

## Original Research Article

# Prevalence of *Staphylococcus aureus*, its antimicrobial resistance and relation to food hygiene practices of food handlers: analysis of food and non-food items from market food shops in Yangon, Myanmar

May Soe Aung<sup>1\*</sup>, Poe Ei Zin<sup>1</sup>, Pan Ei Soe<sup>2</sup>, Hla Hla Win<sup>3</sup>,  
Thi Thi Htoon<sup>2</sup>, Swe Mar Myint Lwin<sup>3</sup>

<sup>1</sup>Department of Preventive and Social Medicine, University of Medicine (1), Yangon, Myanmar

<sup>2</sup>National Health Laboratory, Myanmar

<sup>3</sup>University of Public Health, Yangon, Myanmar

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### \*Correspondence:

Dr. May Soe Aung,

E-mail: maysoeag2010@gmail.com

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## ABSTRACT

**Background:** *Staphylococcus aureus* is the common cause of food poisoning and its rising antibiotic resistance poses a severe threat to public health. In Myanmar, *S aureus* isolation and AMR pattern in food and non-food objects studied at the markets are still limited. This research filled the information gaps regarding the prevalence of *S aureus* in food and non-food items from market food shops relation to hygienic practices of the food handlers and assessed its antimicrobial resistance.

**Methods:** Cross-sectional study was conducted at sixteen markets in Yangon during 2022. The study included 75 food handlers to assess their hygiene practices. From each shop, one food and one non-food samples were taken to reach the total 150 samples. Chi-square test was used for analysis.

**Results:** *S aureus* was found in 4% of food samples and 5.3% of non-food samples. Bacterial contamination in food was satisfactory, 17.3% to unsatisfactory, 60% while non-food samples were 4%, clean to 73.3%, very contaminated. Drug resistance to benzyl penicillin, azithromycin, erythromycin, clindamycin, lincomycin in food samples and tetracycline in both samples were found. Hygiene practices was good among 57.3% of food handlers and there was no association between practices and *S aureus* prevalence although positivity was higher among the samples taken from the shops of handlers with poor hygiene practices.

**Conclusions:** The prevalence of *S aureus* was not different between food and non-food samples and not associated with the hygiene practices of food handlers.

**Keywords:** *Staphylococcus aureus*, Antimicrobial resistance, Food hygiene practices, Myanmar

## INTRODUCTION

*Staphylococcus aureus* (*S aureus*) is the common cause of food poisoning across the world. It can grow in wide variety of foods and produce toxins presenting with various gastrointestinal illnesses.<sup>1</sup> *Staph aureus*'s rising antibiotic resistance poses a severe threat to public health by various strains as healthcare-acquired, community-

acquired, and livestock-associated resistant strain.<sup>2,3</sup> The study in China reported that Methicillin Resistant *S aureus* (MRSA) isolates was present in 7.43% of the 148 isolates of ready-to-eat food.<sup>4</sup> An epidemiological study of a common-source food poisoning pandemic revealed Staphylococcal enterotoxin A (SEA) was the cause of food disease in a rural village ceremony in Myanmar.<sup>5</sup> The prevalence of Enterotoxigenic *S aureus* in street vended

Myanmar traditional snacks in Naypyidaw was 38.1% in 2019.<sup>6</sup> The study in Mandalay, the second largest city of Myanmar reported that more than half of food handlers of eating establishments in the government hospitals had unsatisfactory on food handling practices.<sup>7</sup> The assessment on food safety of street food shops in Naypyidaw Union Territory in 2020 revealed 70% of food-venders were poor in hygiene practice.<sup>8</sup>

In Myanmar, markets in the community are one of the best venues to find conveniently available groceries and ready-made meals. People in Myanmar traditionally go to the nearby markets in the morning and eat the food from markets while shopping. Yangon is the Myanmar's most populated city with a dense concentration of marketplaces. As a result, market food shops in Yangon are an interesting area to investigate *S. aureus* isolation. Although there were many studies that explore the *S. aureus* isolation in biological samples of food handlers in Myanmar, its contamination and antimicrobial resistance (AMR) pattern in both food and non-food objects has been the subject of limited researches. Moreover, although studies on *S. aureus* occurrence in hospital settings, restaurants and street food vendors have been carried out in Myanmar, researches related to the prevalence of *S. aureus* in samples taken from markets food shops are still limited. This research fills the information gaps regarding the prevalence of *S. aureus* in food and non-food items from market food stalls in Yangon. Its related factors such as hygienic practices of the food handlers will be focused not only on food but also on non-food items. Detecting the anti-microbial resistance of *S. aureus* in food and non-food items from market food shops in Yangon is critical for policy intervention, establishment and implementation of suitable policy. It is also an initiative information about food handlers in food shops from markets for contribution in health education, training, strict monitoring of acceptable hygienic practices to eliminate pathogens, combat antimicrobial resistance and prevent food borne diseases.

## METHODS

The cross-sectional analytic study was conducted from September to November, 2022 in sixteen markets from six districts of Yangon region (Ahlone, Botathaung, Kamaryut, Kyauktada, Mayangone, Thingangyun). The study population comprised the food handlers; and food and non-food items from the food shops. Food handlers older than 18 years who sell the ready to eat food composed of meat or fish, who mainly cooked, prepared, served and sold food and those being either owners or workers of the food shops were eligible to participate in the study. The total sample size was 150 samples calculated by population proportion formula with 9.8% prevalence of *S. aureus* in cooked chicken according to the study done in China, precision level at 5% and non-response rate 10%.<sup>3</sup> Therefore, one food specimen and one swab from dishes were selected from each of 75 market food shops for screening of *S. aureus* isolation and anti-microbial resistance. For data collection, sixteen markets from the six

districts of Yangon Region were selected after discussion with the responsible persons from Yangon City development committee (YCDC). Because of unequal distribution of eligible food shops in different markets, three to six food shops from each market are purposely selected. Before data collection, pretesting was conducted in twenty food handlers from three different markets in Yangon.

The face-to-face interview by pretested structured questionnaires and observation by check list was done to assess practices of the food handlers: hand washing practices; cleansing of utensils; safe food storage; proper waste disposal; personal hygiene; and utilization of personal protective equipment PPE (mask, cap, glove and apron). The specimens collecting procedures was done by principal investigators and two co-investigators after receiving training at National health laboratory (NHL). The food samples were collected in sterile plastic containers and sterile swabs was used for non-food samples (Dishes). The specimens from food and dishes were thoroughly labelled and transported to NHL by keeping in an ice box on each data collection day for isolation of *S. aureus* and its antibiotic susceptibility pattern.

## Sample collection

100gm of each food sample was taken with sterile forceps in sterile plastic container. Utensil swab samples were taken from 100 cm<sup>2</sup> area with sterile cotton swabs dipped in phosphate buffered saline. The swabs were then transferred to diluent tube. All the samples were transported to laboratory and analysed within 1 hour of collection or refrigerated at 4°C before being analysed.

## Sample processing

50g of the food sample was aseptically weighed and put into the sterile blender jar. Then, 450 ml Butterfield's phosphate-buffered dilution water (1:10 dilution) was added and homogenized 2 minutes at high speed (16000-18000 rpm). Serial dilutions were prepared by transferring 1ml homogenized samples to 9ml of diluent up to 10<sup>5</sup> dilutions. The swab containing phosphate buffer saline was serially diluted up to 10<sup>5</sup> dilutions. 1 ml of homogenized food samples and 1 mL of phosphate-buffered saline for utensil swabs) were inoculated into the tube containing trypticase soy broth with 10% NaCl and 1% pyruvate acid. The tubes were incubated at 35°C x 24 hours and observed for turbid growth of typical of *S. aureus*.

## Detection of *Staphylococcus aureus*

The turbid tube of inoculated broth was streaked onto cystine lactose electrolyte deficient (CLED) agar. On, next day, the presumptive colonies were identified by Gram's stain and catalase test, mannitol salt egg yolk agar and vitek 2 GP ID card.

### Antibiotic susceptibility testing

Antibiotic susceptibility of isolated *S. aureus* was done by Vitek 2 AST GP 67 cards. Methicillin susceptibility was also confirmed with cefoxitin disc diffusion test according to clinical and laboratory standards institute (CLSI) 2022.<sup>9</sup>

### Aerobic plate count

To access the level of microorganism in food and swab samples, total bacterial count was done and calculated according to procedure of aerobic mesophilic plate count method.<sup>10</sup>

### MPN test

The MPN test was run to calculate the number of probable numbers *S aureus* in food samples. For the three tubes MPN method, 1ml aliquot of serially diluted ( $10^1$ ,  $10^2$  and  $10^3$  dilution) samples was added to three tubes of trypticase soy broth containing 10% NaCL and 1% pyruvate acid, and then incubated at 37°C for 48 hours. The content of each tube was checked for turbidity after 2 days of incubation. Calculation of most probable number (MPN) of *S aureus* per gram of food sample was done by using tables of recommended microbiological limits for various foods.<sup>11</sup>

### Data management and analysis

The isolated *S aureus* was defined if the collected samples were positive and antimicrobial resistance of *S aureus* was measured by description of antimicrobial susceptibility to different antibiotics.

Food was reclassified for bacterial contamination into category A (applies to foods that are ready to eat and have all of their components thoroughly cooked for immediate sale or consumption) and category B. (applies to ready to eat foods that are fully cooked with further handling or processing before consumption). The level of contamination was then categorized based on plate count (CFU/g), with satisfactory ( $<10^4$  CFU/g), borderline (between  $10^4$  and  $10^5$  CFU/g), and unsatisfactory ( $\geq 10^5$  CFU/g) for category A; and satisfactory (between  $10^6$  CFU/g, between  $10^6$  and  $10^7$  CFU/g, and unsatisfactory ( $\geq 10^7$  CFU/g) for category B.<sup>12</sup> Non-food samples were categorized as clean if the plate count was less than 45 CFU/cm<sup>2</sup>, contaminated if it was between 260 and 260 CFU/cm<sup>2</sup>, and very contaminated if it was greater than 260 CFU/cm<sup>2</sup>.<sup>13</sup> The food hygiene practices of food handlers were treated as continuous data for descriptive statistics by total 40 scores of 33 items included in practices questions and observation check list. For analytical purpose, it will be categorized to form two-level categorical variable (poor and good) using median of the total score as cut-off value. To determine the association between categorical variables, Chi-square test was used with  $p < 0.05$  as level of statistical significance. STATA version 15.1 was used for analysis of this study.

## RESULTS

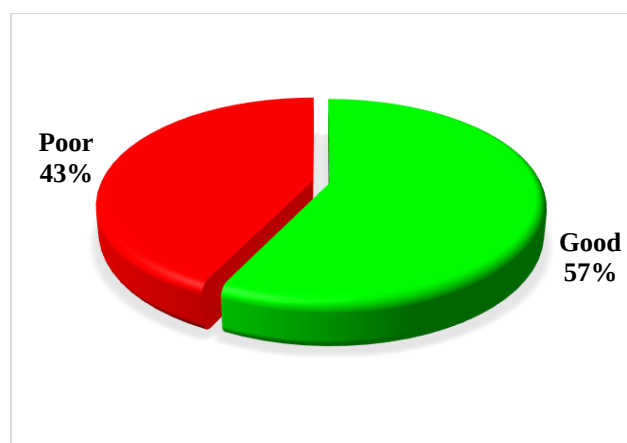
### Background characteristics

Out of 75 food shops, 92% sell ready-to-eat meals and salads made with meat or fish, while the remaining shops sell fried meat and fish balls or sausages (Table 1).

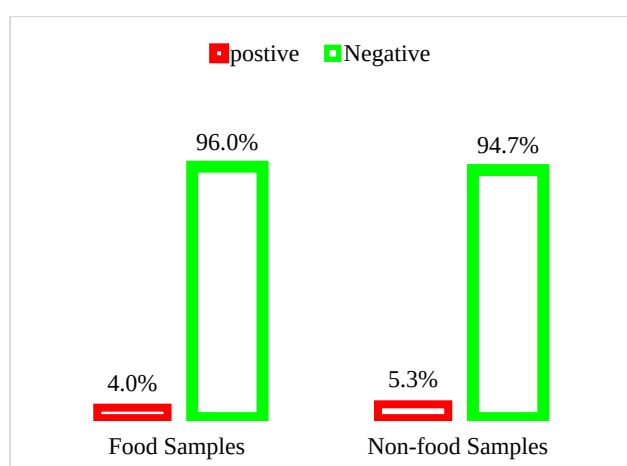
**Table 1: Percent distribution of food handlers by background characteristics.**

| Background characteristics                     | Food handlers |      |
|------------------------------------------------|---------------|------|
|                                                | N             | %    |
| <b>Type of food sold</b>                       |               |      |
| Ready-made cooked food containing meat or fish | 69            | 92.0 |
| Fried meat and fish ball or sausage            | 6             | 8.0  |
| <b>Age (years)</b>                             |               |      |
| ≤20                                            | 1             | 1.3  |
| 21-40                                          | 23            | 30.7 |
| 41-60                                          | 46            | 61.3 |
| >60                                            | 5             | 6.7  |
| <b>Sex</b>                                     |               |      |
| Male                                           | 10            | 13.3 |
| Female                                         | 65            | 86.7 |
| <b>District</b>                                |               |      |
| Ahlone                                         | 17            | 22.7 |
| Botahtaung                                     | 14            | 22.7 |
| Kamaryut                                       | 7             | 9.3  |
| Kyauktada                                      | 6             | 8.0  |
| Mayangone                                      | 4             | 5.3  |
| Thingungyun                                    | 24            | 32.0 |
| <b>Education</b>                               |               |      |
| Read and write                                 | 6             | 8.0  |
| Primary School Level                           | 17            | 22.7 |
| Middle School Level                            | 26            | 34.7 |
| High School Level                              | 13            | 17.3 |
| Graduate                                       | 13            | 17.3 |
| <b>Income (kyats)</b>                          |               |      |
| <300,000                                       | 18            | 24.0 |
| 300,000-600,000                                | 48            | 88.0 |
| > 600,000                                      | 9             | 12.0 |
| Training regarding food hygiene practices      | 17            | 22.7 |
| Difficulties of water for cleaning purposes    | 15            | 20.0 |

The majority of food handlers were between the ages of 41 and 60 (61%) and between 21 and 40 (30.7%). Nearly 90% were females and two-thirds of the food handlers had at least a middle-level education (Grade 5 to 8). A family income of 3 to 6 lakh Myanmar Kyats was earned by the majority of food handlers (64%) per month. About 20% of food handlers have received instruction on good food hygiene procedures and some of the challenges associated with using water for cleaning were reported.



**Figure 1: Food hygiene practices of food handlers.**



**Figure 2: Prevalence of *Staphylococcus aureus* in food and non-food samples.**

### **Food hygiene practices of food handlers**

Total 98.7% of food handlers always wash their hands after using the restroom, and 62.7% always wash their hands before handling food (Table 2). Only approximately 28% of people regularly wash their hands after coughing, sneezing, and handling money. Nearly 90% of food handlers used water, soap, or any other antiseptic treatment to wash their hands and clean their dishes. Only 20% of people wipe tables using antiseptic solution and cloths. The majority of food shops kept raw materials and cooked food separate. Nearly all people who handled food adhered to the municipal garbage disposal system. Most of the respondents and their food shops exhibited the bulk of the behaviors expected of food handlers, according to the observation checklist. Wearing gloves, 16%; wearing a cap, 4%; wearing an apron, 26.7%; and having a cover in the dust bin, 8%, were the other suitable behaviors identified. Among food handlers, 82.7% were found to be improperly handling cooked food with their bare hands. Based on 33 questionnaire items and an observation checklist, the overall hygiene practices were good in 57% of food handlers and bad in 43% (Figure 1).

**Table 2: Food hygiene practices of food handlers.**

| Hygiene practices                                           | N  | %    |
|-------------------------------------------------------------|----|------|
| <b>Hand washing after toilet*</b>                           | 74 | 98.7 |
| <b>Hand washing before handling food*</b>                   | 47 | 62.7 |
| <b>Hand washing after sneezing and coughing *</b>           | 20 | 26.7 |
| <b>Hand washing after handling money*</b>                   | 21 | 28.0 |
| <b>Hand washing between two customers*</b>                  | 29 | 38.7 |
| <b>Method of hand washing</b>                               |    |      |
| Water only                                                  | 9  | 12.0 |
| Water and soap or any antiseptic solution                   | 66 | 88.0 |
| <b>Cleaning of dishes and utensils for food preparation</b> |    |      |
| Water only                                                  | 8  | 10.7 |
| Water and soap or any antiseptic solution                   | 67 | 89.3 |
| <b>Cleaning of tables</b>                                   |    |      |
| Table clothes or tissue paper                               | 60 | 80.0 |
| Table clothes and antiseptic solutions                      | 15 | 20.0 |
| Separation of raw materials according to types              | 73 | 97.3 |
| No storage of cook food together with raw food              | 51 | 68.0 |
| Use of dust bin for leftover food                           | 55 | 73.3 |
| <b>Type of waste Disposal</b>                               |    |      |
| Municipal waste tank                                        | 73 | 97.4 |
| Others (dumping/dispose to nearby places)                   | 2  | 2.6  |
| <b>Observation by the checklist</b>                         |    |      |
| Clean, short and trimmed nail**                             | 44 | 58.7 |
| Wearing gloves while handling food**                        | 12 | 16.0 |
| Wearing caps while handling food**                          | 3  | 4.0  |
| Wearing masks while handling food**                         | 51 | 68.0 |
| Wearing aprons while handling food**                        | 20 | 26.7 |
| Wearing rings while handling food                           | 3  | 4.0  |
| Wearing clean clothes while handling food**                 | 70 | 93.3 |
| Used utensils are clean**                                   | 66 | 88.0 |
| Touching nose, ear and mouth while handling food            | 4  | 5.3  |
| Sneezing and coughing while preparing food                  | 2  | 2.7  |
| Blowing air in the bags before adding food                  | 0  | 0    |
| Handle cooked food with bare hand                           | 62 | 82.7 |
| Presence of insects and pests in working area               | 31 | 41.3 |
| Cleaning of the table**                                     | 52 | 69.3 |
| Presence of dust bin**                                      | 55 | 73.3 |
| Presence of cover in dust bin**                             | 6  | 8.0  |
| Smoking                                                     | 1  | 1.3  |
| Betel chewing                                               | 9  | 12.0 |
| Skin infection in hand                                      | 4  | 5.3  |
| Domestic water supply for hand washing**                    | 73 | 97.3 |
| Presence of soap for hand washing**                         | 60 | 80.0 |

\*Response in "Always"; \*\* Represent the good practices

**Table 3: Contamination in food and non-food samples.**

| Level of contamination                          | N  | %    |
|-------------------------------------------------|----|------|
| <b>Contamination of food samples (N=75)</b>     |    |      |
| Satisfactory                                    | 13 | 17.3 |
| Borderline                                      | 17 | 22.7 |
| Unsatisfactory                                  | 45 | 60.0 |
| <b>Contamination of non-food samples (N=75)</b> |    |      |
| Clean                                           | 3  | 4.0  |
| Contaminated                                    | 17 | 22.7 |
| Very contaminated                               | 55 | 73.3 |

**Prevalence of *Staphylococcus aureus* in food and non-food samples and drug sensitivity patterns**

Seven out of 150 samples were positive for the isolation of *S.aureus*, with three coming from food samples and four from swabs of non-food items (dishes) (Figure 2). According to description of bacterial contamination in (Table 3), food samples had a satisfactory rating in 17.3%, a borderline rating in 22.7%, and an unsatisfactory rating in 60%.

**Table 4: Anti-microbial resistance of drugs for *S aureus*.**

| Drugs tested      | Patterns of isolated <i>S. aureus</i> form food samples (N=3) |           | Patterns of isolated <i>S. aureus</i> form non-food samples (N=4) |           |
|-------------------|---------------------------------------------------------------|-----------|-------------------------------------------------------------------|-----------|
|                   | Sensitive                                                     | Resistant | Sensitive                                                         | Resistant |
| Cefoxitin         | 3                                                             | 0         | 4                                                                 | 0         |
| Benzyl penicillin | 2                                                             | 1         | 1                                                                 | 3         |
| Oxacillin         | 3                                                             | 0         | 4                                                                 | 0         |
| Cefpodoxime       | 3                                                             | 0         | 4                                                                 | 0         |
| Cefepime          | 3                                                             | 0         | 4                                                                 | 0         |
| Gentamicin        | 3                                                             | 0         | 4                                                                 | 0         |
| Ciprofloxacin     | 3                                                             | 0         | 4                                                                 | 0         |
| Levofloxacin      | 3                                                             | 0         | 4                                                                 | 0         |
| Moxifloxacin      | 3                                                             | 0         | 4                                                                 | 0         |
| Azithromycin      | 1                                                             | 2         | 4                                                                 | 0         |
| Erythromycin      | 1                                                             | 2         | 4                                                                 | 0         |
| Clindamycin       | 2                                                             | 1         | 4                                                                 | 0         |
| Lincomycin        | 2                                                             | 1         | 4                                                                 | 0         |
| Quinupristin      | 3                                                             | 0         | 4                                                                 | 0         |
| Linezolid         | 3                                                             | 0         | 4                                                                 | 0         |
| Vancomycin        | 3                                                             | 0         | 4                                                                 | 0         |
| Tetracycline      | 2                                                             | 1         | 2                                                                 | 2         |
| Tigecycline       | 3                                                             | 0         | 4                                                                 | 0         |
| Nitrofurantoin    | 3                                                             | 0         | 4                                                                 | 0         |
| Rifampicin        | 3                                                             | 0         | 4                                                                 | 0         |
| Trimethoprim      | 3                                                             | 0         | 4                                                                 | 0         |

Non-food samples, meanwhile, had ratings of very contaminated in 73.3%, contaminated in 22.7% of, and clean in 4%. *S aureus* isolated from food samples was resistant to Azithromycin, Erythromycin, Clindamycin, and Lincomycin, although Cefoxitin and Oxacillin were still susceptible is depicted in (Table 4). The isolates from samples of both foods and non-foods were shown to be resistant to Benzyl penicillin and Tetracycline.

**Association between food hygiene practices of food handlers and prevalence of *S aureus***

Food samples collected from shops of handlers with poor hygiene practices (6.3%) and from handlers with good hygiene practices (2.3%) were isolated of *S aureus*, respectively as depicted in (Table 5). *S aureus* positivity in food taken from the shops of handlers with poor hygiene practices was 2.8 times higher than that of good practices, despite the fact that there was no significant association between the prevalence of *S aureus* and the food hygiene practices of handlers (OR, 95% CI: 2.8, 0.24 to 32.3). Among 6.3% of swab samples from dishes of food

handlers with poor hygiene practices had *S aureus*, while 4.7% of samples from dishes of those with good hygiene practices contained *S aureus*. Similar to food samples, there was no association between *S aureus* prevalence in non-food samples and food handler hygiene practices. The isolation of bacteria was, however, 1.4 times greater in non-food samples from food handlers who practiced bad hygiene than from those who followed good practices (OR, 95% CI: 1.4, 0.18 to 10.3).

**DISCUSSION**

More than half of respondents (57%) reported that their overall food handling methods were good, which was higher than in prior research in Myanmar: Aung et al. found that food handlers employed by government hospitals in Mandalay handled food good at a rate of 45.9%; street food vendors in Taunggyi had good food practices at a 41.1% rate; and in Naypyidaw Union Territory, good food handling practices in food-vendors from street food shops was 30%.<sup>7,8,14</sup>



**Table 5: Association between food hygiene practices of food handlers and isolation of *Staphylococcus aureus* in food and non-food samples.**

| Food hygiene practices of food handlers | <i>Staphylococcus aureus</i> in food samples |           | <i>Staphylococcus aureus</i> in non-food samples |           |
|-----------------------------------------|----------------------------------------------|-----------|--------------------------------------------------|-----------|
|                                         | Positive                                     | Negative  | Positive                                         | Negative  |
|                                         | N (%)                                        | N (%)     | N (%)                                            | N (%)     |
| <b>Poor</b>                             | 2 (6.3)                                      | 30 (93.7) | 2 (6.3)                                          | 30 (93.7) |
| <b>Good</b>                             | 1 (2.3)                                      | 42 (97.7) | 2 (4.7)                                          | 41 (95.3) |
| <b>Total</b>                            | 3 (4.0)                                      | 72 (96.0) | 4 (5.3)                                          | 71 (94.7) |
| <b>Fisher's Exact p value</b>           | 0.572                                        |           | 0.574                                            |           |
| <b>OR (95%CI)</b>                       | 2.8 (0.24 to 32.3)                           |           | 1.4 (0.18 to 10.3)                               |           |

More than 80% of food handlers handled foods with their bare hands, but this was less common than that of salad vendors in the markets of Naypyidaw (93.5%).<sup>15</sup> Because the food shops in the study's marketplaces were covered by the YCDC, every market had designated responsible individuals who regularly inspect its cleanliness. Additionally, during the COVID-19 pandemic, food handlers may be aware of the importance of maintaining good personal hygiene and using personal protective equipment like masks to avoid becoming infected. Some food handlers had this pre-existing awareness and related behaviors up to the present day. Therefore, the majority of food handlers in our study had reasonable good hygiene habits. In comparison to other national and international studies on ready-to-eat food, the prevalence of *S aureus* in food samples was lower: 38.1% in a Myanmar traditional snack vendor in Naypyidaw; 12.5% in China; 16.6% in street food vendors in Nepal; 17.2% in China; 20% in small businesses in middle Thailand; and 53% in food premises in Putrajaya, Malaysia.<sup>3-6,16-18</sup> In the present study, non-food items (dishes) included more *S aureus* isolates (5.3%) than food samples (4%). This might be because there was less covering on dishes than on food, making them more susceptible to contamination from the surroundings. On the other hand, cooked food was stored more securely in lidded containers or under covering nets. Regarding bacterial contamination, more than half of the food samples were unsatisfactory and nearly two thirds of the non-food samples were very contaminated. Dishes used for food service, can be significant sources of bacterial contamination through direct contact with food items, food handlers and consumers.<sup>19,20</sup> Despite the fact that the majority of the food handlers in our study used good hygiene practices, the high levels of contamination in the collected samples highlighted the need for ongoing surveillance for the isolation of bacteria in the foods sold at the markets in Yangon in order to prevent outbreaks and food-borne illnesses. Regarding the drug sensitivity pattern, all isolated *S aureus* from non-food samples were still susceptible, whereas practically all isolated *S. aureus* from food samples were resistant to microlide antibiotics. There were no MRSA strains in the current investigation, despite the fact that MRSA strains were discovered in studies of food and non-food samples in nearby countries

(8.7% in China; 2.2% in Singapore; 7.4% in China).<sup>3,4,21</sup> *S aureus* is not a pathogen to be ignored due to its methicillin resistance, according to the overview of biological risks and foodborne infections.<sup>2</sup> The existence of MRSA has recently been documented outside of the hospital environment in the community as community-acquired MRSA or CA-MRSA, despite the fact that MRSA was previously believed to be transmitted only in clinical settings, such as hospital-acquired MRSA (HA-MRSA). The threat that AMR poses to public health is highlighted by the World Health Organization, which also urges monitoring of antibiotic residues in food and AMR in priority foodborne pathogens.<sup>22</sup> The current study's high levels of contamination in food and non-food samples point out the necessity of routine evaluations of *S aureus* prevalence and its AMR status, which is a developing worldwide health concern. According to the present study, the prevalence of *S aureus* was not related to the hygiene practices of food handlers. Both food and non-food samples from food handlers with good or bad hygiene practices did not substantially differ in the number of bacterial isolates. This suggests that environmental factors like water for cleaning and cooking, as well as touch surfaces like tables and chairs that are close to food, as important vehicles for both direct and indirect bacterial contamination.<sup>23</sup>

## CONCLUSION

The findings of this study could offer critical baseline data on the prevalence of *S aureus* and its antibiotic resistance in food and non-food items from open marketplaces readily accessible by the community in Yangon. No variation in *S aureus* prevalence was found regardless of food handler hygiene practices, highlighting the need for ongoing monitoring of bacterial contamination in ready-to-eat foods sold in markets to prevent unanticipated food related illnesses.

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