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Aerobic Microbial Skin Flora in Jeddah City, Saudi Arabia

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Abstract

The aerobic microbial skin flora of 40 healthy subjects living in Jeddah city (Saudi Arabia) was determined. Two age groups: children and adults; including males and females were investigated. Seven sites were studied: forehead, axilla, chest, groin, leg, toe web and anterior nares. The skin was sampled by rubbing the chosen site with a surfactant substance (Tween 80) moistened cotton swab which was dipped back in the surfactant container and the resulted suspension was agitated for one minute.

Thirty three microbial species were isolated from the seven sites of the study group, in which *Acinetobacter baumannii, Acinetobacter lwoffii, corynebacterium* species and *Staphylococcus* (Staph.) *aureus* dominated among children (30% each). The most other prevalent isolates recovered were *Alkaligenes* species, *Bacillus species, Chryseomonas luteola, Staph. epidermidis, Enterococcus faecalis* and *Staph. hominis* (27.5% each). Organisms including *Candida albicans, Enterobacter agglomerans, Escherichia coli, Flavobacterium meningosepticum, Klebsiella oxytoca, Micrococcus luteus, Micrococcus roseus, Micrococcus varians, Micrococcus species, Burkholderia cepacia, Stenotrophomonas maltophilia, Pseudomonas paucimobilis, Pseudomonas fluorescence, Pseudomonas species, Staph. capitis, Staph. cohnii, Staph. saprophyticus, Staph. simulans, Staph. warneri, Staph. xylosus,* viridans-type streptococcus and yeasts *were also found in different percentage. Higher isolation rates of Acinetobacter lwoffii, Staph. aureus, Alkaligenes species, Corynebacterium species, Chryseomonas luteola, Enterobacter agglomerans, Staph. epidermidis* and other coagulase negative Staphylococci were noted in children from the seven sites. However, *Chryseomonas luteola*, and *Pseudomonas species*, were found only in the groin area among males. Otherwise, no significant differences were recorded in the isolation rates from each site separately in relation to age and sex. The role of the isolated microorganisms in endogenous, exogenous and nosocomial infections was emphasized.

Introduction

"Surprisingly little is known about the microflora of the skin and its role in common skin infections such as psoriasis and eczema and even less known of the flora in rare diseases". A statement that had been written in 1974 by Noble and Somerville and regrettably, the same can be applied to our knowledge in 1990s, not only to the skin flora but also to the whole microflora of man, in a country that receives millions of people for religious purposes, from all over the world at almost all the year around namely: Saudi Arabia. The importance of such knowledge is certainly obvious, particularly in preventing exogenous and or endogenous infections. Milyani *et. al.* (1987) stressed upon the medical significance of such topic and the lack of information amongst Saudi subjects, and took a step towards that by studying

the throat microbial flora in Jeddah city as a start. Since then our knowledge have accumulated, from other parts of the world, and the role played by the normal microbial flora in different infections became clearly apparent (Maibach and Aly 1981; Noble 1983; Boyce *et. al.* (1990). Though, this phenomenon has gained attention as early as 1843 by Oliver Wendell Holmes who was known to teach at Boston that puerperal fever was caused by germs on the hands of physicians and midwives which were transmitted to the vaginas of women during internal examination. Few took these ideas seriously until Joseph Lister in 1865 used carbolic acid to disinfect the skin of the operation site and the operator's hands (Sethna, 1978). Furthermore, and above all **Prophet Mohammad peace be upon him**, before more than 14 century, taught the world to wash their bodies, faces, rinse the mouth, clear with water the inside of the nose (sniffing), wash hands, forearms to the elbows and feet to the ankles (around five times a day); the wisdom behind that is obviously to rid the body of any transient pathogens, minimize the number of microbial flora to a balanced state and thus preventing the mischief of these organisms that may act as opportunistic pathogens causing different diseases and infections (Milyani, 1998).

With the advent of antibiotics, cytotoxic and immunosuppressive drugs, in parallel to the increase in compromised patients, allowed the so-called innocent normal flora to establish itself and emerge as opportunistic pathogen if not as a true pathogen causing high rates of morbidity and mortality (Mandell *et. al.,* 2000).

The aim of the present study was to determine the microbial flora of the skin among children and adults, in Jeddah city, highlighting its medical significance and to discuss the role of the isolated organisms in endogenous, exogenous and nosocomial infections.

Materials And Methods

Subjects: 40 apparently healthy 22 females and 18 males consisted of two age groups. 1 -12 years (24 children before menarche and puberty); and 13 - 17 years (16 early adults after puberty). None had been receiving antibiotics for nine weeks or using deodorants. Axillary hair was not removed.

Media Used: Five growth media were used: nutrient agar + 0.5% glucose + 0.5% Tween80, for the isolation of skin lipophilic organisms; blood agar + crystal violet 1:666.666; was used to select *Streptococcus pyogenes.* (Milyani, 1976); Tinsdale agar base; MacConkey agar and Cystine-Lactose-Deficient agar (Oxoid Ltd, London).

Sampling method and culture: A modified standardized swabbing method by Selwyn and Ellis (1972) was used. It involved rubbing thoroughly an area of 2 cm^2 of the chosen site with moderate pressure, for one minute with a sterile cotton-wool swab which had been moistened with a sterile solution of 0.5 % Tween 80 (Fluka) in 0.075M phosphate buffer at pH 7.9. The swab was dipped back into a sterile 10ml test tube containing 2ml of the sampling solution (Tween 80, the surfactant substance) and the suspension was mechanically agitated for one minute on a Rotamixer. Whereas, anterior nares were sampled by, rotating the Tween 80 moistened cotton swab inside the nares for one minute. Culturing the samples was within one to two hours of collection . The following procedure was carried out for culturing: the cotton swab was removed from the tube and streaked evenly all over the surface of each growth medium (dipping it in the

suspension each time prior to inoculation of the new medium). The inoculated plates were then incubated aerobically at 37°C for 48 – 72 hours.

Samples were collected within five months when ambient temperature varied between 37°C - 45°C.

Identification:

Commercial identification kits were used: API Staph., API 20E (Analytab Product, Plainview, N.Y) and Spectrum 10 System (ABL, Austin, Texas); In general, identification was carried out according to Koneman *et.al.* (1997).

Statistical analysis: The data were analyzed using Fisher's exact test and Pearson chi-square (each when applicable) to determine the significant differences between the microbial isolation rates in relation to age, sex, seven sites and each site separately.

Results:

The isolation rates of different organisms recovered from the total seven sites of the skin and from each site separately, in relation to age and sex are demonstrated in Tables 1- 16 and Figure 1. Figures 2-7 show the isolation rates of some of the isolates in each site.

Thirty three microbial species were isolated from the seven sites of the study group including Gram positive and Gram negative microorganisms; the Gram positive comprised 20 species while the Gram negative comprised 13 species. *Acinetobacter (A.) baumannii, Acinetobacter (A.) lwoffii, Corynebacterium species* and *Staphylococcus (Staph.) aureus* dominated among children comprising 30% of each isolate. The other microbial isolates followed in prevalence among the same group, were *Alkaligenes species, Bacillus species, Chryseomonas (C.) luteola, Staph. epidermidis, Enterococcus* (E.) *faecalis* and *Staph. hominis* giving an incidence of 27.5% each (Table 1 and Figure 1). Organisms including *Candida* (C.) *albicans, Enterobacter* (E.) *agglomerans, Escherichia* (E.) *coli, Flavobacterium* (F.) *meningosepticum, Klebsiella* (K.) *oxytoca, Micrococcus luteus, Micrococcus roseus, Micrococcus varians, Micrococcus species, Burkholderia (B.) cepacia, Stenotrophomonas (S.) maltophilia, Pseudomonas (P.) paucimobilis, P. fluorescence, Pseudomonas species, Staph. capitis, Staph. cohnii, Staph. haemolyticus, Staph. saprophyticus, Staph. simulans, Staph. warneri, Staph. xylosus,* viridas-type streptococcus and yeasts were also found in different percentage among both age groups, males and females (Table 1 and 2). On the other hand, significant differences between children and adults were found in the isolation rates of *A. lwoffii (P= 0.004), Alkaligenes species (P= 0.027), Corynebacterium species (P= 0.015), C. luteola (P= 0.027), E. agglomerans (P= 0.032), Staph. aureus (P= 0.015), Staph. capitis (P= 0.032), Staph. cohnii (P= 0.027), Staph. epidermidis (P= 0.012), Staph. haemolyticus (P= 0.032), Staph. hominis* (P= 0.012), *Staph. simulans (P= 0.027), Staph. warneri (P= 0.027) and Staph. xylosus (P= 0.027)* from the seven sites (Table 1). However, in relation to sex, significant differences were evident only in the isolation rates of *C. luteola* (P= 0.013), and *P. species* (P= 0.013) in the groin area among males (Table 12). Otherwise, no significant differences were recorded in the isolation rates from each site separately in relation to age and sex (Tables 3-16 and Figures 2-7).

Nonetheless, as shown in Figure 2 and 3 within the age range 1-12 and 13 - 17 years the carriage rate of *Staph. aureus* among children and adults,

males and females, was found to be 5% and 0% in the forehead, 10% and 0% in the anterior nares, 2.5% and 5% in the axilla (both age groups, females and males respectively), whereas, in the chest area it was 7.5% and 0% in children and adults and 2.5% and 7.5% in females and males respectively. On the other hand, the carriage rate in the groin was 10% in children, 2.5% in adults, 7.5% in females and 5% in males; in the leg 10% in children and 0% in adults, 2.5% in females and 7.5% in males; finally in the toe webs, 12.5% in children and 2.5% in adults, whereas, the same carriage rate of 7.5% was noted in both females and males. Turning to other isolates, the incidence of *A. baumannii* and *A. lwoffii* in the seven sites of the skin is shown in Figures 4 and 5 in relation to age. Whereas, Figures 6-7 recorded the isolation rate of *C. albicans* among both age groups and sex.

Table 1: The isolation rates of different organisms recovered from the seven sites of the skin in relation to age

Microbial isolates	age 1-12*		age 13-17**		p-value[a]	p-value©
	Freq	%	freq	%		
01- Acinetobacter baumannii	12	30	4	10		.114
02- Acinetobacter lwoffii	12	30	1	2.5		.004 b
03- Alkaligenes species	11	27.5	2	5		.027 b
04- Bacillus species	6	15	3	7.5	.717	
05- Candida albicans	7	17.5	4	10	1.00	
06- *Corynebacterium species*	12	30	2	5		.015 b
07- Chryseomonas luteola	11	27.5	2	5		.027 b
08- Enterobacter agglomerans	9	22.5	1	2.5	.032 b	
09- Escherichia coli	6	15	2	5	.439	
10- Flavobacterium meningosepticum	6	15	4	10	1.00	
11- Klebsiella oxytoca	8	20	4	10	.729	
12- Micrococcus luteus	8	20	1	2.5	.061	
13- Micrococcus roseus	8	20	2	5	.263	
14- Micrococcus species	6	15	2	5	.439	
15- Micrococcus varians	7	17.5	1	2.5	.114	
16- Burkholderia cepacia	9	22.5	3	7.5	.297	
17- Stenotrophomonas maltophilia	8	20	4	10	.729	
18- Pseudomonas paucimobilis	3	7.5	3	7.5	.668	
19- Pseudomonas fluorescens	7	17.5	1	2.5	.114	
20- Pseudomonas species	7	17.5	5	12.5	1.00	
21- Staph. aureus	12	30	2	5		.015 b
22- Staph. capitis	9	22.5	1	2.5	.032 b	
23- Staph. cohnii	10	25	1	2.5	.027 b	
24- Staph. epidermidis	11	27.5	1	2.5	.012 b	
25- Enterococcus faecalis	11	27.5	3	7.5		.079
26- Staph. haemolyticus	9	22.5	1	2.5	.032 b	
27- Staph. hominis	11	27.5	1	2.5	.012 b	
28- Staph. saprophyticus	8	20	2	5	.263	
29- Staph. simulans	10	25	1	2.5	.027 b	
30 -Staph. warneri	10	25	1	2.5	.027 b	
31- S.xylosus	10	25	1	2.5	.027 b	
32- Viridans- type streptococci	10	25	2	5	.079	
33- Yeasts	7	17.5	3	7.5	.711	

a. Using Fisher's Exact test (Exact Sig. 2 sided), using α=0.05

b. The test is significant (otherwise the test is not significant).

©.Using Pearson Chi-square test (Asymp.sig.2-sided).

* Age 1- 12 years were 24 subjects

** Age 13 -17 years were 16 subjects

Table 2: The isolation rates of different organisms recovered from seven sites of the skin in relation to sex

Microbial isolates	Females*		Males**		p-value[a]	p-value©
	Freq	%	freq	%		
01- Acinetobacter baumannii	6	15	10	25		.069
02- Acinetobacter lwoffii	6	15	7	17.5		.435
03- Alkaligenes species	7	17.5	6	15		.919
04- Bacillus species	5	12.5	4	10	1.00	
05- Candida albicans	6	15	5	12.5	1.00	
06- *Corynebacterium species*	10	25	4	10		.125
07- Chryseomonas luteola	6	15	7	17.5		.435
08- Enterobacter agglomerans	6	15	4	10	1.00	
09- Escherichia coli	^	10	4	10	1.00	
10- Flavobacterium meningosepticum	6	15	4	10	1.00	
11- Klebsiella oxytoca	9	22.5	3	7.5		.096
12- Micrococcus luteus	6	15	3	7.5	.476	
13- Micrococcus roseus	6	15	4	10	1.00	
14- Micrococcus species	^	10	4	10	1.00	
15- Micrococcus varians	5	12.5	3	7.5	.709	
16- Burkholderia cepacia	6	15	6	15		.677
17- Stenotrophomonas maltophilia	8	20	4	10		.332
18- Pseudomonas paucimobilis	1	2.5	5	12.5	.073	
19- Pseudomonas fluorescens	3	7.5	5	12.5	.430	
20- Pseudomonas species	^	10	8	20		.071
21- Staph. aureus	8	20	6	15		.842
22- Staph. capitis	6	15	4	10	1.00	
23- Staph. cohnii	7	17.5	4	10	.723	
24- Staph. epidermidis	5	12.5	7	17.5		.267
25- Enterococcus faecalis	8	20	6	15		.842
26- Staph. haemolyticus	7	17.5	3	7.5	.464	
27- Staph. hominis	8	20	4	10		.332
28- Staph. saprophyticus	6	15	4	10	1.00	
29- Staph. simulans	8	20	3	7.5	.286	
30 -Staph. warneri	6	15	5	12.5	1.00	
31- S.xylosus	^	10	7	17.5	.173	
32- Viridans- type streptococci	8	20	4	10		.332
33- Yeasts	6	15	4	10	1.00	

All tests are not significant by using α=0.05 - a. Using Fisher's Exact test (Exact Sig. 2 sided)

©.Using Pearson Chi-square test (Asymp.sig.2-sided).

Table 3: The isolation rates of different organisms recovered from forehead in relation to age

Microbial isolates	Age 1-12*		Age 13-17**		p-value[a]
	freq	%	freq	%	
01- Acinetobacter baumannii	4	10	0	0	.136
02- Acinetobacter lwoffii	2	5	0	0	.508
03- Alkaligenes species	3	7.5	1	2.5	.638
04- Bacillus species	0	0	1	2.5	.400
05- Candida albicans	3	7.5	0	0	.262
06- *Corynebacterium species*	3	7.5	0	0	.262
07- Chryseomonas luteola	1	2.5	0	0	1.00
08- Enterobacter agglomerans	3	7.5	0	0	.262
09- Escherichia coli	3	7.5	1	2.5	.638
10- Flavobacterium meningosepticum	4	10	1	2.5	.631
11- Klebsiella oxytoca	3	7.5	1	2.5	.638
12- Micrococcus luteus	6	15	1	2.5	.210
13- Micrococcus roseus	4	10	0	0	.136
14- Micrococcus species	2	5	1	2.5	1.00
15- Micrococcus varians	5	12.5	1	2.5	.373
16- Burkholderia cepacia	1	2.5	0	0	1.00
17- Stenotrophomonas maltophilia	1	2.5	1	2.5	1.00
18- Pseudomonas paucimobilis	2	5	1	2.5	1.00
19- Pseudomonas fluorescens	2	5	0	0	.508
20- Pseudomonas species	3	7.5	1	2.5	.638
21- Staph. aureus	2	5	0	0	.508
22- Staph. capitis	2	5	1	2.5	1.00
23- Staph. cohnii	4	10	0	0	.136
24- Staph. epidermidis	3	7.5	0	0	.262
25- Enterococcus faecalis	4	10	0	0	.136
26- Staph. haemolyticus	4	10	1	2.5	.631
27- Staph. hominis	4	10	0	0	.136
28- Staph. saprophyticus	2	5	0	0	.508
29- Staph. simulans	3	7.5	0	0	.262
30 -Staph. warneri	3	7.5	0	0	.262
31- S.xylosus	2	5	1	2.5	1.00
32- Viridans- type streptococci	3	7.5	0	0	.262
33- Yeasts	1	2.5	3	7.5	.283

a. All tests are not significant by using Fisher's Exact test (Exact Sig. 2 sided) using α=0.05

* Age 1- 12 years were 24 subjects

** Age 13 -17 years were 16 subjects

Table 4: The isolation rates of different organisms recovered from forehead in relation to sex

Microbial isolates	Females		Males		p-value[a]
	freq	%	freq	%	
01- Acinetobacter baumannii	2	5	2	5	1.00
02- Acinetobacter lwoffii	1	2.5	1	2.5	1.00
03- Alkaligenes species	2	5	2	5	1.00
04- Bacillus species	0	0	1	2.5	.450
05- Candida albicans	2	5	1	2.5	1.00
06- *Corynebacterium species*	2	5	1	2.5	1.00
07- Chryseomonas luteola	0	0	1	2.5	.450
08- Enterobacter agglomerans	2	5	1	2.5	1.00
09- Escherichia coli	1	2.5	3	7.5	.310
10- Flavobacterium meningosepticum	4	10	1	2.5	.355
11- Klebsiella oxytoca	3	7.5	1	2.5	.613
12- Micrococcus luteus	4	10	3	7.5	1.00
13- Micrococcus roseus	2	5	2	5	1.00
14- Micrococcus species	2	5	1	2.5	1.00
15- Micrococcus varians	3	7.5	3	7.5	1.00
16- Burkholderia cepacia	1	2.5	0	0	1.00
17- Stenotrophomonas maltophilia	1	2.5	1	2.5	1.00
18- Pseudomonas paucimobilis	1	2.5	2	5	.579
19- Pseudomonas fluorescens	0	0	2	5	.196
20- Pseudomonas species	2	5	2	5	1.00
21- Staph. aureus	2	5	0	0	.492
22- Staph. capitis	2	5	1	2.5	1.00
23- Staph. cohnii	2	5	2	5	1.00
24- Staph. epidermidis	2	5	1	2.5	1.00
25- Enterococcus faecalis	4	10	0	0	.114
26- Staph. haemolyticus	2	5	3	7.5	.642
27- Staph. hominis	3	7.5	1	2.5	.613
28- Staph. saprophyticus	1	2.5	1	2.5	1.00
29- Staph. simulans	1	2.5	2	5	.579
30 -Staph. warneri	2	5	1	2.5	1.00
31- S.xylosus	1	2.5	2	5	.579
32- Viridans- type streptococci	2	5	1	2.5	1.00
33- Yeasts	2	5	2	5	1.00

a. All tests are not significant by using Fisher's Exact test (Exact Sig. 2 sided) using α=0.05

Table 5: The isolation rates of different organisms recovered from the anterior nares in relation to age

Microbial isolates	age 1-12*		age 13-17**		p-value[a]
	freq	%	freq	%	
01- Acinetobacter baumannii	5	12.5	1	2.5	.373
02- Acinetobacter lwoffii	3	7.5	0	0	.262
03- Alkaligenes species	4	10	1	2.5	.631
04- Bacillus species	3	7.5	0	0	.262
05- Candida albicans	4	10	0	0	.136
06- *Corynebacterium species*	1	2.5	0	0	1.00
07- Chryseomonas luteola	2	5	0	0	.508
08- Enterobacter agglomerans	2	5	0	0	.508
09- Escherichia coli	1	2.5	0	0	1.00
10- Flavobacterium meningosepticum	2	5	0	0	.508
11- Klebsiella oxytoca	1	2.5	0	0	1.00
12- Micrococcus luteus	3	7.5	0	0	.262
13- Micrococcus roseus	2	5	1	2.5	1.00
14- Micrococcus species	3	7.5	1	2.5	.638
15- Micrococcus varians	0	0	0	0	h
16- Burkholderia cepacia	4	10	0	0	.136
17- Stenotrophomonas maltophilia	3	7.5	1	2.5	.638
18- Pseudomonas paucimobilis	1	2.5	0	0	1.00
19- Pseudomonas fluorescens	1	2.5	0	0	1.00
20- Pseudomonas species	1	2.5	2	5	.553
21- Staph. aureus	4	10	0	0	.136
22- Staph. capitis	1	2.5	0	0	1.00
23- Staph. cohnii	3	7.5	0	0	.262
24- Staph. epidermidis	3	7.5	0	0	.262
25- Enterococcus faecalis	2	5	0	0	.508
26- Staph. haemolyticus	2	5	0	0	.508
27- Staph. hominis	4	10	1	2.5	.631
28- Staph. saprophyticus	3	7.5	0	0	.262
29- Staph. simulans	5	12.5	0	0	.071
30 -Staph. warneri	2	5	1	2.5	1.00
31- S.xylosus	3	7.5	0	0	.262
32- Viridans- type streptococci	3	7.5	0	0	.262
33- Yeasts	2	5	0	0	.508

a. All tests are not significant by using Fisher's Exact test (Exact Sig. 2 sided) using α=0.05

h. No statistics are computed because ANTERIOR NARES are a constant.

* Age 1- 12 years were 24 subjects

** Age 13 -17 years were 16 subjects

Table 6: The isolation rates of different organisms recovered from the anterior nares in relation to sex

Microbial isolates	Females		Males		p-value[a]
	freq	%	freq	%	
01- Acinetobacter baumannii	4	10	2	5	.673
02- Acinetobacter lwoffii	2	5	1	2.5	1.00
03- Alkaligenes species	3	7.5	2	5	1.00
04- Bacillus species	2	5	1	2.5	1.00
05- Candida albicans	3	7.5	1	2.5	.613
06- *Corynebacterium species*	1	2.5	0	0	1.00
07- Chryseomonas luteola	2	5	0	0	.492
08- Enterobacter agglomerans	2	5	0	0	.492
09- Escherichia coli	1	2.5	0	0	1.00
10- Flavobacterium meningosepticum	2	5	0	0	.492
11- Klebsiella oxytoca	1	2.5	0	0	1.00
12- Micrococcus luteus	2	5	1	2.5	1.00
13- Micrococcus roseus	1	2.5	2	5	.579
14- Micrococcus species	2	5	2	5	1.00
15- Micrococcus varians	0	0	0	0	h
16- Burkholderia cepacia	4	10	0	0	.114
17- Stenotrophomonas maltophilia	3	7.5	1	2.5	.613
18- Pseudomonas paucimobilis	1	2.5	0	0	1.00
19- Pseudomonas fluorescens	1	2.5	0	0	1.00
20- Pseudomonas species	2	5	1	2.5	1.00
21- Staph. aureus	4	10	0	0	.114
22- Staph. capitis	1	2.5	0	0	1.00
23- Staph. cohnii	2	5	1	2.5	1.00
24- Staph. epidermidis	1	2.5	2	5	.579
25- Enterococcus faecalis	2	5	0	0	.492
26- Staph. haemolyticus	2	5	0	0	.492
27- Staph. hominis	4	10	1	2.5	.355
28- Staph. saprophyticus	2	5	1	2.5	1.00
29- Staph. simulans	3	7.5	2	5	1.00
30 -Staph. warneri	2	5	1	2.5	1.00
31- S.xylosus	1	2.5	2	5	.579
32- Viridans- type streptococci	3	7.5	0	0	.238
33- Yeasts	2	5	0	0	.492

a. All tests are not significant by using Fisher's Exact test (Exact Sig. 2 sided) using α=0.05

h. No statistics are computed because ANTERIOR NARES are a constant.

Table 7: The isolation rates of different organisms recovered from the axilla in relation to age

Microbial isolates	age 1-12*		age 13-17**		p-value[a]
	freq	%	freq	%	
01- Acinetobacter baumannii	1	2.5	2	5	.553
02- Acinetobacter lwoffii	8	20	1	2.5	.061
03- Alkaligenes species	2	5	1	2.5	1.00
04- Bacillus species	2	5	0	0	.508
05- Candida albicans	1	2.5	0	0	1.00
06- *Corynebacterium species*	4	10	0	0	.136
07- Chryseomonas luteola	1	2.5	1	2.5	1.00
08- Enterobacter agglomerans	5	12.5	0	0	.071
09- Escherichia coli	4	10	0	0	.136
10- Flavobacterium meningosepticum	4	10	1	2.5	.631
11- Klebsiella oxytoca	1	2.5	4	10	.138
12- Micrococcus luteus	3	7.5	0	0	.262
13- Micrococcus roseus	3	7.5	1	2.5	.638
14- Micrococcus species	1	2.5	0	0	1.00
15- Micrococcus varians	5	12.5	0	0	.071
16- Burkholderia cepacia	4	10	0	0	.136
17- Stenotrophomonas maltophilia	3	7.5	1	2.5	.638
18- Pseudomonas paucimobilis	3	7.5	2	5	1.00
19- Pseudomonas fluorescens	2	5	0	0	.508
20- Pseudomonas species	2	5	1	2.5	1.00
21- Staph. aureus	1	2.5	2	5	.553
22- Staph. capitis	4	10	1	2.5	.631
23- Staph. cohnii	3	7.5	0	0	.262
24- Staph. epidermidis	0	0	0	0	h
25- Enterococcus faecalis	2	5	1	2.5	1.00
26- Staph. haemolyticus	3	7.5	0	0	.262
27- Staph. hominis	4	10	1	2.5	.631
28- Staph. saprophyticus	3	7.5	0	0	.262
29- Staph. simulans	3	7.5	0	0	.262
30 -Staph. warneri	4	10	1	2.5	.631
31- S.xylosus	1	2.5	0	0	1.00
32- Viridans- type streptococci	5	12.5	0	0	.071
33- Yeasts	3	7.5	1	2.5	.638

a. All tests are not significant by using Fisher's Exact test (Exact Sig. 2 sided) using α=0.05

h. No statistics are computed because AXILLA is a constant.

* Age 1- 12 years were 24 subjects

** Age 13 -17 years were 16 subjects

Table 8: The isolation rates of different organisms recovered from the axilla in relation to sex

Microbial isolates	Female		Males		p-value[a]
	freq	%	freq	%	
01- Acinetobacter baumannii	1	2.5	2	5	.579
02- Acinetobacter lwoffii	^	10	5	12.5	.705
03- Alkaligenes species	2	5	1	2.5	1.00
04- Bacillus species	1	2.5	1	2.5	1.00
05- Candida albicans	0	0	1	2.5	.450
06- *Corynebacterium species*	2	5	2	5	1.00
07- Chryseomonas luteola	2	5	0	0	.492
08- Enterobacter agglomerans	2	5	3	7.5	.642
09- Escherichia coli	3	7.5	1	2.5	.613
10- Flavobacterium meningosepticum	3	7.5	2	5	1.00
11- Klebsiella oxytoca	3	7.5	2	5	1.00
12- Micrococcus luteus	2	5	1	2.5	1.00
13- Micrococcus roseus	3	7.5	1	2.5	.613
14- Micrococcus species	0	0	1	2.5	.450
15- Micrococcus varians	3	7.5	2	5	1.00
16- Burkholderia cepacia	2	5	2	5	1.00
17- Stenotrophomonas maltophilia	2	5	2	5	1.00
18- Pseudomonas paucimobilis	1	2.5	4	10	.155
19- Pseudomonas fluorescens	0	0	2	5	.196
20- Pseudomonas species	0	0	3	7.5	.083
21- Staph. aureus	1	2.5	2	5	.579
22- Staph. capitis	3	7.5	2	5	1.00
23- Staph. cohnii	2	5	1	2.5	1.00
24- Staph. epidermidis	0	0	0	0	h
25- Enterococcus faecalis	3	7.5	0	0	.238
26- Staph. haemolyticus	1	2.5	2	5	.579
27- Staph. hominis	2	5	3	7.5	.642
28- Staph. saprophyticus	1	2.5	2	5	.579
29- Staph. simulans	1	2.5	2	5	.579
30 -Staph. warneri	2	5	3	7.5	.642
31- S.xylosus	1	2.5	0	0	1.00
32- Viridans- type streptococci	4	10	1	2.5	.355
33- Yeasts	4	10	0	0	.114

a. All tests are not significant by using Fisher's Exact test (Exact Sig. 2 sided) using α=0.05

h. No statistics are computed because AXILLA is a constant.

Table 9: The isolation rates of different organisms recovered from the chest skin in relation to age

Microbial isolates	age 1-12*		age 13-17**		p-value[a]
	freq	%	freq	%	
01- Acinetobacter baumannii	2	5	2	5	1.00
02- Acinetobacter lwoffii	2	5	0	0	.508
03- Alkaligenes species	4	10	1	2.5	.631
04- Bacillus species	2	5	2	5	1.00
05- Candida albicans	2	5	1	2.5	1.00
06- *Corynebacterium species*	1	2.5	0	0	1.00
07- Chryseomonas luteola	1	2.5	0	0	1.00
08- Enterobacter agglomerans	4	10	0	0	.136
09- Escherichia coli	3	7.5	0	0	.262
10- Flavobacterium meningosepticum	1	2.5	3	7.5	.283
11- Klebsiella oxytoca	3	7.5	0	0	.262
12- Micrococcus luteus	2	5	1	2.5	1.00
13- Micrococcus roseus	3	7.5	1	2.5	.638
14- Micrococcus species	1	2.5	2	5	.553
15- Micrococcus varians	3	7.5	0	0	.262
16- Burkholderia cepacia	4	10	0	0	.136
17- Stenotrophomonas maltophilia	3	7.5	3	7.5	.668
18- Pseudomonas paucimobilis	0	0	0	0	h
19- Pseudomonas fluorescens	1	2.5	1	2.5	1.00
20- Pseudomonas species	2	5	1	2.5	1.00
21- Staph. aureus	4	10	0	0	.136
22- Staph. capitis	3	7.5	0	0	.262
23- Staph. cohnii	3	7.5	1	2.5	.638
24- Staph. epidermidis	3	7.5	0	0	.262
25- Enterococcus faecalis	4	10	0	0	.136
26- Staph. haemolyticus	1	2.5	0	0	1.00
27- Staph. hominis	4	10	0	0	.136
28- Staph. saprophyticus	4	10	0	0	.136
29- Staph. simulans	1	2.5	0	0	1.00
30 -Staph. warneri	2	5	0	0	.508
31- S.xylosus	5	12.5	0	0	.071
32- Viridans- type streptococci	3	7.5	0	0	.262
33- Yeasts	3	7.5	2	5	1.00

a. All tests are not significant by using Fisher's Exact test (Exact Sig. 2 sided) using α=0.05

h. No statistics are computed because CHEST is a constant.

* Age 1- 12 years were 24 subjects

** Age 13 -17 years were 16 subjects

Table 10: The isolation rates of different organisms recovered from the chest skin in relation to sex

Microbial isolates	Females		Males		p-value[a]
	freq	%	freq	%	
01- Acinetobacter baumannii	2	5	2	5	1.00
02- Acinetobacter lwoffii	2	5	0	0	.492
03- Alkaligenes species	2	5	3	7.5	.642
04- Bacillus species	3	7.5	1	2.5	.613
05- Candida albicans	2	5	1	2.5	1.00
06- *Corynebacterium species*	1	2.5	0	0	1.00
07- Chryseomonas luteola	1	2.5	0	0	1.00
08- Enterobacter agglomerans	3	7.5	1	2.5	.613
09- Escherichia coli	2	5	1	2.5	1.00
10- Flavobacterium meningosepticum	2	5	2	5	1.00
11- Klebsiella oxytoca	3	7.5	0	0	.238
12- Micrococcus luteus	2	5	1	2.5	1.00
13- Micrococcus roseus	1	2.5	3	7.5	.310
14- Micrococcus species	3	7.5	0	0	.238
15- Micrococcus varians	2	5	1	2.5	1.00
16- Burkholderia cepacia	1	2.5	3	7.5	.310
17- Stenotrophomonas maltophilia	4	10	2	5	.673
18- Pseudomonas paucimobilis	0	0	0	0	h
19- Pseudomonas fluorescens	2	5	0	0	.492
20- Pseudomonas species	2	5	1	2.5	1.00
21- Staph. aureus	1	2.5	3	7.5	.310
22- Staph. capitis	1	2.5	2	5	.579
23- Staph. cohnii	3	7.5	1	2.5	.613
24- Staph. epidermidis	1	2.5	2	5	.579
25- Enterococcus faecalis	3	7.5	1	2.5	.613
26- Staph. haemolyticus	1	2.5	0	0	1.00
27- Staph. hominis	3	7.5	1	2.5	.613
28- Staph. saprophyticus	3	7.5	1	2.5	.613
29- Staph. simulans	1	2.5	0	0	1.00
30 -Staph. warneri	2	5	0	0	.492
31- S.xylosus	1	2.5	4	10	.155
32- Viridans- type streptococci	2	5	1	2.5	1.00
33- Yeasts	2	5	3	7.5	.642

a. All tests are not significant by using Fisher's Exact test (Exact Sig. 2 sided) using α=0.05

h. No statistics are computed because CHEST is a constant.

Table 11: The isolation rates of different organisms recovered from the groin in relation to age

Microbial isolates	age 1-12*		age 13-17**		p-value[a]
	freq	%	freq	%	
01- Acinetobacter baumannii	4	10	2	5	1.00
02- Acinetobacter lwoffii	1	2.5	0	0	1.00
03- Alkaligenes species	2	5	0	0	.508
04- Bacillus species	1	2.5	0	0	1.00
05- Candida albicans	4	10	3	7.5	1.00
06- *Corynebacterium species*	5	12.5	2	5	.681
07- Chryseomonas luteola	4	10	1	2.5	.631
08- Enterobacter agglomerans	6	15	1	2.5	.210
09- Escherichia coli	0	0	0	0	h
10- Flavobacterium meningosepticum	2	5	1	2.5	1.00
11- Klebsiella oxytoca	5	12.5	0	0	.071
12- Micrococcus luteus	4	10	0	0	.136
13- Micrococcus roseus	2	5	0	0	.508
14- Micrococcus species	1	2.5	0	0	1.00
15- Micrococcus varians	3	7.5	0	0	.262
16- Burkholderia cepacia	2	5	1	2.5	1.00
17- Stenotrophomonas maltophilia	3	7.5	0	0	.262
18- Pseudomonas paucimobilis	0	0	1	2.5	.400
19- Pseudomonas fluorescens	1	2.5	0	0	1.00
20- Pseudomonas species	3	7.5	2	5	1.00
21- Staph. aureus	4	10	1	2.5	.631
22- Staph. capitis	2	5	1	2.5	1.00
23- Staph. cohnii	2	5	0	0	.508
24- Staph. epidermidis	3	7.5	0	0	.262
25- Enterococcus faecalis	4	10	2	5	1.00
26- Staph. haemolyticus	3	7.5	0	0	.262
27- Staph. hominis	2	5	0	0	.508
28- Staph. saprophyticus	3	7.5	2	5	1.00
29- Staph. simulans	6	15	1	2.5	.210
30 -Staph. warneri	4	10	0	0	.136
31- S.xylosus	1	2.5	0	0	1.00
32- Viridans- type streptococci	4	10	2	5	1.00
33- Yeasts	0	0	0	0	h

a. All tests are not significant by using Fisher's Exact test (Exact Sig. 2 sided) using α=0.05

h. No statistics are computed because GROIN is a constant.

* Age 1- 12 years were 24 subjects

** Age 13 -17 years were 16 subjects

Table 12: The isolation rates of different organisms recovered from the groin in relation to sex

Microbial isolates	Females		Males		p-value[a]
	freq	%	freq	%	
01- Acinetobacter baumannii	2	5	4	10	.381
02- Acinetobacter lwoffii	0	0	1	2.5	.450
03- Alkaligenes species	2	5	0	0	.492
04- Bacillus species	1	2.5	0	0	1.00
05- Candida albicans	3	7.5	4	10	.680
06- *Corynebacterium species*	4	10	3	7.5	1.00
07- Chryseomonas luteola	0	0	5	12.5	.013 b
08- Enterobacter agglomerans	3	7.5	4	10	.680
09- Escherichia coli	0	0	0	0	h
10- Flavobacterium meningosepticum	1	2.5	2	5	.579
11- Klebsiella oxytoca	3	7.5	2	5	1.00
12- Micrococcus luteus	2	5	2	5	1.00
13- Micrococcus roseus	1	2.5	1	2.5	1.00
14- Micrococcus species	0	0	1	2.5	.450
15- Micrococcus varians	1	2.5	2	5	.579
16- Burkholderia cepacia	2	5	1	2.5	1.00
17- Stenotrophomonas maltophilia	2	5	1	2.5	1.00
18- Pseudomonas paucimobilis	0	0	1	2.5	.450
19- Pseudomonas fluorescens	0	0	1	2.5	.450
20- Pseudomonas species	0	0	5	12.5	.013 b
21- Staph. aureus	3	7.5	2	5	1.00
22- Staph. capitis	3	7.5	0	0	.238
23- Staph. cohnii	1	2.5	1	2.5	1.00
24- Staph. epidermidis	1	2.5	2	5	.579
25- Enterococcus faecalis	1	2.5	5	12.5	.073
26- Staph. haemolyticus	2	5	1	2.5	1.00
27- Staph. hominis	2	5	0	0	.492
28- Staph. saprophyticus	3	7.5	2	5	1.00
29- Staph. simulans	6	15	1	2.5	.105
30 -Staph. warneri	2	5	2	5	1.00
31- S.xylosus	1	2.5	0	0	1.00
32- Viridans- type streptococci	4	10	2	5	.673
33- Yeasts	0	0	0	0	h

a. Using Fisher's Exact test (Exact Sig. 2 sided) using α=0.05
b. The test is significant (otherwise the test is not significant).
h. No statistics are computed because GROIN is a constant.

Table 13: The isolation rates of different organisms recovered from the leg in relation to age

Microbial isolates	age 1-12*		age 13-17**		p-value[a]
	freq	%	freq	%	
01- Acinetobacter baumannii	3	7.5	1	2.5	.638
02- Acinetobacter lwoffii	3	7.5	0	0	.262
03- Alkaligenes species	4	10	0	0	.136
04- Bacillus species	0	0	0	0	h
05- Candida albicans	0	0	1	2.5	.400
06- *Corynebacterium species*	2	5	0	0	.508
07- Chryseomonas luteola	2	5	0	0	.508
08- Enterobacter agglomerans	2	5	0	0	.508
09- Escherichia coli	0	0	0	0	h
10- Flavobacterium meningosepticum	3	7.5	1	2.5	.638
11- Klebsiella oxytoca	1	2.5	1	2.5	1.00
12- Micrococcus luteus	3	7.5	0	0	.262
13- Micrococcus roseus	4	10	0	0	.136
14- Micrococcus species	3	7.5	0	0	.262
15- Micrococcus varians	2	5	0	0	.508
16- Burkholderia cepacia	1	2.5	2	5	.553
17- Stenotrophomonas maltophilia	1	2.5	1	2.5	1.00
18- Pseudomonas paucimobilis	0	0	0	0	h
19- Pseudomonas fluorescens	2	5	1	2.5	1.00
20- Pseudomonas species	2	5	1	2.5	1.00
21- Staph. aureus	4	10	0	0	.136
22- Staph. capitis	1	2.5	0	0	1.00
23- Staph. cohnii	3	7.5	1	2.5	.638
24- Staph. epidermidis	3	7.5	0	0	.262
25- Enterococcus faecalis	3	7.5	1	2.5	.638
26- Staph. haemolyticus	4	10	0	0	.136
27- Staph. hominis	3	7.5	0	0	.262
28- Staph. saprophyticus	2	5	0	0	.508
29- Staph. simulans	3	7.5	0	0	.262
30 -Staph. warneri	5	12.5	0	0	.071
31- S.xylosus	3	7.5	0	0	.262
32- Viridans- type streptococci	1	2.5	1	2.5	1.00
33- Yeasts	2	5	0	0	.508

a. All tests are not significant by using Fisher's Exact test (Exact Sig. 2 sided) using α=0.05

h. No statistics are computed because LEG is a constant.

* Age 1- 12 years were 24 subjects

** Age 13 -17 years were 16 subjects* Age 1- 12 years were 24 subjects

Table 14: The isolation rates of different organisms recovered from the leg in relation to sex

Microbial isolates	Females		Males		p-value[a]
	freq	%	freq	%	
01- Acinetobacter baumannii	2	5	2	5	1.00
02- Acinetobacter lwoffii	3	7.5	0	0	.238
03- Alkaligenes species	3	7.5	1	2.5	.613
04- Bacillus species	0	0	0	0	h
05- Candida albicans	1	2.5	0	0	1.00
06- *Corynebacterium species*	2	5	0	0	.492
07- Chryseomonas luteola	2	5	0	0	.492
08- Enterobacter agglomerans	2	5	0	0	.492
09- Escherichia coli	0	0	0	0	h
10- Flavobacterium meningosepticum	3	7.5	1	2.5	.613
11- Klebsiella oxytoca	2	5	0	0	.492
12- Micrococcus luteus	2	5	1	2.5	1.00
13- Micrococcus roseus	3	7.5	1	2.5	.613
14- Micrococcus species	1	2.5	2	5	.579
15- Micrococcus varians	1	2.5	1	2.5	1.00
16- Burkholderia cepacia	3	7.5	0	0	.238
17- Stenotrophomonas maltophilia	1	2.5	1	2.5	1.00
18- Pseudomonas paucimobilis	0	0	0	0	h
19- Pseudomonas fluorescens	2	5	1	2.5	1.00
20- Pseudomonas species	1	2.5	2	5	.579
21- Staph. aureus	1	2.5	3	7.5	.310
22- Staph. capitis	1	2.5	0	0	1.00
23- Staph. cohnii	2	5	2	5	1.00
24- Staph. epidermidis	2	5	1	2.5	1.00
25- Enterococcus faecalis	3	7.5	1	2.5	.613
26- Staph. haemolyticus	3	7.5	1	2.5	.613
27- Staph. hominis	2	5	1	2.5	1.00
28- Staph. saprophyticus	2	5	0	0	.492
29- Staph. simulans	2	5	1	2.5	1.00
30 -Staph. warneri	4	10	1	2.5	.355
31- S.xylosus	3	7.5	0	0	.238
32- Viridans- type streptococci	2	5	0	0	.492
33- Yeasts	2	5	0	0	.492

a. All tests are not significant by using Fisher's Exact test (Exact Sig. 2 sided) using α=0.05

h. No statistics are computed because LEG is a constant.

Table 15: The isolation rates of different organisms recovered from the toe webs in relation to age

Microbial isolates	age 1-12*		age 13-17**		p-value[a]
	freq	%	freq	%	
01- Acinetobacter baumannii	1	2.5	0	0	1.00
02- Acinetobacter lwoffii	3	7.5	0	0	.262
03- Alkaligenes species	1	2.5	0	0	1.00
04- Bacillus species	1	2.5	2	5	.553
05- Candida albicans	3	7.5	3	7.5	.668
06- *Corynebacterium species*	3	7.5	0	0	.262
07- Chryseomonas luteola	5	12.5	0	0	.071
08- Enterobacter agglomerans	1	2.5	0	0	1.00
09- Escherichia coli	3	7.5	2	5	1.00
10- Flavobacterium meningosepticum	3	7.5	1	2.5	.638
11- Klebsiella oxytoca	4	10	0	0	.136
12- Micrococcus luteus	4	10	0	0	.136
13- Micrococcus roseus	3	7.5	0	0	.262
14- Micrococcus species	1	2.5	1	2.5	1.00
15- Micrococcus varians	4	10	1	2.5	.631
16- Burkholderia cepacia	6	15	0	0	.064
17- Stenotrophomonas maltophilia	3	7.5	1	2.5	.638
18- Pseudomonas paucimobilis	2	5	0	0	.508
19- Pseudomonas fluorescens	3	7.5	1	2.5	.638
20- Pseudomonas species	2	5	1	2.5	1.00
21- Staph. aureus	5	12.5	1	2.5	.373
22- Staph. capitis	5	12.5	0	0	.071
23- Staph. cohnii	3	7.5	0	0	.262
24- Staph. epidermidis	3	7.5	1	2.5	.638
25- Enterococcus faecalis	4	10	0	0	.136
26- Staph. haemolyticus	4	10	1	2.5	.631
27- Staph. hominis	1	2.5	0	0	1.00
28- Staph. saprophyticus	2	5	0	0	.508
29- Staph. simulans	2	5	0	0	.508
30 -Staph. warneri	2	5	1	2.5	1.00
31- S.xylosus	2	5	0	0	.508
32- Viridans- type streptococci	2	5	0	0	.508
33- Yeasts	2	5	0	0	.508

a. All tests are not significant by using Fisher's Exact test (Exact Sig. 2 sided) using α=0.05

* Age 1- 12 years were 24 subjects

** Age 13 -17 years were 16 subjects

Table 16: The isolation rates of different organisms recovered from the toe webs in relation to sex

Microbial isolates	Females		Males		p-value[a]
	freq	%	freq	%	
01- Acinetobacter baumannii	1	2.5	0	0	1.00
02- Acinetobacter lwoffii	1	2.5	2	5	.579
03- Alkaligenes species	0	0	1	2.5	.450
04- Bacillus species	1	2.5	2	5	.579
05- Candida albicans	3	7.5	3	7.5	1.00
06- *Corynebacterium species*	2	5	1	2.5	1.00
07- Chryseomonas luteola	1	2.5	4	10	.155
08- Enterobacter agglomerans	0	0	1	2.5	.450
09- Escherichia coli	2	5	3	7.5	.642
10- Flavobacterium meningosepticum	2	5	2	5	1.00
11- Klebsiella oxytoca	2	5	2	5	1.00
12- Micrococcus luteus	1	2.5	3	7.5	.310
13- Micrococcus roseus	2	5	1	2.5	1.00
14- Micrococcus species	1	2.5	1	2.5	1.00
15- Micrococcus varians	3	7.5	2	5	1.00
16- Burkholderia cepacia	2	5	4	10	.381
17- Stenotrophomonas maltophilia	2	5	2	5	1.00
18- Pseudomonas paucimobilis	1	2.5	1	2.5	1.00
19- Pseudomonas fluorescens	1	2.5	3	7.5	.310
20- Pseudomonas species	0	0	3	7.5	.083
21- Staph. aureus	3	7.5	3	7.5	1.00
22- Staph. capitis	2	5	3	7.5	.642
23- Staph. cohnii	2	5	1	2.5	1.00
24- Staph. epidermidis	2	5	2	5	1.00
25- Enterococcus faecalis	2	5	2	5	1.00
26- Staph. haemolyticus	2	5	3	7.5	.642
27- Staph. hominis	1	2.5	0	0	1.00
28- Staph. saprophyticus	1	2.5	1	2.5	1.00
29- Staph. simulans	0	0	2	5	.196
30 -Staph. warneri	1	2.5	2	5	.579
31- S.xylosus	0	0	2	5	.196
32- Viridans- type streptococci	1	2.5	1	2.5	1.00
33- Yeasts	1	2.5	1	2.5	1.00

a. All tests are not significant by using Fisher's Exact test (Exact Sig. 2 sided) using α=0.05

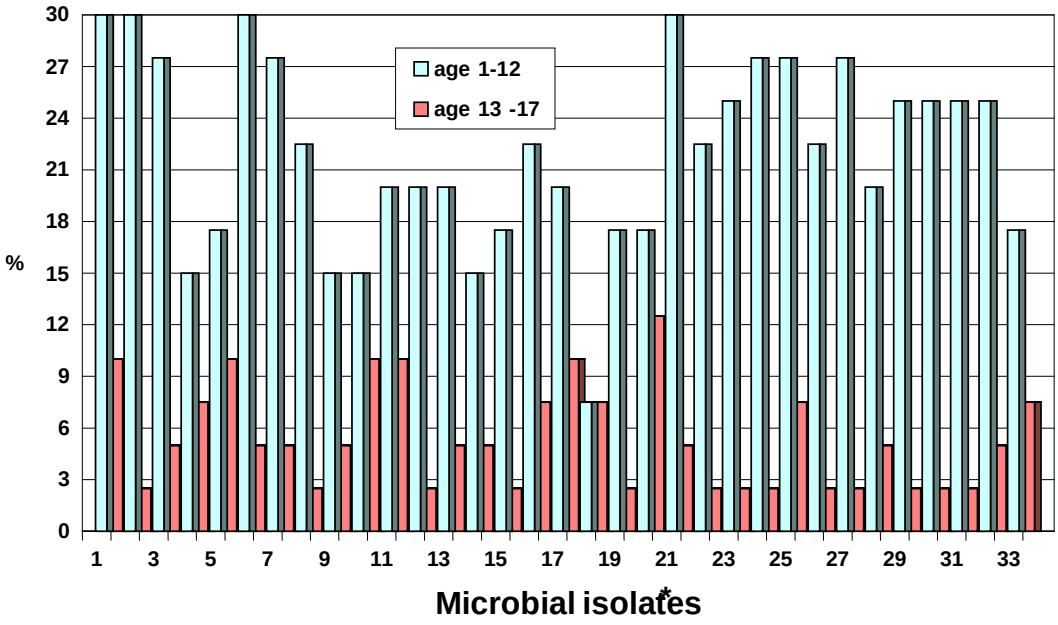

Figure 1 The isolation rates of different organisms recovered from the seven sites of the skin in relation to age

*** The microbial isolates are numbered as shown in Tables 1-16**

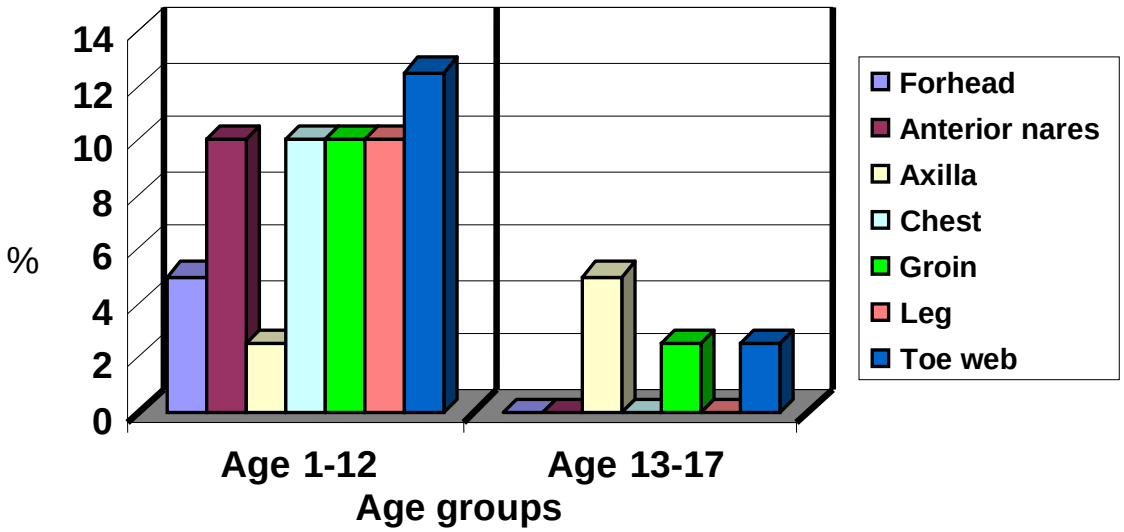

Figure 2: Isolation rates of *Staph aureus* among children and adults from seven skin sites

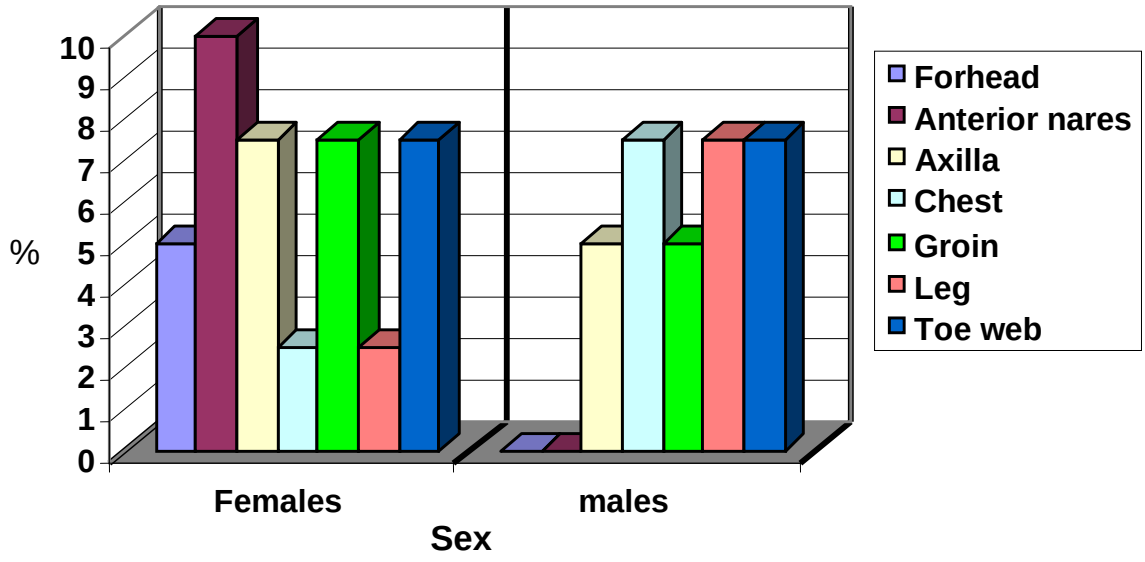

Figure 3: Isolation rates of *Staph . aureus* among females and males from seven skin sites

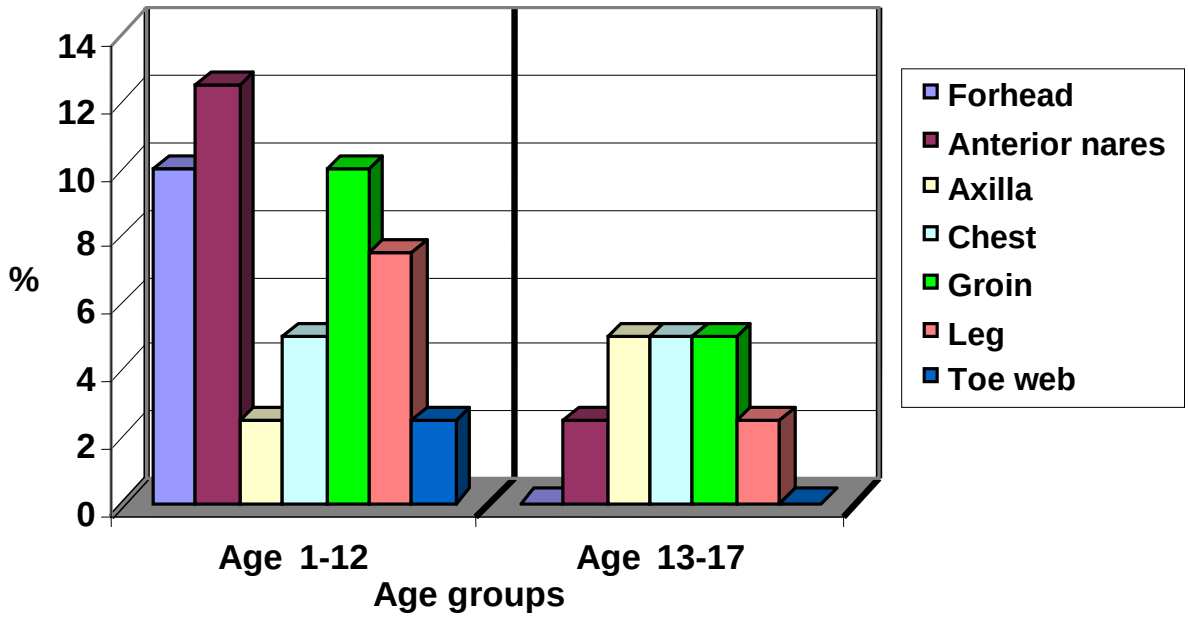

Figure 4: Isolation rates of *Acinetobacter baumannii* among children and adults from seven skin sites

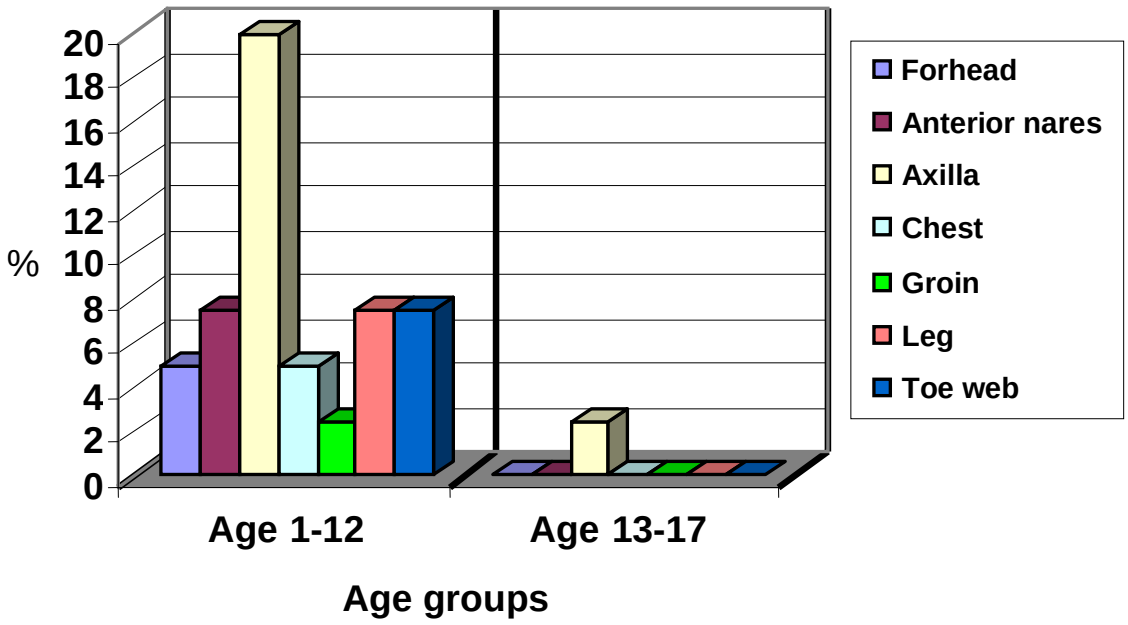

Figure 5: Isolation rates of *Acinetobacter lwoffii* among children and adults from seven skin sites

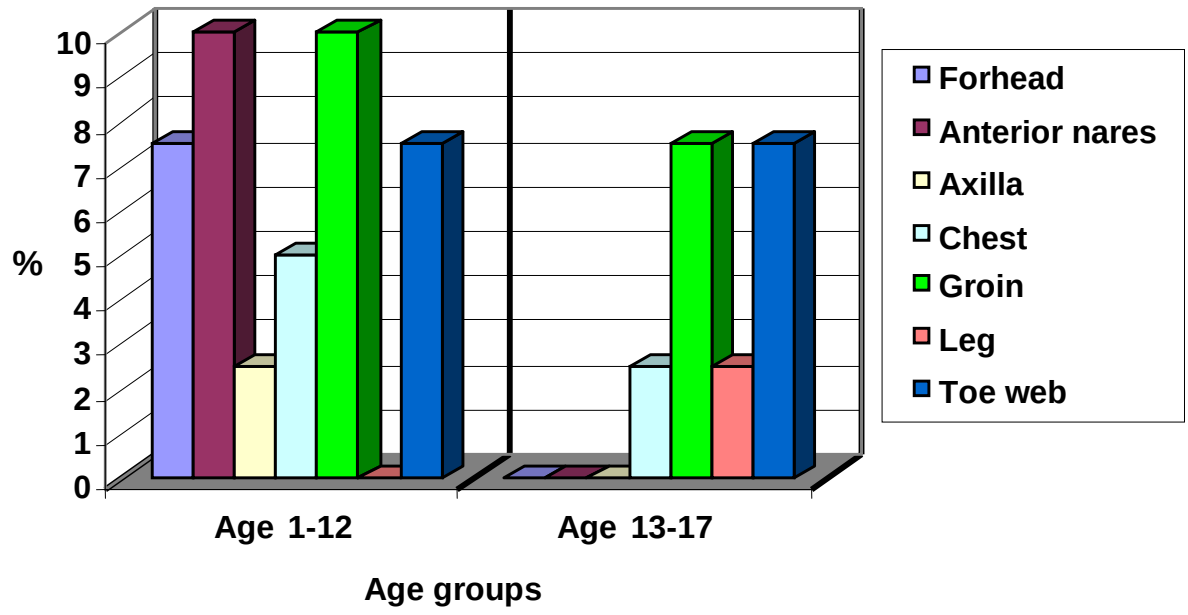

Figure 6: Isolation rates of *Candida albicans* among children and adults from seven skin sites

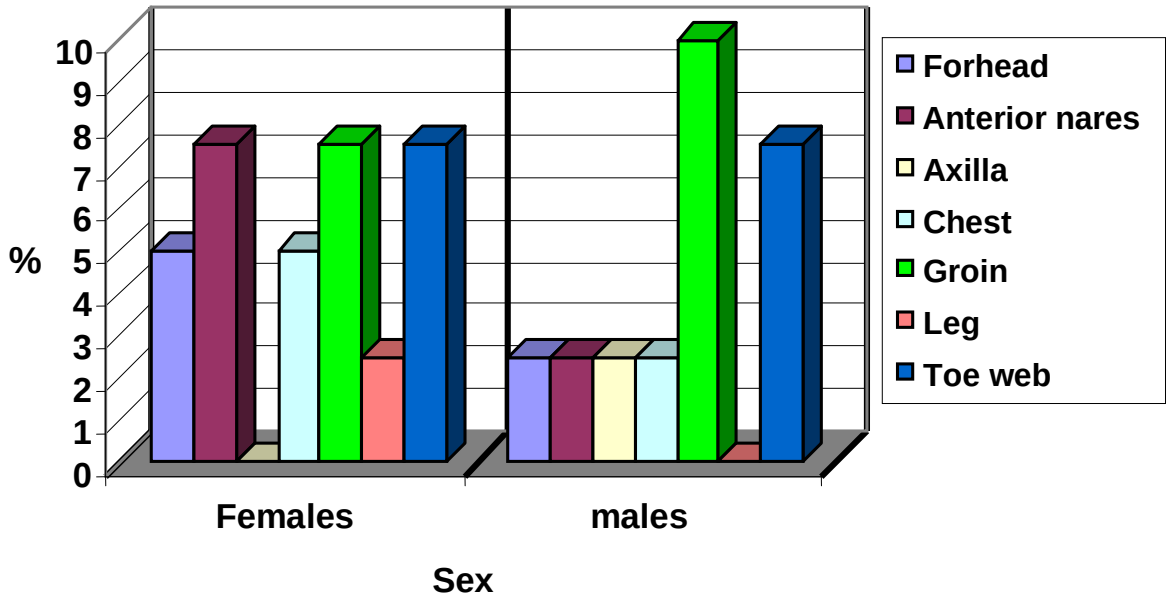

Figure7: Isolation rates of *Candida albicans* among females and males from seven skin sites

Discussion

Reproducibility of the sampling method:

Although there are different methods for the investigation of skin microflora, rubbing technique was used for sampling the skin in the present study as a qualitative method rather than quantitative. Moistening the cotton swab with 0.5% Tween 80 and scrub - bing the skin with moderate pressure for one minute, gave reproducible results. Agitation of the samples in addition to using a surfactant substance (Tween 80) allowed the removal of bacteria from the skin and the dispersal of the majority of microorganisms held on the cotton swab; moreover this procedure had lead to the breakdown of bacterial aggregates, thus achieving an optimal recovery of organisms (DeCoursey *et.al.*, 1956; Milyani and Selwyn, 1976). In the standardized swabbing method by Selwyn and Ellis (1972), Triton X-100 was used as a surfactant substance. However, Tween 80 was replaced in this study since Triton X-100 was found to have to some extent bactericidal activity if there was a delay in processing the specimen for more than three hours. The lipophilic *Corynebacterium species* are destroyed (Noble and Somerville, 1974). Furthermore, the variety of media and identification techniques used in the present work allowed adequate isolation and identification of various species and a higher yield of organisms.

Incidence of the isolated microorg- anisms:

Thirty three species including Gram positive and Gram negative microorganisms have been isolated from the seven sites of the skin; the Gram positive microorganisms comprised 20 species while the Gram negative ones comprised 13 species. It is well known that Gram negative rods other than *Acinetobacter species* are rare on normal skin, and only occasio- nally are found in quantity in moist

areas (Noble and Somerville, 1974). In the present study, the incidence of *A. baumannii and A. lwoffii* dominated among children within the seven sites, comprising 30% of each isolate. However, the isolation rates of these species varied in each separate site (Figures 4-5), and this is in agreement with researchers who isolated this species from different skin sites (Marples, 1965; Somerville, 1966; Noble and Somerville, 1974). Though, the role of *Acinetobacter species* as a ubiquitous opportunistic pathogen is now appreciated (Mandell, *et.al.*, 2000). Surprisingly, other Gram negative rods isolates followed in prevalence among the same group within all sites with significant difference namely: *Alkaligenes species, C. luteola* (an incidence of 27.5% each); *E. agglomerans* (22.5%) and *E. coli (15%)*. On the other hand, *F. meningosepticum* (15%); *K. oxytoca* (20%), *B. cepacia* (22.5%) and different species of *Pseudomonas* (7.5%-17.5%) were isolated from children and adults and females and males but no significant difference was evident. Also, similar incidence was noted between different sites among the age groups. However, in relation to sex, significant differences were recorded only in the isolation rates of *C. luteola* and *P. species* (P= 0.013 each) in the groin area among males; and this could be attributed to the micro-climate and humidity at this occluded area which favoured the establishment of these species. Differences were expected between children and adults especially in the microbial flora of the axilla, since axillary hair was not removed in addition to the presence of excessive sebum in adults, thus providing a green house atmosphere. Yet the isolation rates of microbial isolates were not significantly different at this site in spite of variations in hygienic habits, dietary habits, different activities and hormonal factors between children before puberty and adults after puberty in both sexes which are known to play a role in the qualitative and quantitative composition of skin microbial flora (Marples, 1965; Noble and Somerville, 1974; Skinner and Carr, 1974). In this respect, **Prophet Mohammad peace be upon him** 14 century ago instructed us to remove axillary and pubic hair periodically.

Although, desiccation is known to be the prime reason for the failure of many organisms to survive on skin, such as the Gram negative rods yet, a considerable species numbers of these organisms have been isolated. However, it has been reported that increasing humidity lead to an immense increase in the bacterial population (Marples, 1965; Noble and Somerville, 1974); and these paradoxical results may be attributed to the humid and hot climate of Jeddah city which may have encouraged these organisms to survive on the skin of the study group. Factors such as occlusion (clothing), hormonal changes, nutrients, pH, body temperature and hygiene should not be ignored since they are indeed important in the diversity of microbial flora not only from time to time but also from site to site and within the same site (McBride *et.al*, 1975; McBride *et.al*, 1977). Moreover, most of the Gram negative rods that have been isolated in this study have not been isolated elsewhere as normal skin flora, but have been reported only as common isolates from clinical specimens especially from compromised patients (Noble, 1981; Koneman *et.al.*, 1997; Mandell, *et.al.*, 2000).

The Gram positive isolates consisted of rods and cocci, where *Corynebacterium species* (coryneforms) *and Bacillus species* represented the

rods, while members of the Family *Micrococcaceae,* viridans-type streptococci and yeasts represented the coccal forms in the present work. The isolation of coryneforms from the skin is expected since it is well established that they are dominant residents of the skin flora and mucous surfaces. Coryneforms have been isolated from the seven skin sites in different percentage among the study group as well as by others (Marples, 1969b; Noble and Somerville, 1974; Maibach and Aly, 1981). Unfortunately, because of their varied characteristics and unavailable (local) simple identification methods, further identification up to the species level was hindered in this work. On the other hand the recovery of *Bacillus species* is considered as transient flora, nonetheless, it has been implicated in serious nosocomial infections and in intravenous drug abusers injection (Sliman, *et. al.*, 1987; Richard, *et.al.*, 1988; Mandell, *et.al* 2000)

The Family *Micrococcaceae* includes the genus *Staphylococcus* and the genus *Micrococcus.* The genus *Staphylococcus* comprises the coagulase negative staphylococci and the coagulase positive staphylococci, the former staphylococci are the second normal resident flora of the human skin, in addition to members of the genus *Micrococcus* (Leyden *et.al.,* 1981; Leyden *et.al.*, 1987). Different species of coagulase negative staphylococci, *micrococcus* and coagulase positive staphylococci namely: *Staph. aureus* have been isolated in the present work from the seven sites at different percentage as shown in all Tables. Other researchers have also reported similar findings (Kloos and Musselwhite, 1975; Maibach and Aly, 1981; Romero, *et. al.*, 1990). However, *Staph. aureus* was not recovered from chest and legs of adults and surprisingly also from forehead and anterior nares of both adults and males (Figures 2-3), though Milyani and Memish (1987) reported a carriage rate of 12% and 9% in the throat of children and adults in Jeddah city and from the anterior nares of female adults (Milyani, unpublished data). However, significant difference was not found when each site was studied separately at the present study, and this could be attributed to the rather small number of subjects investigated.

Among the streptococci, viridans – type *streptococcus* was isolated at variable rates from different sites. Though, in other studies streptococci were not recovered frequently from skin (unpublished data). However, Noble (1981) reported that Alpha and Gamma –haemolytic streptococci are found well over the body especially in infants and children. On the other hand, *Streptococcus pyogenes* was not recovered in this work as expected. Apart from bacterial species, *C. albicans* (Figure 6-7) and yeasts were noted among the aerobic isolated organisms in different sites of the skin and at different isolation rates, this is also in accordance with Marples, (1965); Noble, (1981) and O'Connell *et. al*., (1995).

The role of the isolated organisms in endogenous, exogenous and nosocomial infections:

The diversity of microorganisms isolated from the skin in the present study highlights the importance of pursuing similar investigation on a wide scale; since it is known that every movement an individual makes dislodges epidermal fragments which act as 'rafts', carrying microorganisms to the surrounding habitat (Smith and Bruch, 1969). Thus, most of these isolates or the carriage of a true pathogen might be a potential risk for the individual himself or others,

especially, in the hospital environment. It has been documented that Coagulase negative staphylococci especially *Staph. epidermidis* are significant nosocomial pathogens complicating central venous catheters, indwelling prosthetic medical devices, intensive care units, catheter related septisaemia and a cause of infection of peritoneal dialysis catheters and postoperative wound infections Lowy, *et. al.*, 1983; Andremont, *et. al.* 1988; Boyce, *et. al.*,1990; Kamath *et. al.*, 1992; Mandell, *et. el.* 2000). It is obvious that the source of these organisms could be mainly from the skin or the body normal flora in addition to the hospital environment (Maibach and Aly, 1981; Benson, 2000). *Staph. aureus, Micrococcus, Corynebacterium, Acinetobacter, Pseudomonas,* a wide variety of Gram negative rods and *C. albicans* are also incriminated in a wide range of endogenous, exogenous and nosocomial infections particularly, in compromised patients (Flynn, *et. el*. 1987; Govan, *et. al.*1996; Rangel-Frausto, *et. al.* 1999).

In view of the most common organisms encountered in three main hospitals in Jeddah city during two years (1995- 1997), the predominant organisms reported were *Staph. aureus, Staph. epidermidis, Staph. Haemolyticus, Staph. saprophyticus, Staph. warneri, Staph. capitis, E. faecalis, E. agglomerans, E. coli, Proteus, Serratia, C. luteola, S. maltophilia, F. meningosepticum, Klebsiella oxytoca, Klebsiella pneumoniae, B. cepacia, Pseudomonas species,* viridans streptococci and yeasts. These organisms were incriminated in upper respiratory tract, urinary tract, postoperative wound and burn infections, bacteraemia, and infections related to indwelling medical devices and in intensive–care units (personal communication). Preventive measures should be undertaken and strictly followed to reduce the morbidity and mortality associated with microbial infections. Basic hygiene, hand hygiene and care with catheter insertion and maintenance using aseptic techniques, are of all importance in prevention. Also, rapid diagnosis and aggressive effective treatment may reduce morbidity and mortality, bearing in mind the growing microbial resistance in hospitals, at different parts of the world (Bergogne-Berezin, *et. al.*, 1993; Roberts, *et. al*., 2001; Wang, *et. al.*, 2001).

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p-value[a] age 13-17** age 1-12* Microbial isolates

p-value[a] age 13-17** age 1-12*

p-value[a] age 13-17**

p-value[a]

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الفلورا الميكروبيه الهوائية للجلد في مدينة جدة - المملكة العربية السعودية

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لقد تم التعرف على الفلورا الميكروبية الهوائية لجلد أربعين شخصاً يعيشون في مدينة جدة (المملكة العربية السعودية). وتضمنت الدراسة مجموعتين من الأعمار: أطفال وبالغين من الذكور والإناث، شملت سبعة مناطق: الجبين، الابط، الارب، الرجل، الجليدة بين أصابع القدم ثم فتحتي الأنف الأمامية. وقد أخذت عينات الجلد بدعك المنطقة بواسطة ماسحة قطنية مشبعة بمادة منظفة للجلد (توين 80) توضع بعدها في الوعاء المحتوي على هذه المادة ثم يخض العلق الناتج لمدة دقيقة واحدة.

عزلت ثلاث وثلاثون نوعاً من السبع مناطق من المجموعة قيد الدراسة حيث سادت بين الأطفال كل من أساينتوبكتر بوميناي، أساينتوبكتر لوفاي، كوراينبكتيريم، والمكورات العنقودية الذهبية (بنسبة 30% لكل منها). ومن أكثر العزلات الأخرى شيوعاً: نوع من الكالاجينز، نوع من باسيللاس، كرايزومونـاس لاتيولا، المكورات العنقودية الجلدية، المكورات المعوية البرازية والمكورات العنقودية هومينـاس (بنسبة 27% لكل منها). كما ظهرت ميكروبات مثل: كانديدا البيكانز، إينتيروبكتر أجلوميرانس، الإيشيريشيا القولونية، فلافوبكتيريم مينينجوسيبتيكم، كليبسيللا أوكزيتوكا، المكورات الدقيقة لوتيس، المكورات الدقيقة الوردية، المكورات الدقيقة فيرينس، نوع من المكورات الدقيقة، بيركهولديريا سيبيشيا، ستينوتروفوموناس مالتوفيليا، سودوموناس بوسيموبيلاس، سودوموناس فلوريسانس، نوع من السودوموناس، المكورات العنقودية كابيتيس، المكورات العنقودية كوناي، المكورات العنقودية المترممة، المكورات العنقودية سيميولانس، المكورات العنقودية ورنيراي، المكورات العنقودية زايلوزيس، المكورات العقدية من الأنواع المخضرة ث و خمائر بنسب مختلفة. كما لوحظ لدى الأطفال في السبع مناطق نسب أعلى من: أساينتوبكتر لوفاي، المكورات العنقودية الذهبية، نوع من الكالاجينز، كوراينبكتيريم، كرايزومونـاس لاتيولا، إينتيروبكتر أجلوميرانس، المكورات العنقودية الجلدية ومكورات عنقودية اخرى سالبة للكوأجيوليز. بينما وجد كل من كرايزومونـاس لاتيولا ونوع من السودوموناس في منطقة الإرب لدى الذكور فقط. عدا ذلك لم تسجل أي فروقات معنوية في نسب العزل لكل منطقة على حدة بالنسبة للعمر والجنس.

وقد تم التأكيد على دور الميكروبات المعزولة في العدوى الداخلية والخارجية والعدوى المكتسبة داخل المستشفيات.