



## CARRIAGE OF *STAPHYLOCOCCUS AUREUS* ON ARMPITS OF SECONDARY SCHOOL AND UNIVERSITY STUDENTS IN PORT HARCOURT, NIGERIA

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### ABSTRACT

A study of carriage of *Staphylococcus aureus* on armpits and factors affecting it was carried out on 50 students from Community Secondary School, Oroworokwu, Port Harcourt and 50 University of Port Harcourt students. Samples were inoculated onto mannitol salt agar plates and coagulate positive *S. aureus* isolates were identified. Questionnaires on gender and health related factors were given to students before collection of samples. Epi-info version 6 software was used for data analysis. Most students regardless of age or sex, used toilet soap (63%), had their bath twice daily (84%), used sponge (78.6%), shaved regularly (89.9%) and 80% did not use powders on armpits. More females used powders ( $P=0.00170$ ). Only 12.2% of teenagers used deodorants compared to 80.4% adults. Teenagers had significantly more profuse growth ( $P = 0.038$ ), pure cultures ( $P = 0.036$ ) on primary isolation, and *S. aureus* carriage of 61.2% compared to 25.5% for adults ( $P = 0.0003$ ) and use of deodorants ( $P = 0.0003$ ) influenced *S. aureus* Carriage.

**Keywords:** *Staphylococcus aureus*, carriage, Armpit, students.

### INTRODUCTION

The number and kinds of microbes associated with our skin is dependent on the nutrients present. More bacteria are found in moist areas, such as the axillae/armpits and the sides of the nose (2.5 million/cm<sup>2</sup>) than on the dry surfaces of arms and legs (20,000/cm<sup>2</sup>). Transient microbiota are present on hands and arms in contact with the environment. Normal bacterial flora of the skin include *Propionibacterium acnes*, *Streptococcus* sp., *Staphylococcus*, *Staphylococcus aureus* and *Staphylococcus epidermidis*, which reside as commensals but can cause opportunistic infection in tissues and sites with lowered host – resistance as in damaged skin and mucous membranes (Freeman, 1979). *Staphylococcus aureus* has several virulent factors which make it highly pathogenic. *S. aureus* cell wall exhibit receptor (adhesins) for epidermal and dermal fibronectin and fibrinogen. In conditions where intact stratum corneum is lacking such as atopic dermatitis, dermal fibronectin might be uncovered and increase adherence of *S. aureus*. (Breuer et al; 2002). Various infections caused by *S. aureus* include superficial infections such as skin pustules, boils, carbuncles, impetigo, pemphigus neonatorum, sycosis barbae, paronychia, styes, blepharitis, conjunctivitis and infections of

accidental and surgical wounds and burns. Subcutaneous infections include abscesses and whitlows. Systemic infections include bronchopneumonia osteomyelitis, pyelonephritis, acute bacterial endocarditis and septicaemia. Staphylococcal food poisoning is a common cause of vomiting and diarrhoea following ingestion of foods contaminated by enterotoxin producing strains (Kloos and Jorgensen, 1982). *Staphylococcus aureus* is one of the most frequent microorganisms involved in neonatal septicaemia (Kallman et al; 1997; Sarlangue et al; 1998). Recent studies also indicate increasing number of cases of bullous impetigo and scalded skin syndrome due to *S. aureus* (Faden, 2003; El Helali et al; 2005).

Concern over nosocomial infections of patients in intensive care units and rehabilitation centres from carriers especially carriers of drug resistant strains of *S. aureus* gave rise to several studies on the relationship between nose and skin of *S. aureus* (Breuer et al; 2002; Moss et al; 1948; White, 1961; White and Swith, 1963) and the elimination of nasal, hand and skin carriage (Bareuer et al; 2002; Yu et al; 1986, Reagan et al; 1991). Reagan et al; (1991) showed that the frequency of skin colonization is proportional to the density of nasal colonization and only nasal de-colonization reduced density of skin colonization. They observed that 15 of 21 patients (71.4%) with colonized healthy skin (armpits) were successfully decontaminated through the use of mupirocin for nasal treatment. Antiseptic wash using bisepitine

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with chlorhexidine was recommended for patients in intensive care units. Nose masks and gloves were recommended for handling newborns in nurseries. Hand washing with soap was recommended to minimize spreading of infections (Yu et al; 1986). The observation of high level of mupirocin resistance in greater than 50% of community acquired methicillin – Resistant *S. aureus* (CA-MRSA) isolates (Mulvey et al; 2005) and that CA – MRSA have caused serious and sometimes fatal diseases especially in otherwise healthy children poses further challenges (CDC. 1999; Gwynne-Jones and Stott, 1999; Nainii et al 2001).

This study was undertaken to determine carriage of *S. aureus* on the armpits (axillae) of university and secondary school students and also to determine the role of age, gender and health related characteristics such as use of soap, sponges, deodorant, powder and frequency of bathing and shaving of armpit hairs on carriage.

## MATERIALS AND METHODS

### SOURCE OF MATERIALS

The armpit swabs were obtained from students of the University of Port Harcourt and Community Secondary School, Oroworukwo, near the University. Permission was sought and obtained from the Principal of the secondary school through a letter from the Department of Microbiology, Faculty of Science, and University of Port Harcourt. The materials for the sample collection and an overview of the study were shown and briefly described to the principal, teachers and participants. Confidentiality of the result was explained to the participants.

### COLLECTION OF SAMPLES

One hundred samples were randomly collected in February 2004, from age groups of 14 – 17 and 18 – 30 years, irrespective of sex, nationality and economic status. A sterile swab stick was dipped into sterile distilled water to moisten it before rubbing or rolling it over the armpit of each participant.

Questionnaires on health related characteristics of the participants were completed by the researcher before sample collection. Information was obtained on gender, age, use of soap, sponge, deodorant and powder, frequency of bathing and shaving of armpit hairs.

### CULTURE CONDITIONS AND IDENTIFICATION OF ISOLATES

The swabs were inoculated immediately after rolling them over the armpits of participants onto

Mannitol Salt Agar (MSA) plates. The plates were incubated at 37°C aerobically for 24 hours. The plates were examined for growth at the end of incubation period. Typical colonies were picked aseptically with inoculating loop and purified by sub-culturing. *Staphylococcus aureus* was identified on the basis of colonial morphology, gram-stain reaction, positive catalase test, coagulase production and fermentation of mannitol.

### DATA ANALYSIS

Data analysis was performed using the Epi-info version 6 software.

## RESULTS

Observations on the effect of age of participants on cultural characteristics of the bacterial isolates showed that almost all students (98.00%) had growth on Mannitol Salt Agar. Growth from the secondary school students was significantly more profuse (79.20%) and mainly pure (71.40%) compared to 60.80% ( $P = 0.038$ ) and 51.00% ( $P = 0.036$ ) respectively for adults. On the average, there were 61.00% pure cultures and 39.00% mixed cultures on primary isolation. The pure colonies were mostly yellow and fermented mannitol while the pure white colonies were mucoid and non-mannitol fermenting. The mixed cultures consisted of yellow colonies (2 – 3mm) in diameter, tiny background white colonies (0.5mm) in diameter, medium white colonies (2 – 3mm) in diameter and large white colonies (4 – 5mm) in diameter. *S. aureus* was isolated from more secondary school students (65.30%) than university students (25.50%,  $P = 0.00006$ ).

Table 1 shows the percentage distribution of health related characteristics of participants according to gender. This table shows that there were no significant differences in most of the variables examined between males and females including type of soap used ( $p = 0.6905$ ), use of deodorant ( $P = 0.7837$ ), frequency of bathing ( $P = 0.5289$ ), shaving ( $P = 0.2265$ ), isolation of *S. aureus* from the armpit ( $P = 0.7459$ ) and numbers of *S. aureus* carriers ( $P = 0.4346$ ). However, there were significant differences in the use of powder ( $P = 0.0017$ ) and the use of sponge ( $P = 0.002$ ) among males and females, with more females using these. Majority of the participants used toilet soap (63.00%), had bath twice daily (84.00%), used sponge (78.60%) while 80.00% did not use powder on armpits and 53.00% used deodorant. The average percentage of *S. aureus* carriage was 43.35%.

**TABLE 1: PERCENTAGE DISTRIBUTION OF HEALTH RELATED CHARACTERISTICS OF PARTICIPANTS BY GENDER**

Health Related Characteristic	Males n = 56 (%)	Females n = 44 (%)	Total n = 100 (%)	P - Value
<b>Soaps Used:</b>				
Medicated	20 (35.70)	14 (31.80)	34 (34.00)	0.6905
Toilet	35 (62.50)	28 (63.60)	63 (63.00)	
Local	1 (1.80)	2 (4.50)	3 (3.00)	
<b>Deodorant Used:</b>				
Yes	27 (48.20)	20 (45.50)	47 (47.00)	0.7837
No	29 (51.80)	24 (54.50)	53 (53.00)	
<b>Powder Used:</b>				
Yes	5 (8.90)	15 (34.10)	20 (20.00)	0.0017
No	51 (91.10)	29 (65.90)	80 (80.00)	
<b>Bath in a Day:</b>				
Once	4 (7.10)	2 (4.50)	6 (6.00)	0.5289
Twice	45 (80.40)	39 (88.60)	84 (84.00)	
Thrice	7 (12.50)	3 (6.80)	10 (10.00)	
<b>Sponge Used:</b>				
Yes	37 (67.30)	40 (93.00)	77 (78.60)	0.002
No	18 (32.70)	3 (7.00)	21 (21.40)	
<b>Shaving Pattern:</b>				
Once a Week	10 (18.20)	14 (31.80)	24 (24.20)	0.2265
Once in 3 Weeks	16 (29.10)	12 (27.30)	28 (28.30)	
Once a Month	21 (38.20)	16 (36.40)	37 (37.40)	
Once in 2 Months	8 (14.50)	2 (4.50)	10 (10.10)	
<b>S. aureus Isolated:</b>				
Yes	26 (46.40)	19 (43.20)	45 (45.00)	0.7459
No	30 (53.00)	25 (56.50)	55 (55.00)	
<b>S. aureus Carriers:</b>				
Yes	26 (46.80)	17 (38.60)	43 (43.00)	0.4346
No	30 (53.60)	27 (61.40)	57 (57.00)	

Table 2 shows the influence of age on health related characteristics of participants. There were no significant differences according to age in types of soap used ( $P = 0.1997$ ), use of powder ( $P = 0.109$ ) or sponge ( $P = 0.597$ ), frequency of bathing ( $P = 0.0974$ ) and shaving frequency ( $P = 0.2278$ ). use of deodorant was significantly less among 12 – 17 years old (12.20%) compared to 18 – 30 years old (80.40%,  $P = 0.0000$ ).

Table 3 summarises the effect of the variables on *S. aureus* carriage in armpits of participants. Age and use of deodorants affected carriage of *S. aureus* in armpits. Most of the teenagers (12 – 17 years) did not use deodorants and *S. aureus* carriage was significantly high among them. Age difference was significant ( $P = 0.003$ ) with 61.20% of teenagers being carriers compared to 25.50% adult carriers. The other variables such as gender, soaps used, use of powder or sponge, bathing and shaving frequency had no effect on *S. aureus* carriage.

## DISCUSSION

The observation in this study that *S. aureus* armpit carriage was 43.35% for the population studied,

with 61.20% carriage among secondary school students, ages 12 – 17 years and 25.50% among University students, ages 18 – 30 years is comparable to estimates by previous researches. Kloos and Jorgensen (1982) estimated *S. aureus* carriage in anterior nares and moist areas of the skin including the armpits of apparently healthy persons to be 20 – 30%. Brance, (1986) reported that 30 – 40% of adults are asymptomatic carriers of *S. aureus*. Treagan and Pulliam, (1982) estimated nasal carriage in Children to be as high as 100% and up to 50% in adults. Breuer., (2002) observed that *S. aureus* can be isolated from the skin of 5 – 30 % of normal individuals, mainly from intertriginous areas and that persistent nasal carriage is present in 20% of normal adults. Stewart and Beswick, (1977) estimated that about 5 – 10% of any population are carriers Chin (2000) estimated 20% nasal carriage among population and noted that areas of the world which lack water and soaps and are filthy have higher incidence of *S. aureus* infection.

**TABLE 2: PERCENTAGE DISTRIBUTION OF HEALTH RELATED CHARACTERISTICS OF PARTICIPANTS BY AGE**

Health Related Characteristic	Males (12 – 17 Yrs.) n = 49 (%)	Females (18 – 30 Yrs) n = 51 (%)	Total n = 100 (%)	P – Value
<b>Type of Soaps Used:</b>				
Medicated	16 (32.70)	18 (35.30)	34 (34.00)	0.1997
Toilet	30 (61.50)	33 (64.70)	63 (63.00)	
Local	3 (6.10)	0 (0.00)	3 (3.00)	
<b>Deodorant Used:</b>				
Yes	6 (12.20)	41 (80.40)	47 (47.00)	0.0000
No	43 (87.20)	10 (19.60)	53 (53.00)	
<b>Powder Used:</b>				
Yes	13 (26.50)	7 (13.70)	20 (20.00)	0.1095
No	36 (73.50)	44 (86.30)	80 (80.00)	
<b>Bath in a Day:</b>				
Once	2 (4.10)	4 (7.80)	6 (6.00)	0.0974
Twice	39 (79.60)	45 (88.20)	84 (84.00)	
Thrice	8 (16.30)	2 (3.90)	10 (10.00)	
<b>Sponge Used:</b>				
Yes	38 (80.90)	39 (76.50)	77 (78.60)	0.5975
No	9 (19.10)	12 (23.50)	21 (21.40)	
<b>Shaving Pattern:</b>				
Once a Week	12 (25.00)	12 (23.50)	24 (24.20)	0.2278
Once in 3 Weeks	13 (27.10)	15 (29.40)	28 (28.30)	
Once a Month	21 (43.80)	16 (31.40)	37 (37.40)	
Once in 2 Months	2 (4.20)	8 (15.70)	10 (10.10)	

**TABLE 3: EFFECT OF VARIABLES ON CARRIAGE OF *S. aureus* ON ARMPITS OF PARTICIPANTS**

Variable	% <i>S. aureus</i> Carriage		P - Value
<b>Sex:</b>			
Males	25/56	(46.40)	0.1997
Females	17/44	(38.60)	
<b>Age:</b>			
12 - 17 Years	30/49	(61.20)	0.0003
18 – 30 Years	13/51	(25.50)	
<b>Soaps Used:</b>			
Medicated	10/34	(29.40)	0.6905
Toilet	32/63	(50.80)	0.1202
Local	1/3	(33.30)	
<b>Deodorant Used:</b>			
Yes	10/47	(21.30)	0.0003
No	33/53	62.30	
<b>Powder Used:</b>			
Yes	10/20	(50.00)	0.4769
No	33/80	(41.30)	
<b>Bath in a Day:</b>			
Once	3/6	(50.00)	0.4683
Twice	34/84	(40/50)	
Thrice	6/10	(60.00)	
<b>Sponge Used:</b>			
Yes	32/77	(41.60)	0.6188
No	10/21	(47.60)	
<b>Shaving Pattern:</b>			
Once a Week	9/24	(87.50)	0.7681
Once in 3 Weeks	14/28	(50.00)	
Once a Month	15/37	(40.50)	
Once in 2 Months	5/10	(50.00)	

This study observed that age has a major influence on armpit carriage of *S. aureus*. Lack of use of deodorants by most of the secondary school students was clearly the only other health factor responsible for the higher carriage of *S. aureus*. These findings support the fact that the normal flora is acquired rapidly during and shortly after birth and changes continuously throughout life and that the organisms present at any given time reflect the age, nutrition and environment. Deodorants are known to work by suppressing the growth of *S. aureus* and hence armpit odours. The observation in this study that the use of soaps, sponges, powders, frequency of bathing or shaving did not affect carriage of *S. aureus* also agrees with the findings of Reagan et al. (1991) who observed that skin decontamination among hospitalised patients who were nasal carriers was not easy. They observed that armpit decolonization in 71.40% of patients was possible within six months when daily wash with antiseptic solution (biseptine with chlorhexidine) was combined with nasal de-colonization using mupirocin. Brener et al; (2002) also observed that recolonization of the skin by *S. aureus* occurred after 4 – 8 weeks of decontamination with mupirocin, chlorhexidine and potassium permanganate bath.

Since teenagers had more profuse growth of *S. aureus* they should be made aware of the importance of personal hygiene and the use of deodorants. Mitehell et al; (1999) suggested that teenagers should be taught to pay attention to hygiene by bathing frequently and paying special attention to underarms and pubic areas, using underarm deodorants and changing under wears daily. In our communities where teenagers hawk various food items, the role of carriers of enterotoxin producing strains of *S. aureus* in food poisoning should be of concern.

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