NASAL CARRIAGE OF STAPHYLOCOCCUS AUREUS AMONG FOOD HANDLERS AND RESTAURANT WORKERS IN EKPOMA EDO STATE, NIGERIA


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ABSTRACT

Food handlers have been recognized to play a major role in the transmission of food borne diseases; contributing significantly to the global incidence and burden of the diseases. This study therefore, assesses the nasal carriage of *Staphylococcus aureus* among food handlers and restaurant workers in Ekpoma, Edo State, Nigeria. A total of 100 nasal swab samples were collected and analyzed for *Staphylococcus aureus* using standard methods. The results showed that the prevalence of nasal carriage of *Staphylococcus aureus* among food handlers and restaurant workers in Ekpoma was 60%. The males had the highest prevalence of 58%, while the females had a prevalence rate of 42%. Those within age 26-30 had the highest prevalence of 67%, followed by those within the age group of ≤25 (17%) and 31-35 (17%). Antibiotic sensitivity results showed that Gentamycin, Levofloxacin, Septrin, Rocephin and Ciprofloxacin had 100% sensitivity pattern, while Pefloxacin and Ampiclox exhibited 75% and 25% sensitivity patterns respectively. Ampicillin however, showed no sensitivity (0%). It is our opinion that concerted efforts need to be made to educate food handlers and restaurant workers on the importance of personal hygiene and the use of protective gadgets like nose masks while handling food products; since they serve as potential sources of staphylococcal food poisoning.

Keywords: Food Handlers, Food borne diseases, *Staphylococcus aureus*, Nasal Carriage, Restaurants

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INTRODUCTION

*Staphylococcus aureus* remains a significant cause of mortality and morbidity in tropical countries (Kluytmansm *et al.*, 1997; Onile *et al.*, 1985). Available reports have also shown that about 30-50% of the human population are carriers of *Staphylococcus aureus* especially in the nasopharynx (Hennekinne *et al.*, 2010) and that the nasal carriage of *Staphylococcus aureus* is implicated in most community and hospital infections (Von Eiff *et al.*, 2001; Olonitola *et al.*, 2007; Gorwitz *et al.*, 2008; Onanuga and Temedie, 2011; Guido *et al.*, 2012).

Of interest however, is the evidence that food borne diseases can be spread by food handlers. This had remained a common and persistent problem worldwide (Zain and Naing, 2002; Scott, 2003) and food handlers with poor personal hygiene serve as potential sources of pathogenic organisms like *Staphylococcus aureus* (Gashaw *et al.*, 2008). Such food poisoning may also result from infections with enterotoxigenic strains of *Staphylococcus aureus* (Carmo *et al.*, 2003; Arbuthnott *et al.*, 1990; Buckle *et al.*, 1993; Mossel and Netten, 1990; Tranter and Brehm, 1994 and Todd, 1998).

Indeed, restaurants have been classified as the second most important place for acquiring *staphylococcal* food poisoning and it accounts for 14–20% of outbreaks involving contaminated food in the USA and United Kingdom (Wieneke *et al.*, 1993 and Ughes and Tauxe, 1990). Obviously, the ingestion of preformed toxins by enterotoxigenic strains in food often leads to the development of food poisoning
symptoms like nausea, vomiting, diarrhea and abdominal pain (Hennekinne et al., 2010).

Unfortunately, *Staphylococcus aureus* have a record of developing resistance quickly and successfully to antibiotics via a mechanism that involves the acquisition and transfer of antibiotic resistance plasmids (Tenover et al., 2004), as well as the possession of intrinsic resistance mechanisms (Kloos, 1998). More so, *Staphylococcus aureus* has been recognized as a persistent nosocomial and community acquired pathogen with a capacity to evolve different mechanisms of resistance to most antimicrobial agents (Montefiore et al., 1989). In fact, the emergence of antibiotic resistant bacterial constitutes a major problem in antibiotic therapy due to antibiotics drug-abuse (Nwankwo and Nasiru, 2011).

Considering therefore, the rising concerns over food safety and the lack of research to ascertain the extent of *Staphylococcus aureus* colonization among food handlers, this study was designed to assess the prevalence, antibiotics sensitivity pattern, and potential risk factors associated with nasal carriage of *Staphylococcus aureus* amongst food handlers and restaurant workers in Ekpoma, Edo State, Nigeria.

MATERIALS AND METHODS

**Study Area:** The study was carried out in Ekpoma –a town located in Esan West Local Government of Edo State, Nigeria, within longitude 6.130E and latitude 6.730N and incidentally, the headquarters of Esan West Local Government Area.

**Sample Collection:** A total of 100 nasal swab samples were collected using swab sticks from apparently healthy food handlers and restaurant workers in Ekpoma, Edo State, Nigeria. The ages of the subjects ranged from 21-40 years. The swab sticks were immediately and carefully returned to their sterile containers and sealed with an adhesive tape. The collected specimens were then taken to the diagnostic laboratory for bacteriological analysis.

**Inclusion and Exclusion Criteria:** Only the food handlers and restaurant workers who have not being treated with antibiotic agents or inhaler spray for at least one month prior to the day of specimen collection, were included in this study, while those who do not fall into this category were excluded.

**Ethical Consideration:** Informed consent was requested and granted by the food handlers and restaurant workers under investigation. The concept of the study was explained to them and having understood its dimensions, granted their informed consent.

**Sample Analysis:** The nasal swab specimens were inoculated on mannitol salt agar and the plates were incubated at 37°C for 24 hours under aerobic conditions. After 24 hours of incubation, the culture plates were examined macroscopically to evaluate the appearance, size, colour, and morphology of the colonies. The bacterial isolates were identified using standard bacteriological procedures, including Gram staining, microscopic examination and biochemical tests as described by Cheesbrough (2004).

**Antibiotics sensitivity test:** A commercially prepared multidisc with known minimum inhibitory concentration (MIC) was used for this test. The sensitivity test was conducted using a 1: 100 dilution of an overnight broth culture of the organism to flood the surface of the nutrient agar media to ensure that the broth culture was poured out from the plates and left on the bench in an inverted position for 30 minutes. The antibiotic sensitive discs were aseptically placed on the surface of the agar and incubated for 24 hours. The zone of inhibition for each antibiotic was measured using the National Committee for Clinical Laboratory Standards (NCCLS, 2002).

**RESULTS**

The results showed that the prevalence of nasal carriage of *Staphylococcus aureus* among the food handlers in Ekpoma was 60% (n=60). The results also showed that the prevalence of nasal carriage according to gender was highest among the males (58%; n=35) as against that of the females (42%; n=25) (see table 1). Similarly, results on the prevalence of *S. aureus* according to age, indicated that those within the age range of 26-30 had the highest prevalence of 67% (n=40), followed by those within the age range of ≤25 and 31-35 (17% each respectively) (see table 2). Results on the antibiotic sensitivity to *Staphylococcus aureus* shows that gentamycin, levofloxacin, septrim, rocephin and ciprofloxacin exhibited the highest sensitive pattern (100%; n=60), followed by pefloxacin 75% (n=45),
ampiclox 25% (n=15). Ampicillin however, exhibited no sensitive pattern (0% ; n=0) (Table 3).

DISCUSSION

Nasal carriage is an important risk factor in outbreaks of food-borne diseases in which *Staphylococcus aureus* is implicated and it has remained one of the battled bacterial agents of infection in the African continent. The overall prevalence of nasal carriage of *Staphylococcus aureus* amongst the restaurant workers and food handlers in our study recorded a high prevalence rate (60%) and this is in line with the findings of Soto *et al.* (1997) and Loeto *et al.* (2007) who reported the high prevalence of nasal carriage of 65% and 57.5% respectively.

**Table 1: The prevalence of staphylococcus aureus in the Nasal carriers among the food handlers in Ekpoma according to gender.**

<table>
<thead>
<tr>
<th>SEX</th>
<th>NUMBER OF SAMPLES</th>
<th>PREVALENCE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>50</td>
<td>35(58%)</td>
</tr>
<tr>
<td>Female</td>
<td>50</td>
<td>25(42%)</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>60(60%)</td>
</tr>
</tbody>
</table>

**Table 2: Prevalence of staphylococcus aureus in the nasal carriers among the food handlers in Ekpoma according to age.**

<table>
<thead>
<tr>
<th>AGE</th>
<th>NUMBER OF ISOLATES</th>
<th>PREVALENCE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤25</td>
<td>10</td>
<td>17%</td>
</tr>
<tr>
<td>26-30</td>
<td>40</td>
<td>67%</td>
</tr>
<tr>
<td>31-35</td>
<td>10</td>
<td>17%</td>
</tr>
<tr>
<td>36-40</td>
<td>0</td>
<td>0%</td>
</tr>
</tbody>
</table>

**Table 3: Antimicrobial sensitivity pattern of the bacterial isolates**

<table>
<thead>
<tr>
<th>DRUGS</th>
<th>SENSITIVE (%)</th>
<th>RESISTANCE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pefloxacin</td>
<td>45(75)</td>
<td>15(25)</td>
</tr>
<tr>
<td>Gentamycin</td>
<td>60(100)</td>
<td>0(0)</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>0(0)</td>
<td>60(100)</td>
</tr>
<tr>
<td>Levofoxacin</td>
<td>60(100)</td>
<td>0(0)</td>
</tr>
<tr>
<td>Ampiclox</td>
<td>15(25)</td>
<td>45(75)</td>
</tr>
<tr>
<td>Rocephin</td>
<td>60(100)</td>
<td>0(0)</td>
</tr>
<tr>
<td>Ciproloxin</td>
<td>60(100)</td>
<td>0(0)</td>
</tr>
<tr>
<td>Septrin</td>
<td>60(100)</td>
<td>0(0)</td>
</tr>
</tbody>
</table>

Meanwhile, the prevalence of the *Staphylococcus aureus* in this study is higher than those observed in similar studies in US (23%) (Mainous *et al.*, 2006) and UK (25%) (Wieneke *et al.*, 1993) and among food handlers working in Ethiopia (20.5%) (Dagnew *et al.*, 2012), Turkey (23.1%) (Simsek *et al.*, 2009) and Brazil (29%) (Carmo *et al.*, 2003). Similarly, lower prevalent rates of 30%, 31% and 44.6%, have been reported in Brazil, Egypt and Botswana respectively (El-Shenawy *et al.*, 2013; Acco *et al.*, 2003; Loeto *et al.*, 2007). Varying prevalent rates have also been recorded for hospital personnel in Cameroon (23.7%) (Eyoh *et al.*, 2012), and among healthy subjects working in hospitals in Iran (35.7%), India (37.3%) and Nigeria (50%) (Kluytmansm *et al.*, 1997), while studies conducted by Teferi *et al.* (2012)...
found that 20.5% of food handlers working in a University students' canteen were nasal carriers of Staphylococcus aureus. Above all, the prevalent rate observed in this study (60%), especially within the age range of 20-31%, contradicts some of these existing findings.

These variations in nasal carriage rates are probably due to the ecological differences between the study populations (Bassyonyi et al., 2012). Generally, there exists considerable variation of nasal carriage of S. aureus prevalence within regions, countries and even inside each country. Global trends of staphylococcal nasal carriage demonstrated that nasal carriage is high in developed countries, as compared to underdeveloped and developing countries (Sivaraman et al., 2009) which is not in line with the result of this study.

However, gender has become a predisposing factor for nasal carriage of Staphylococcus aureus as shown by the findings of this study, with males having a high prevalence of 58% compared to females with 42%. This is in line with report from several studies that male gender has more risk factors for nasal carriage of Staphylococcus aureus (Bischoff et al., 2004 and Riewerts Eriksen et al., 1995); though the present findings disagrees with those of Khorvash et al., (2012), Ghasemian et al. (2010) and Isibor and Otabor (2014), who found no significant difference between gender and rate of nasal carriage of the pathogen.

On the other hand, age has been identified in earlier studies as a factor influencing nasal colonization with Staphylococcus aureus (Bischoff et al., 2004). The prevalence of Staphylococcus aureus according to age in this study showed that the age range of 26-30 has the highest prevalence of 50% which is attributed to the maturity and sexually active age of the correspondents. Our findings in this study is not in line with the report by El-Shenawy et al. (2014), Warren (2012), Ibe and Wariso (2005) and Donker et al. (2009) whose findings show that the prevalence of Staphylococcus aureus is higher in higher age group of above 70 years and teenage age group of 13-18 years.

Moreover, the antibiotic susceptibility profile of the isolates to commonly used antibiotics showed high susceptibility except ampicillin and ampiclox. This is in line with the findings by Deng et al. (2014), Isibor and Octabor (2014), Chatterjee et al. (2009) and Erami et al.(2014) who reported high susceptibility of Gentamycin and ciprofloxacin among Staphylococcus aureus nasal carriage individuals. Also the report by Dagnew et al. (2012) and Eke et al. (2012) on the antibiotic susceptibility of Gentamycin, Ciprofloxacin and Septrin above 70% as well as Ampicicillin below 30% are within the range observed in our finding in this study. Nevertheless, our findings disagrees with Udo et al. (2009) who reported 92.5% of bacterial isolates resistance to antibacterial agents in his study on the prevalence of antimicrobial resistance and carriage of virulence genes in Staphylococcus aureus isolated from food handlers in Kuwait City restaurants as well as those found in Staphylococcus aureus isolates from food handlers in Chile and Botswana (Figueroa et al., 2002 and Loeto et al., 2007).

In conclusion, a relatively high prevalence rate of Staphylococcus aureus nasal carriage was recorded among the investigated food handlers and restaurant workers. These findings resurges the imperative need for protective measures including increased public awareness programs, regular monitoring of food handlers for food borne pathogens and intensive training on primary health care and hygiene. The use of nose masks by food handlers and restaurant workers and periodical medical examination of correspondents could help to prevent spread of resistant strains of Staphylococcus aureus. Finally, the current findings clearly highlights the significance of implementation of efficient quality control systems in areas of direct contact with food product as good manufacturing practices and standard operational procedures and future research addressing effective methods for sustained eradication of staphylococcal nasal carriage are clearly warranted to reduce the high risk of subsequent infection.

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**AUTHORS CONTRIBUTIONS:**

All the authors played significant roles in the different stages that culminated to this research report. These include field work/sample collection, literature search, laboratory analysis, data analysis, and article drafting/revision.