

# Ornaments of daily usage can be a source of microbial contamination and a causative agent of diseases

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**Hand hygiene is the most simple and effective way to prevent infection. Contaminated hand and related ornaments act as a vector of transmitting diseases. The main goal of this study was to find out whether personal accessories of different categories of working women are responsible for foodborne illness or contagious diseases. For this purpose, six categories of individuals were chosen, and five types of ornaments were taken from each individual. Total thirty swab samples were taken from the surface of bangles, nose pins, ear rings, finger rings and chains. Conventional culture techniques and biochemical tests were performed to determine the presence and identification of the pathogenic microorganisms. Total viable bacteria was present in all those samples but the presence of specific microorganisms were not found in all of those samples. Moderate growth of *Staphylococcus* spp. was found in finger rings and ear rings of the home makers and presence of *Escherichia coli* was detected in 16% of these samples as an indicator of fecal contamination. In the light of these results, it is essential to maintain proper hand hygiene and sanitation practice as some ornaments could be the significant source of pathogenic microorganisms. Food handlers and health care workers should abide by the rules and regulations of personal hygiene.**

**Keywords:** Hand hygiene, Microbial load, Ornaments, Antimicrobial susceptibility.

## INTRODUCTION

Hygiene practice is very essential for preventing transmission of infectious agents in every sector including food industry, healthcare institutions, household works and other sectors in the community (1-4). Bangle, wrist watch, rings, nose pin, ear rings and cell phone are the common accessories worn or carried by women of all socioeconomic status. Hand hygiene is linked with the usage and maintenance of jewelry items worn by the women population. The skins underneath rings were reported to have more microorganisms than those of control sites (5-7). Some previous studies demonstrated that rings can act as carrier of Gram-negative bacilli and *Staphylococcus aureus* on hands, which can be transmitted and cause nosocomial infections as well as food borne illness (8, 6, 9). If Health care and foodservice workers wear rings with complicated designs they could serve as carriers of pathogenic bacteria causing nosocomial and foodborne infections (10, 11). Bacteria found on hands could be categorized as either resident or transient micro biota (5). Wearing rings can help increase skin contamination especially with yeasts and Gram-negative bacilli up to 10 fold in hands of nurses (12-14).

Besides healthcare services, food sector requires compulsory knowledge of hygiene of food workers. Food processing area of both domestics and restaurant kitchens should be free from pathogenic microorganisms in order to ensure the safety and quality of food (15-17). In addition to this, food

handlers are often not aware of standard hygiene protocols which should be followed by the personnel who is directly or indirectly associated with food making. Consequently, they are serving as major sources of contamination in food processes areas (18, 19). Several foodborne outbreaks caused due to lack of hygienic practices among the food makers were reported by other researchers (20). Presence of *Staphylococcus* spp. and *Escherichia coli* in food samples indicates the possibility of contamination from worker during cooking and serving (21, 22). It has been already proven that worker's skin lesions, sneezing or coughing are possible causes of contamination from *S. aureus*. Prevalence of *E. coli* also indicates fecal contamination in foods through contaminated hands of food makers (23, 24, 25). Based on the previous findings, this study was designed to determine the presence of microorganisms in the accessories of several groups of working women and students which may pose risk of food contamination.

## MATERIALS AND METHODS

**Sample collection.** Samples were collected from women of different perspectives like students, housewives, maids, hospital cleaners and working women. Sampling was done from different ornament surfaces which remained in direct contact with the skin such as nose pins, bangles, ear rings, wrist watches and chains. These samples have been collected from women belonging to different places like universities, hospitals, banks and houses between October and November 2019.

**Sample processing.** Some Glass vials containing 3 ml of normal saline (0.85% NaCl) in each were used to collect surface samples from various ornament surfaces of different women with sterile cotton swabs (14). After collecting sample, 1 ml of normal saline was transferred into test tubes containing 9 ml of nutrient broth (NB) in each tube and kept in the incubator

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at 37°C for 24 hours for enrichment so that organisms which are under stressed or starved condition to allow them grow or multiply before they are introduced into different growth media. This enrichment step is included in order to assist stressed microorganisms to utilize complex nutrients while growing in different media and. After 24 h of enrichment, samples were inoculated (by making lawn) onto different media using sterile cotton swabs (26).

**Identifying microorganisms from different ornament surfaces.** In this experiment, different types of agar media were used to determine the presence of pathogenic microorganisms and measuring the microbial loads and on different ornaments surfaces. Nutrient Agar (NA) media were used for determining total bacterial growth, Sabouraud Dextrose Agar (SDA) media were used for estimating total fungal growth, Mannitol Salt Agar (MSA) media were used for determining growth of *Staphylococcus* spp., McConkey Agar (MAC) media were used for the estimating growth of *E. coli* and *Klebsiella* spp. and Cetrimide agar was used for isolation and of *Pseudomonas* spp. All the media plates were incubated at 37°C for 24 h for determining bacterial growth and at 25°C for 48 h for estimating fungal growth (SDA) (17). The presence of microorganisms has been displayed as '+' and the absence of microbial growth is indicated as '-' sign. A series of biochemical tests were performed following the standard protocol to identify the bacteria isolated from the ornaments.

**Determination of antibiotic susceptibility.** The standard agar disc diffusion method known as the Kirby-Bauer method was applied (27). Suspensions of the test organisms were prepared by adjusting the turbidity of the broth in phosphate buffer saline by comparing with McFarland 0.5 solution. Bacterial lawn from each suspension was prepared on Muller Hinton agar plates using sterile cotton swabs. Commercially available antimicrobial discs (Oxoid, Hampshire, UK) were placed aseptically (neomycin-10 µg, chloramphenicol-10 µg, polymyxin B-30 µg, ofloxacin-5 µg, amoxicillin-10 µg, ciprofloxacin-5 µg, cefpodoxime-30 µg, nalidixic acid-30 µg, imipenem-10 µg, tetracycline-30 µg) on the surface of the inoculated plates at appropriate spatial arrangement by means of a sterile needle. Susceptibility to the specific antibiotic was interpreted by the presence of the clear zone around the disc after incubation (27).

## RESULTS AND DISCUSSION

Table 1 summarizes the prevalence of the monitored microorganisms in various types of ornament samples examined in this study. Total viable bacteria (TVB) were present in all accessories during this study. Heavy growth of TVB was found in ring samples compared to other samples. Presence of fungus was noticed in the finger ring which was collected from housewives, servants and nurses. The fungal load was predominant in the finger ring and bangle of housewives and servants. Lower growth of *Staphylococcus* spp. was found in finger ring and nose pin from all categories of individuals. Finger rings, nose pins and bangles of housewives and servants showed growth of *Staphylococcus* spp. Finger rings, bangles, chains and nose pin of students, health workers and nurses were also found to be a reservoir of *Staphylococcus* spp. *Pseudomonas* spp. was found in finger rings, ear rings and bangles of every individual. *Escherichia coli* were infrequently present in their finger and ear rings. Out of 10 common antibiotics, tetracycline and chloramphenicol were found to be effective against *E. coli* isolates. Imipenem, nalidixic acid and cefpodoxime were found effective against *Pseudomonas* spp. and ciprofloxacin, tetracyclin and ofloxacin were found to be effective against *S. aureus* (Table 3).

Proper hand hygiene can reduce the incidence of both foodborne and skin infections. Firstly, the sources of foodborne disease could be the handlers but it is difficult to find out the true etiology of the outbreak. A fresh uncontaminated food can be contaminated from the kitchen and unhygienic hands

(3). Secondly, to prevent the post-surgical infection and nosocomial infection, hygiene practices are

Table 1. Microbiological analysis of ornament samples.

Different Group	Accessories	Microbial Load				
		Total viable bacteria	Fungi	<i>Staphylococcus</i> spp.	<i>E. coli</i>	<i>Pseudomonas</i> spp.
House wife	Finger ring	++	++	+	+	+
	Chain	++	-	-	-	-
	Nose Pin	++	++	+	-	-
	Ear Ring	+++	-	-	+	+
	Bangle	+	++	++	-	+
Hospital cleaner	Finger ring	+++	+	+	+	++
	Chain	++	-	-	-	-
	Nose Pin	+++	++	-	-	-
	Ear Ring	++	-	-	-	-
	Bangle	++	-	-	-	++
Servant	Finger ring	+++	++	++	+	+
	Chain	++	-	-	-	-
	Nose Pin	+++	+	+	-	-
	Ear Ring	+++	-	-	-	+
	Bangle	+++	++	+	-	-
Student	Finger ring	+++	-	+	-	+
	Chain	++	-	+	-	-
	Nose Pin	++	+	-	-	-
	Ear Ring	++	-	-	-	+
	Bangle	++	-	+	-	+
Working woman	Finger ring	+++	-	++	-	++
	Chain	++	-	-	-	-
	Nose Pin	++	+	-	-	-
	Ear Ring	+++	-	+	+	+
	Bangle	++	-	+	-	+
Nurse	Finger ring	+++	-	+	-	+
	Chain	+	-	-	-	-
	Nose Pin	++	+	-	-	-
	Ear Ring	++	-	+	-	+
	Bangle	++	-	++	-	+

Note: +, poor growth; ++, moderate growth; +++, heavy growth; -, no growth.

crucial for the nurse and health care workers (28). Finally and most importantly for personal safety and for a healthy life, individuals from every occupation must follow the rules of hygiene. The presence of *Staphylococcus* spp. and *E. coli* is highly alarming as they can cause foodborne intoxication and presence of *E. coli* is an indicator of fecal contamination. Intricate design of jewelries can entrap microorganisms from different sources, and they can be shed into food items during handling. On the other hand presence of fungi in ornaments samples increase the chances of skin lesions or infections. The fungus settles on the skin and forms hyphae, which grows out to produce circular lesions. Pieces of jewelries harboring these organisms could serve as a vehicle for transmission of fungi from health worker to immune-compromised patient (29). Antibiotic resistant isolates increases the risk of infections spreading due to wearing jewelry.

Table 2. Biochemical identification of the bacteria.

Assumed pathogenic microorganisms	TSI				Motility	Indole Production	MR	VP	Citrate utilization	Catalase	Oxidase
	Slant	Butt	Gas	H <sub>2</sub> S							
<i>E. coli</i>	Y	Y	+	-	+	+	+	-	-	+ve	-ve
<i>Staphylococcus</i> spp.	Y	Y	-	-	+	-	+	-	-	+ve	-ve
<i>Pseudomonas</i> spp.	R	Y	-	-	+	-	+	-	-	+ve	+ve

Note: TSI= Triple Sugar Iron Test; Y=Yellow (Acid); R=Red (Alkaline); MR=Methyl red; VP= Voges-Proskauer.

Table 3. Antimicrobial susceptibility pattern of different bacteria isolated from ornament samples.

Organisms	<i>E. coli</i> (n=4)		<i>Pseudomonas</i> spp. (n=5)		<i>Staphylococcus</i> spp. (n=5)	
	R	S	R	S	R	S
CIP (5µg)	67%	33%	70%	30%	40%	60%
CPD (30µg)	80%	20%	34%	66%	ND	ND
AMO (10µ)	ND	ND	80%	20%	100%	1%
IPM (30µg)	90%	10%	20%	80%	ND	ND
N (10µg)	73%	27%	ND	ND	ND	ND
CHL (10µg)	45%	55%	66%	34%	ND	ND
TE (30 µg)	20%	80%	ND	ND	30%	70%
PB (30µg)	ND	ND	80%	20%	ND	ND
NA (30µg)	80%	20%	40%	60%	ND	ND
OFL (5µg)	70%	30%	ND	ND	22%	78%

Note: ND=Not Done.

## CONCLUSION

The present study demonstrates that accessories from every individual can be a source of significant bacterial source which means that these objects can act as potential sources of contamination of foods if they are not removed when working at their work place. According to the discussion above, it would be convenient to restrict the use of accessories during surgical operations, cooking, serving and most importantly while using toilet. Overall, everyone should follow the guidelines for routine hand hygiene and to protect against increased transmission of pathogenic bacteria.

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