4.8%), *Streptococcus spp* 3 (4.8%), *Proteus mirabilis* 1 (1.6%).

**Keywords:** Primary Schools, Bacteria, Contamination.

### التحري عن التلوث المايكروبي للمدارس الابتدائية في مدينة بغداد

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### الخلاصة

أجريت دراسة للتلوث المايكروبي لعشرة مدارس ابتدائية (حكومية وأهلية) في مدينة بغداد وقد تم أخذ العينات لكل مدرسة من (مقاعد الطلاب ومقابض الابواب وأيدي الطلاب). أخذت أكثر من 113 مسحة (مقاعد و أيدي الطلاب و مقابض الابواب) من عشرة مدارس ابتدائية و قد لوحظ النمو في 91 (80.5%) من العينات المدارس الحكومية كانت (84.6%) و في المدارس الاهلية (71.4%)، أيضا تم فحص العينات المأخوذة لمعرفة مستوى التلوث المايكروبي بواسطة حساب وحدة تكوين المستعمرة لكل سطح. وفقا للنتائج اظهرت المدارس الحكومية تلوث اعلى (130 وحدة تكوين المستعمرة) مقارنة بالمدارس الاهلية (90 وحدة تكوين المستعمرة).

اظهرت النتائج وجود 12 نوع بكتيري مختلف من مجموع 62 عزلة بكتيرية وكانت نسبة البكتريا السالبة لصبغة كرام 64.5% (عزلة 40) والموجبة لصبغة كرام 35.4% (22 عزلة). اعتمادا على الفحص المجهرى والاختبارات البايوكيميائية ونظام الابي ظهرت نتائج التشخيصية التالية:

*staphylococcus aureus* 8 ( 12.9 %) *staphylococcus epidermidis* 10 (16 .1%).  
*Escherichia spp* 7 (11.2%) *Escherichia.coli* 7 (11.2%), *Enterobacter sakazaki* 5 (8%),  
*Enterobacter cloacae* 5(8%), *Bacillus spp* 5(8%), *Pseudomonas aeruginosa* 4(6.45%),  
*Klebsiella spp* 4(6.45%), *Klebsiella pneumoniae* 3(4.8%), *Streptococcus spp* 3(4.8%),  
*Proteus mirabilis* 1(1.6%).

## Introduction

School classrooms present the classic factors important for the efficient spread of microbes; close contact of people for prolonged periods, numerous commonly touched, communal surfaces and isolated cleaning. School facilities are densely populated, so the maintaining of good quality indoor environments is a difficult problem [1]. In the indoor environment, we encounter microorganisms on virtually every surface we touch, and this frequent exposure to indoor microbes carries with it the potential for disease transmission, as well as interactions with our own commensal micro biome [2].

Primary schools and day care centers are often involved in outbreaks of these diseases, in 1988, nearly a tenth of reported diarrhea and fecal contamination or even poisoning a cases were part of school outbreaks [3]. This has important health and economic implications for both schools and families. Until recently, most research into the epidemiology of a diarrheal diseases has concentrated on day-care centers. Black and colleagues [4] found handwashing to be an important part of controlling diarrheal diseases in day-care centers. In order to explore spread of fecal contamination in the environment and on the hands, most workers have used a bacterial indicator of fecal contamination rather than the detection of pathogens presence [5].

However, studies have shown that fecal streptococci longer survive on the hands [6] and in the environment [7] than fecal coliforms. Increasing quantitative evidence points to the conclusion that children are more susceptible to infection by microbial pathogens picked up from their environments than older persons exposed to the same pathogens [8]. The increased risk for infection coupled with crowding in schools, the fact that children may not all have developed sanitary habits and have frequent hand-to-mouth and object-to-mouth contacts, etc. make it very important to understand what environmental sources present the most important risks for infection.

The current study aimed to to determine the relationship between children's hygiene knowledge and presence of pathogenic bacterial contamination on the hands, as weel as determine which surfaces within the schools facilities and classroom were bacterially contaminated more than other.

## Materials and Methods

### Samples collection:

Sampling was carried from ten primary school (Official and private school) all schools are located in Baghdad. In each school, collection of surface samples were performed from different classes Surface ( door handles, desks, children's hands ) were swabbed using sterile cotton swab moistened with sterile normal saline . Swabs were used to inoculate Nutrient Agar, MacConkey Agar, mannitol salt agar and blood agar.

**Table 1** - Collected samples from surfaces.

Type of samples	Number of samples
Desks	36
Hands	62
Door handles	15

The classes and children were randomly chosen. A story and questionnaire were administered to each child taking part in this study. Both hands were tested, by placing each fingertip on to the agar

plate for about (5 s). Plates from the hands (agar of finger tip ) and swabs were stored in a cold box, then transported back to the laboratory. The inoculated plates were incubated at 37°C for 18-24 hours. The isolated microorganisms were identified using Gram's stain and further subjected to biochemical analysis [9,10] and by using API 20E.

#### **Isolation and Identification:**

After 24 hrs., incubation cultures were examined for distinct colonies, the colonies were transferred on to surface of nutrient agar in plates and incubated at 37°C for 18- 24 h. The average number of bacterial colony-forming units (CFU) for each site was enumerated and all the colonies were tested for colony morphology. All bacterial isolates were examined morphologically by Gram's stain and subjected to some biochemical tests and for further identification used API 20 systems.

#### **Results and discussion:**

##### **Isolation of bacterial isolates.**

Out of 113 swabs ( classes desk, door holder , and students hands ) obtained from ten primary schools, growth was observed with average of colony forming unit ( CFU ) was illustrated in Table-2.

The results of recent study revealed that the official schools showed higher (130CFU) contamination levels than private ones (90 CFU), also results showed in Table-1 , described that student 's hands were highly infected among other types of swabs, on other side boys exhibited higher levels of contamination.

The educational level of parents correlated well with the contamination of children's hands, these results agree with Kyriacou, et al. [10, 11].

A story and questionnaire were administered to each child taking part in this study and the results of the questionnaire are presented in Table-3.

**Table 2** -Mean of bacterial CFU of different surfaces in official and private schools.

Surfaces	CFU	
	Official school	Private school
Desks	45	30
Hands	60	45
Door handles	25	15
<b>Total</b>	<b>130</b>	<b>90</b>

**Table 3** - Results of questionnaire.

Questions	Answers	%
1. Do you wash your hands before eating?	Yes	28 %
	No	72 %
2. Do you wash your hands after going to the toilet?	Yes	80 %
	No	20 %
3. When do you wash your hands at school ?	After toilet	49 %
	Before meals	20 %
	After meals	22 %
	Don't know	10 %
4. Do you think it is important to wash your hands? Why or why not'?	Yes	89 %
	Remove germs	34 %
	Remove dirt	10 %
	Mother said so	6 %
	Don't know why	50%

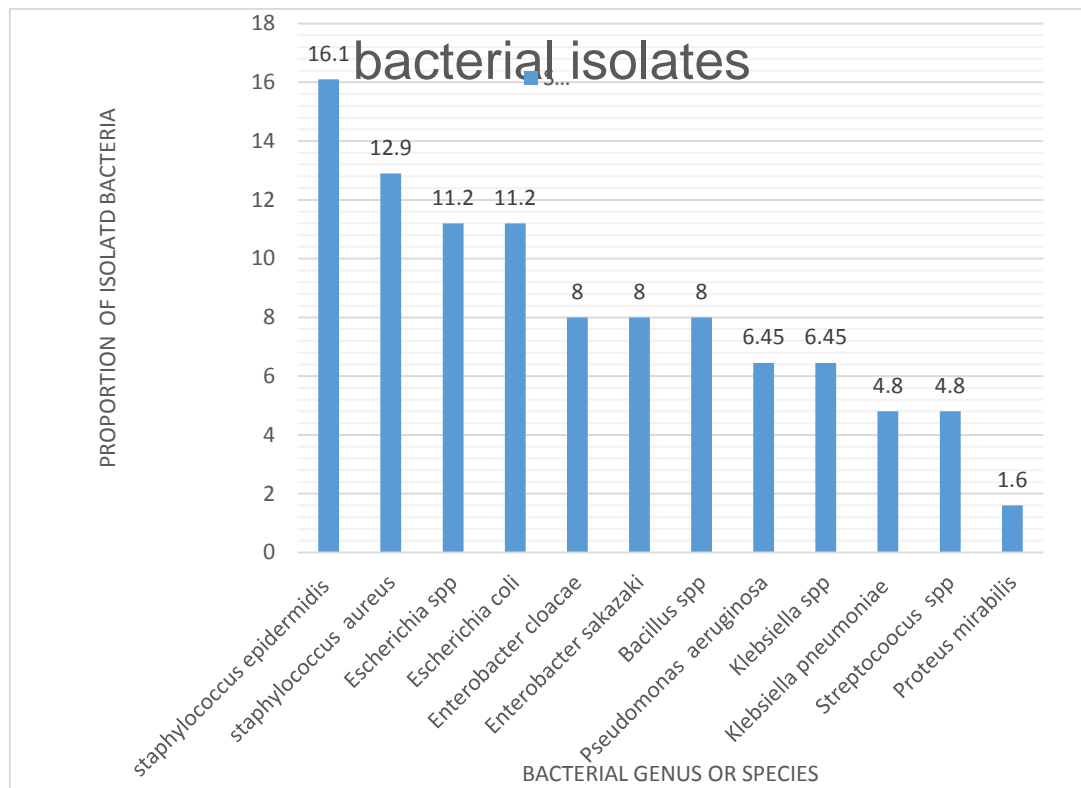
**Identification of bacterial isolates.**

Results revealed that a total of 12 morphologically different bacterial species were isolated from 62 bacterial isolates, among which gram negative bacteria are 40 isolates (64.5%) were higher than gram-positive bacteria 22 isolates (35.4%). The results were listed in Table-4.

**Table 4** -Bacterial isolates and it's proportions.

Bacterial genus or species	No. isolats (%)
<i>Staphylococcus epidermidis.</i>	10 (16.1%)
<i>Staphylococcus aureus</i>	8 (12.9%)
<i>Escherichia spp</i>	7 (11.2%)
<i>E.coli</i>	7 (11.2%)
<i>Enterobacter cloacae</i>	5 (8%)
<i>Enterobacter sakazaki</i>	5(8%)
<i>Bacillus spp</i>	5(8%)
<i>Pseudomonas aeruginosa</i>	4 (6.45%)
<i>Klebsiella spp</i>	4(6.45%)
<i>Klebsiellapneumoniae</i>	3(4.8%)
<i>Streptococcus spp.</i>	3 (4.8%)
<i>Proteus mirabilis</i>	1 (1.6%)

According to the microscopic examination , biochemical tests and API system , the results were showed that *S.epidermidis* was the most frequently isolated bacterial species with recovery rate 16.1%. followed by *staphylococcus. aureus* ( 12.9 %) *Escherichia spp*7 (11.2%) *E .coli*7 (11.2%) as shown in Figure-1.



**Figure 1 - Ratio of bacterial isolates.**

Among the gram negative bacilli *P. aeruginosa* and *Klebsiella* was also were isolated 4 (6.45%) . Kathenthaler *et al* [12], mention that Schools which had previously reported outbreaks of gastro-intestinal infections had higher levels offecal contamination on children's hands than schools which had not reported out breaks .

### Discussion

It was observed that the prevalence of Gram negative bacteria were more than Gram positive in environmental samples originating from the different sites in the primary school under study , that results agreed with Lubna, *et al.* [11], while results of recent study was not accordance with the study of Jomha *et al.* [13]. Hand contamination of sites such as desk and other classroom objects were found to be significant predictors of diarrhea risk. Ways to reduce these contaminations need to be explored including greater emphasis on hygiene education and monitoring of hand washing [12], concluded that during outbreaks of diarrhea, hands and classroom objects play a role in the transmission of diarrhea in day care centers.

The highest contamination level was ascribed to the number of students, the location and the environment surrounding the school's buildings and the cleaning protocols in the schools. The bacterial CFU recorded displayed the high surface contaminants that were encountered in the official schools ( 130 CFU) in comparison with that in private schools (90 CFU). This was linked to the high number of students in official schools that lacked suitable hygiene attitudes due to their low economic level. Ten out of the twelve identified bacterial isolates in the current investigation were found to be *S. epidermidis*, Meadow [2] was also detected *S. epidermidis* on chairs of classroom, which are always in contact with human skin. *S.epidermidis* often colonizes the skin and mucous membranes of the human body, representing an important part of its normal micro flora. It has the ability to adhere to biomaterials surface and develop as biofilm, which constitutes an important virulence factor and the most important pathogenic mechanism of staphylococcal infection [14]. Disinfectants and antiseptics are freely available without prescription and they are widely used as part of infection control practices

and in the prevention of infections [15,16]. The increased usage of these biocides has raised the emergence of microbial resistance and outbreaks.

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