

Nasal Carriage of *Staphylococcus aureus*, Related Knowledge and Hygienic Status in Healthy School Children

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Abstract

Introduction	<i>Staphylococcus aureus</i> is the causative agent for various diseases. It is one of the most common etiological agents for a range of skin diseases like impetigo, carbuncle, folliculitis and boils, and scalded skin syndrome, which is the highly prevalent disease (5.76%) among other diseases in Nepal. It is also responsible for food poisoning and diarrheal diseases, which comes under the third ranking in the country's most prevalent disease (3.38%). It is also one of the etiological agents for Acute Respiratory Disease, which has second highest (3.44%) prevalence and sometimes associated with T.S.S (Toxic Shock Syndrome).
Objective	This study was sought to determine the prevalence of <i>Staphylococcus aureus</i> in a healthy school children, related knowledge, hygienic behavior, attitude and practices that may be relevant for the design of appropriate health education and epidemiological control program in context to Nepal
Methods	The study was both qualitative and quantitative school based descriptive cross-sectional study. The study was conducted among 200 healthy school children from three different schools within the Kathmandu Valley from June 2002-March 2003. <i>Staphylococcus aureus</i> isolation with standard microbiological protocol, structured and opened questionnaires along with laboratory findings, in-depth interviews and focus group discussions were used for the data collection. For sampling Non-probability-simple random stratified sampling was applied.
Results	The study found that 24.5% (49/200) of the healthy school children as the nasal carriers of <i>Staphylococcus aureus</i> . Regarding knowledge and perception, 100% of the school children had knowledge on microorganisms and their close association towards health and disease. Only 2% (4/200) had knowledge on <i>Staphylococcus aureus</i> , whilst 40.5% (81/200) had knowledge on food poisoning. Very few (9.5%, 19/200) subjects had good hygienic status, while 45% (90/200) had satisfactory hygienic status and 45.5% (91/200) had poor hygienic status. There was a significant difference observed between the hygienic status and age ($P=0.001$ at 95% CI).
Conclusion	The present study showed that despite cent percent knowledge on microorganisms in relation to health and disease, very few proportion of the nasal carriers of <i>Staphylococcus aureus</i> had good hygienic status. The gap between the knowledge and hygienic status was recognized. Therefore, it is very necessary that the children and other denizens of the community need to be made well known or informed about the diseases and preventive measures against the staphylococcal infections for lowering the occurrence of staphylococcal diseases.
Keywords	<i>Staphylococcus aureus</i> , Nasal Carriage, Knowledge, Hygienic Status, School children.

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Introduction

Staphylococcus aureus are Gram-positive spherical bacteria that occur in microscopic clusters resembling grapes. They are the opportunistic pathogen. The anterior nares are the major reservoirs of *Staphylococcus aureus* in human. Approximately 20% of humans are persistently colonized intra-nasally by a single strain of *S. aureus*. Another 60% of individuals are intermittent nasal carriers of *S. aureus* strains that change with varying frequency. The remaining 20% are classified as persistent non-carriers.

Persistent carriage is more common in children than in adults and the carrier type change in many people between the ages of 10 and 20 years (Williams, 1963).

Although *S. aureus* colonization of the nares is asymptomatic, nasal carriage is a risk factor for subsequent infection. Measures to prevent *S. aureus* nasal carriage may lower the prevalence of infection in the high-risk groups, since most of the staphylococcal infections are of endogenous origin.

More than one fifth (22%) of the total population of Nepal comprises of the children of age group 10-19 years; a proportion that is expected to grow over the years to come due to high fertility rate (Fact sheet 2000, FHD/MOH). The health of adolescents is profoundly associated with their behavior and development process. Healthy development of adolescent depends upon several complex factors: socio-economic circumstances, the environment in which they live and grow, standard of the family, community and peer relationships, available

opportunities for education and access to health information and services.

Staphylococcus aureus is the causative agent for various diseases. It is one of the most common etiological agents for a range of skin diseases like impetigo, carbuncle, folliculitis and boils, and scalded skin syndrome, which is the highly prevalent disease (5.76%) among other diseases in the country. It is also responsible for food poisoning and diarrheal diseases, which comes under the third ranking in the country's most prevalent disease (3.38%). It is also one of the etiological agents for Acute Respiratory Disease, which has second highest (3.44%) prevalence (Fact Sheet 2002, MOH), and sometimes associated with T.S.S (Toxic Shock Syndrome).

Staphylococcus aureus has long been recognized as an important pathogen in human disease. It is one of the most common causes of both endemic and epidemic infections acquired in hospitals and community, which result in substantial morbidity and mortality. The severe consequences of infection with *S. aureus* heighten the importance of prevention. Due to an increasing number of infections caused by methicillin-resistant *S. aureus* (MRSA) strains, therapy has become problematic. Therefore, prevention of staphylococcal infections has become more important. Carriage of *S. aureus* appears to play a key role in the epidemiology and pathogenesis of infection. Thus, this study aims to explore the carriage pattern of *S. aureus*, knowledge and perceptions, hygienic practices and attitudes that is associated with health and disease.

Methodology

The study was both qualitative and quantitative school based descriptive cross-sectional study. The study was conducted among 200 healthy school children from three different schools within the Kathmandu Valley from June 2002-March 2003. Non-probability- simple random stratified sampling was applied for the study. Structured and opened questionnaires along with laboratory findings, in-depth interviews and focus group discussions were used for the data collection.

Microbiological sample was collected from the anterior nares of healthy school children with a sterile swab, then kept in a sterile screw capped test tube and transported to the research laboratory with regard to all the safety precautions and necessary steps as per microbiological needs and requirements. All the collected swab samples were inoculated in mannitol salt agar (MSA) and incubated at 37°C for 24 hours. Colonies formed on MSA were picked up and gram stained. For conformational identification, catalase test, coagulase (slide and tube) tests, Lipase and DNase tests etc were also performed.

Results

Prevalence of *Staphylococcus aureus*

Table 1: Prevalence of *Staphylococcus aureus*

		Present (%)	Absent (%)
Staphylococcus aureus		49(24.5)	151(75.5)
Age Groups	11-14 yrs	26(22.8)	88(77.2)
	15-18 yrs	23(26.7)	63(73.3)
Gender	Male	28(24.6)	86(75.4)
	Female	21(24.4)	65(75.6)
Caste	Newar	31(26.1)	88(73.9)

	Brahmin	7(21.9)	25(78.1)
	Chettri	8(27.6)	21(72.4)
	Limbu	1(9.1)	10(90.9)
	Magar	1(16.7)	5(83.3)
	Others	1(33.3)	2(66.7)
School	Government	17(23.9)	54(76.1)
	Non-Government A	9(26.5)	25(73.5)
	Non-Government B	23(24.2)	72(75.8)

Nearly one fourth (24.5%) of the healthy school children were found to be the carriers of *Staphylococcus aureus*.

Among the various ages, maximum occurrence was observed in age 16 years (40%) Statistically, the carriage of *S. aureus* was found to be independent of the age of the carrier. (P=0.552 at 95% CI)

About one fourth (24.6%) of 114 boys and (24.4%) girls of 86 girls of the total students were found to be the carriers of *S. aureus*. There was not any

significant difference in carriage of *S. aureus* with respect to gender. (P=0.981 at 95% CI).

When the data was analyzed on the basis of caste, the carrier state of *S. aureus* was found highest in Chettri (27.5%). Nonetheless, there was not any significant association between the carriage of *S. aureus* and the caste of the respondent. (P=0.826 at 95% CI).

There was not any significant difference in the carriage of *S. aureus* and the type of school the child goes to. (P=0.957 at 95% CI).

Knowledge and Hygienic Status

Table 2: Knowledge on microorganisms

Characteristics	Frequency (%)
Knowledge on Microorganisms	
Present	200 (100.0)
Knowledge on S. aureus	
Present	4 (2.0)
Absent	196 (98.0)
Knowledge on Food Poisoning	
Present	81 (40.5)
Absent	119 (59.5)

Taking all (200) the study population into account irrespective of carriage of *S. aureus*, none of the boys had knowledge on *S. aureus* whereas four among the girls (4.7%) had.

Table 3: Hygienic Status of school children

Characteristics	Frequency (%)
Hygienic Status	
Good	19 (9.5%)
Satisfactory	90 (45.0%)
Poor	91 (45.5%)

This statistic reflects that the presence of knowledge on *S. aureus* in female students was significantly higher than in the male students. (P=0.02 at 95% CI). All the four girls having knowledge on *S. aureus* was from non-government school (11.8%).

22 children harboring *S. aureus* had the knowledge on food poisoning. When considering only the carrier of *S. aureus* knowledge on food poisoning was high (58.8%) within the subjects of government school in comparison to non-government school (44.8% within non-government A and 34.8% within the non-government B).

Only 9.5% of 200 subjects were categorized as having good hygienic status, 45% were classified as possessing satisfactory hygienic practices and 45.5% were classified as having poor hygienic status.

Table 4: Hygienic status with other variables

Characteristics		Hygienic Status		
		Good (%)	Satisfactory (%)	Poor (%)
Staphylococcus aureus				
Present	Count (49)	5 (10.2)	22 (44.9)	22 (44.9)
Absent	Count (151)	14 (9.3)	68 (45.0)	69 (45.7)
Knowledge on Microorganisms				
Present	Count (200)	19 (9.5)	90 (45.0)	91 (45.5)
Knowledge on S.aureus				
Present	Count (4)	1 (25.0)	3 (75.0)	
Absent	Count (196)	18 (9.2)	87 (44.4)	91 (46.4)
Knowledge on Food Poisoning				
Present	Count (81)	6 (7.4)	34 (42.0)	41 (50.6)
Absent	Count (119)	13 (10.9)	56 (47.1)	50 (42.0)
Age Groups				
11-14 yrs	Count (114)	13 (11.4)	62 (54.4)	39 (34.2)
15-18 yrs	Count (86)	6 (7.0)	28 (32.6)	52 (60.5)
Gender				
Male	Count (114)	13 (11.4)	46 (40.4)	55 (48.2)
Female	Count (86)	6 (7.0)	44 (51.2)	36 (41.9)
Caste				
Newar	Count (119)	13 (10.9)	51(42.9)	55 (46.2)

Brahmin	Count (32)	2 (6.3)	16 (50.0)	14 (43.8)
Chettri	Count (29)	2 (6.9)	18 (62.1)	9 (31.0)
Limbu	Count (11)	1 (9.1)	2 (18.2)	8 (72.7)
Magar	Count (6)	1 (16.7)	2 (33.3)	3 (50.0)
Others	Count (3)		1 (33.3)	2 (66.7)
School				
Government	Count (71)	6 (8.5)	20 (28.2)	45 (63.4)
Non-Government A	Count (34)	5 (14.7)	18 (52.9)	11 (32.4)
Non-Government B	Count (95)	8 (8.4)	52 (54.7)	35 (36.8)

In 11-14 yrs and 15-18 yrs age group, former had greater proportion (11.4%) of good hygienic status while most (60.5%) of later had poor hygienic status which is highly significant ($P=0.001$ at 95% CI).

The majority (11.4%) of the boys had good hygienic status in comparison to the girls (7.0%). Nearly the same proportion of the boys and girls had poor hygienic status. More than half of the girls (51.2%) had satisfactory hygienic status, while 40.4% of the boys reflected satisfactory hygienic status. However, there was not any significant difference between hygienic status and gender. ($P=0.25$ at 95% CI)

Stratification of hygienic status with different caste revealed that Newar had higher proportion (10.9%) of subjects having good hygienic status, in comparison to other caste. Statistical analysis revealed that hygienic status of an individual was irrespective of caste. ($P=0.52$ at 95% CI)

The subjects from Non-Government School A had highest proportion (14.7%), good hygienic status, respectively 63.4% of the subjects from Government School had poor hygienic status.

Discussion

Prevalence of *Staphylococcus aureus*

In the present study, 24.5% of the healthy school children were found to be the carriers of *Staphylococcus aureus*. Similar findings were reported by Shrestha et al in 1997 (23.3%). The reported frequency of nasal carriage of *S. aureus* varies from 20% to 35%, depending on the criteria used and the population tested. Minor alterations in nasal structure may influence the propensity to carriage of *S. aureus*.

From the data obtained, it might be assumed that the students of age 16 years are under high-risk group, since they had higher prevalence of *S. aureus* (40%). Furthermore, it is stated that approximately 60% of the healthy populations are intermittent carriers and only 20% are persistent carriers. Therefore, the students of age 16 years could have fall under those of 60% category. Nonetheless, the *S. aureus* carriage is irrespective of age.

Almost similar proportion of boys (24.6%) and girls (24.4%) of the subjects were found to be the

Statistical analysis reflected the significance difference between hygienic status and the type of school. ($P=0.003$ at 95% CI)

One tenth (10.2%) of the subjects from whom *S. aureus* was isolated had good hygienic status, whilst the proportions of the subjects possessing poor and satisfactory hygienic practices were equal (44.9%). However, the occurrence of *S. aureus* was independent with hygienic status. ($P=0.98$ at 95% CI)

9.5% of the student acquiring the knowledge had good hygienic status, whereas nearly the same proportion (45.0% and 45.5%) of the subjects had satisfactory and poor hygienic status respectively.

7.4 % of the subjects having knowledge on food poisoning had good hygienic status, while more than half (50.6%) of the subjects having the knowledge on food poisoning had poor hygienic status.

25% of those possessing the knowledge on food poisoning had good hygienic status, while remaining 75% had satisfactory.

carriers of *S. aureus*, which reflects that there is no correlation between the gender and the carriage of *Staphylococcus aureus*. In similar studies conducted by Shrestha et al 1997, males showed higher (25.33%) proportion than females (21.33%), however the difference occurred were insignificant. This difference in carriage pattern could be due to the difference on the study population. This study simply focused on healthy school children, while the previous study focused on healthy population of varying age groups.

Adolescent students of caste Chettri had highest carriage of *S. aureus*, followed by Newar, Brahmin, Magar and Limbu. This could be due to improper distribution of sample in accordance with different caste. Furthermore, the variation in the carriage pattern could be due to the different living standard in different caste, their surrounding, socio-economic factors, culture and their feeding habits. This can again be supported by the evidences led out by various studies on nasal colonization factors

for *S. aureus*, like the variety of adaptive mechanisms, including nutrient acquisition, adherence to host tissues, and evasion of, or protection against, host defenses. (Kiser *et al* 1999)

The prevalence of *S. aureus* in non-government school A was found to be slightly higher than in the

Distribution Pattern of Hygienic Status

Very few of the subjects in the present study had good hygienic status, while the proportion of the subjects having satisfactory hygienic status and poor hygienic status were almost equal. These statistics possibly strengthen the fact that the children are under high-risk group.

Greater proportion of students of 15-18 yrs age group had poor hygienic status than 11-14 yrs age group. This significant difference might be accountable to negligence, adolescence, ignorance of parents and wide exploring attitude of the children within the age group 15-18 yrs. This emphasizes specific authority to focus on implementing or bringing health awareness among children for the improvement of hygienic status and healthy living.

The boys (11.4%) had good hygienic status in comparison to the girls (7.0%). The study revealed that boys were sound in hygienic practices than the girls. This variation might be because of the improper distribution of the sample.

Stratification of hygienic status with different caste revealed that Newar had higher proportion of students with good hygienic status than the other castes. Fifty percent of the Bhramins had satisfactory hygienic status while Chettri had the highest proportion of the satisfactory hygienic status. Remaining castes had poor hygienic status. However, the association between the caste and the hygienic status was statistically insignificant. This reflects that there is no co-relation between hygienic status and caste.

In the present study, significant difference was observed between the hygienic status and the type of school. It is quite clear from the statistics that the

Conclusion and Recommendation

All the above findings concerning the knowledge and carriage of *Staphylococcus aureus*, the hygienic status reflects that the school children are prone to staphylococcal infection. They might

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rest of the schools. This difference in proportion could be due to small sample size. The results thus obtained did not reflect the carriage pattern of *S. aureus* with reference to the type of school, whether it is a government or a non-government.

students enrolled in government school had poor hygienic status than in non-government school. Furthermore, the hygienic status of the students from non-government school A was superior to non-government B. This difference may be due to better educational activities and awareness programs in non-government school than in government school. Moreover, most of the students in non-government school are generally from affluent families. Thus, socio-economic status of the family and the community might have made the difference.

One tenth (10.2%) of the subjects with the carriage of *S. aureus* had good hygienic status, whilst the proportions of the subjects possessing poor and satisfactory hygienic practices were equal (44.9%). These figures are alarming, which reflects the consequences that could bring staphylococcal outbreaks.

Very few of the subjects having the knowledge on microorganism in relation to health and disease had good hygienic status. Approximately 50% of the subjects with carriage of *S. aureus* had poor hygienic status. This again stresses the danger of staphylococcal infections and complication in treatment.

Although most of the students had knowledge on microorganism, their hygienic status was not so good. It was observed that the occurrence of *S. aureus* was higher in satisfactory and poor hygienic status. It could be stated that with the improvement of hygienic status from satisfactory and poor to good, the possible risks towards staphylococcal infection could be minimized.

further act as the source for the staphylococcal epidemic. Therefore necessary steps are to be undertaken to reduce the possible risk factors.

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