Bacterial Contamination of Women's Handbags and Their Contents in Ajilat City, Libya

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ABSTRACT

This study aimed to investigate the types and prevalence of bacterial contamination in women's handbags and their commonly used contents in Ajilat City, Libya. A total of 100 samples were randomly collected from handbags, mobile phones, makeup brushes and sponges, bank cards, paper currency, and coins. Ethical approval and informed consent were obtained prior to sample collection. Samples were collected using a Z-pattern swabbing method and preserved in blood culture media for transport to the microbiology laboratory. The cotton swabs were cultured on selective and differential media, including blood agar and MacConkey agar, and incubated at 37°C for 48 hours. Bacterial colonies were examined based on morphological characteristics and microscopic analysis to identify the species present. The results revealed that 98% of handbag samples contained bacterial colonies, with Escherichia coli and Staphylococcus spp. being the most frequently identified. Mobile phones were predominantly contaminated with Staphylococcus spp., while makeup brushes and sponges were contaminated with both Streptococcus spp. and Staphylococcus spp. Escherichia coli was also detected on 50 bank card samples and in all paper currency and coin samples. These findings indicate that women's handbags and their contents act as potential fomites, facilitating the transmission of pathogenic and opportunistic bacteria in community settings. The study highlights the importance of personal hygiene, regular cleaning of handbags and personal items, and public health awareness to reduce bacterial spread and prevent infection.

Keywords: *Bacterial Contamination , Women's Handbags, Escherichia Coli, Staphylococcus spp., Public Health.*

1. INTRODUCTION

Bacteria live almost everywhere, parasitizing living organisms, but they also invade inanimate objects such as soil, water, and surfaces. A woman's handbag is one such item that can harbor various types of germs, including bacteria. Al-Ghamdi et al. (2011) have previously documented the presence of pathogenic germs on inanimate surfaces. Sometimes, women's handbags are a social status symbol; some people consider them merely accessories. However, women's handbags have become essential for carrying valuables, keys, bank cards, mobile phones, and receipts. Feldman and Feldman (2012) concluded that bags are often stored in environments teeming with bacteria, so they can easily become contaminated with infectious agents. Bags can be vectors of disease from place to place because most are rarely washed and are discarded after years of use. Dotan et al. (2009) stated that bacterial colonies have been isolated from medical staff handbags in healthcare settings.

Studies have shown that many types of bacteria can spread through contaminated mobile phones and computer keyboards, such as Gram-positive cocci, *Staphylococcus spp*, *Micrococcus spp*, Gram-negative bacteria, *Bacillus spp*. Verran (2012) pointed out that bacteria can survive on surfaces by developing biofilms of a single bacterial agent. Studies have confirmed that pathogenic microorganisms can survive for extended periods. [14] Studies have confirmed that pathogenic microorganisms can survive for extended periods on surfaces, for several days or weeks, causing infectious diseases, depending on the surrounding environmental factors (Odoya et al., 2015).

Studies have shown that humidity, frequent use, and general hygiene affect the rate of bacterial transmission. Door handles, bags, mobile phones, money, toilet seats, chairs, sinks, and tables, which are commonly found in public places such as restaurants, hotels, hospitals, and bathrooms, can be vectors for bacterial infection. The risk of disease transmission via inanimate objects in both community and medical settings. Opportunistic bacteria have been reported on banknotes, mobile phones, playground equipment, computers, keyboards, and medical equipment from healthcare facilities.

Staphylococcus spp., *Enterococcus spp*., *Escherichia coli*, *Pseudomonas spp*., and *Micrococcus spp*. were isolated from contaminated instruments. This study aims to isolate potential bacterial species from the handbag women's volunteers from the Ajilat city.

2. SIGNIFICANCE OF THE STUDY

Women's handbags and their contents represent an often-overlooked source of bacterial contamination in the community. Handbags are frequently handled, placed on contaminated surfaces, and rarely cleaned, making them suitable environments for microbial survival and transmission (Dotan et al., 2009; Feldman & Feldman, 2012). Previous studies have reported the presence of pathogenic bacteria on personal belongings such as mobile phones, banknotes, and cosmetic tools, indicating a potential risk to public health (Bhoonderowa et al., 2014; Ulger et al., 2009). In Libya, limited data exist on bacterial contamination of personal items, highlighting the importance of this study in providing local evidence to support hygiene awareness and infection prevention strategies.

3. WOMEN'S HANDBAGS AS FOMITES

Fomites are inanimate objects capable of transmitting infectious agents through contact with contaminated surfaces or hands (Neff & Rosenthal, 1957). Women's handbags function as fomites due to their frequent exposure to diverse environments and continuous handling. Studies have documented bacterial contamination on handbags used by hospital staff and community members, confirming their role as reservoirs for pathogenic microorganisms (Dotan et al., 2009; Biranjia-Hurdoyal et al., 2015). Items commonly stored inside handbags, such as mobile phones, cosmetics, and money, further contribute to microbial accumulation and cross-contamination (Verran, 2012; Ahmed et al., 2010).

4. FACTORS CONTRIBUTING TO BACTERIA CONTAMINATION

Several factors contribute to bacterial contamination of women's handbags, including frequent handling, environmental exposure, and lack of regular cleaning. Handbags are frequently touched throughout the day, often by hands that have contacted various surfaces, which facilitates the direct transfer of microorganisms (Bright et al., 2010). Additionally, placing handbags on floors, public seating, restroom surfaces, or other potentially contaminated areas increases the risk of indirect microbial transfer, allowing bacteria to colonize both the interior and exterior surfaces of the bag (Bright et al., 2010). Handbags also provide favorable conditions for bacterial survival; the enclosed space limits ventilation and traps moisture, creating a warm and humid microenvironment that supports bacterial growth (Reynolds et al., 2005). Furthermore, items stored inside handbags, such as mobile phones, cosmetics, bank cards, and money, can carry their own microbial load, which can spread to the bag and other objects through frequent handling (Reynolds et al., 2005). Previous studies have demonstrated that hygiene practices, including handwashing and regular cleaning of personal items, as well as environmental conditions such as temperature and surface exposure, significantly influence microbial contamination levels, indicating that both user behavior and situational factors play an important role in the accumulation and persistence of bacteria on handbags (Al-Ghamdi et al., 2011). Taken together, these factors highlight why handbags are not merely personal accessories but potential vectors for bacterial transmission in daily life.

5. SURVIVAL OF BACTERIA ON INANIMATE SURFACES

Bacteria are capable of surviving on inanimate surfaces for extended periods, with their persistence influenced by environmental factors such as humidity, temperature, and the nature of the surface material (Vriesekoop et al., 2010). Surfaces that are porous or retain moisture may support bacterial survival for longer periods compared to dry or smooth surfaces. Gram-positive bacteria, including *Staphylococcus* spp., demonstrate particularly strong resistance to desiccation, enabling them to remain viable on dry surfaces for days or even weeks (Odoya et al., 2015). The ability of these microorganisms to survive outside a host organism allows everyday objects, such as handbags and personal items, to serve as reservoirs for infection. Consequently, the prolonged survival of bacteria on these objects increases the likelihood of indirect transmission, as individuals can come into contact with contaminated items multiple times during daily activities. Tagoe et al. (2011) stated that this persistent contamination, combined with frequent handling and environmental exposure, facilitates the spread of bacteria within the community and underscores the importance of hygiene practices aimed at reducing microbial load on personal belongings

6. PUBLIC HEALTH IMPLICATIONS

The presence of potentially pathogenic bacteria on women's handbags poses a significant risk of cross-contamination to hands, food, and facial areas. Items such as mobile phones, cosmetics, bank cards, and currency, when stored together in handbags, can accumulate microbial populations that are easily transferred during daily activities (Bhoonderowa et al., 2014). Contaminated personal items have been shown to contribute to the spread of community-acquired infections, particularly among vulnerable populations such as children, the elderly, and immunocompromised individuals (Bright et al., 2010). The findings of this study highlight the importance of personal hygiene practices, including thorough handwashing before and after handling handbags, as well as the routine cleaning and disinfection of frequently used items, in order to reduce bacterial transmission (Messina et al., 2013). By adopting these preventive measures, individuals can minimize the risk of infection, limit the spread of pathogenic bacteria, and promote safer interactions within both household and community settings.

7. METHODS

7.1 Materials and tools

The materials and tools used in this study included latex gloves, sterile cotton swabs, nutrient media, and an incubator. These items were employed to ensure safe and aseptic collection, handling, and cultivation of bacterial samples from handbags and their contents.

7.2 Ethical considerations and the type of study samples

Ethical approval was obtained prior to the commencement of the study, and informed consent was secured from all participating women. The study involved the collection of 100 samples, randomly selected from women's handbags and their most commonly used contents, including paper currency, coins, mobile phones, bank cards, lipstick, and makeup brushes. Participation was voluntary, and all personal information was kept confidential. The study was designed to minimize any risk to participants while ensuring accurate collection and identification of bacterial contaminants.

7.3 Sample collection

Samples were collected using the Z-pattern sampling method, in which a cotton swab is moved in a zigzag or "Z" pattern across the sampling surface to ensure representative coverage of the area. After swabbing, each sample was immediately placed into a blood culture medium to preserve bacterial viability during transport. The samples were then transferred to the microbiological analysis laboratory for further processing and identification. This method was chosen to maximize the recovery of bacteria from both the interior surfaces of handbags and the various items contained within them.

7.4 Sample Culture

The collected cotton swab samples were cultured on selective and differential nutrient media, including blood agar and MacConkey agar, to facilitate the growth and identification of a wide range of bacterial species. After inoculation, all culture data were recorded, and the plates were incubated at 37°C for 48 hours under standard laboratory conditions. This procedure allowed for the development of bacterial colonies, which were subsequently examined for morphological characteristics, including size, shape, color, and hemolytic activity, as part of the identification process.

7.5 Biological analysis and observation

The identification of bacterial species in the study samples was conducted using standard bacteriological methods. Isolated colonies were examined based on their morphological characteristics, including colony size, shape, color, and texture, and were further analyzed using microscopic examination to confirm their cellular structure and Gram-staining properties (Mohamad & Noorain, 2014). Also, Ahmed et al. (2010) stated that this approach allowed for the accurate differentiation and identification of bacterial species present on the handbags and their contents, providing insight into the types of microbial contamination encountered in the study.

8. RESULTS

The study revealed that bacterial contamination was widespread across the sampled handbags and their contents, with multiple bacterial species detected on the surfaces of the collected items. Specifically, *Escherichia coli*,

Streptococcus spp., and *Staphylococcus* spp. were the most commonly identified bacteria, demonstrating the presence of both Gram-negative and Gram-positive microorganisms (Figures 1, 2, and 3). *E. coli* was primarily detected on bank cards, paper currency, and coins, suggesting fecal contamination and highlighting the potential for these items to act as vectors for bacterial transmission. *Staphylococcus* spp. was frequently observed on mobile phones, handbag interiors, and cosmetic tools, reflecting the bacteria's ability to persist on skin-contact surfaces and withstand desiccation. *Streptococcus* spp. was primarily found on makeup brushes and sponges, indicating the risk of bacterial transfer to facial areas and potential skin infections. The morphological diversity of the bacterial colonies, including variations in shape, color, size, and texture, demonstrated the complexity of the microbial communities present in these everyday personal items. These findings underscore that women's handbags and their commonly used contents are not only contaminated but also harbor multiple potentially pathogenic bacterial species, emphasizing the importance of routine cleaning and hygiene practices to mitigate the risk of infection.

8.1 Microbial culture of Escherichia coli on blood agar

Figure 1 shows isolated colonies of *E. coli* grown on blood agar following incubation at 37°C for 48 hours. The colonies appear circular, smooth, and slightly raised with a grayish-white coloration. The distinct morphology of the colonies, including their size and texture, allows differentiation from other bacterial species present in the samples. This culture demonstrates the presence of *E. coli* on sampled personal items, highlighting the potential for fecal contamination and the risk of bacterial transmission from everyday objects such as banknotes, coins, and handbag surfaces.

Figure (1): Microbial culture: E.coli

8.2 Microbial culture of Streptococcus spp. on selective agar

Figure 2 shows isolated colonies of *Streptococcus* spp. grown on selective nutrient media following incubation at 37°C for 48 hours. The colonies appear small, round, and slightly raised with a translucent to whitish appearance, often showing partial hemolysis on the agar surface. The distinct colony morphology allows differentiation from other bacterial species present in the samples, such as *E. coli* and *Staphylococcus* spp. This culture illustrates the presence of *Streptococcus* spp. on makeup brushes and sponges, highlighting the potential for bacterial transfer to facial areas through contaminated personal items.

Figure (2): Microbial culture Streptococcus spp.

8.3 Microbial culture of Staphylococcus spp. on nutrient agar

Figure 3 shows isolated colonies of *Staphylococcus* spp. grown on nutrient agar following incubation at 37°C for 48 hours. The colonies appear circular, convex, and creamy-white with smooth margins, distinguishing them from other bacterial species such as *E. coli* and *Streptococcus* spp. The distinct morphological characteristics observed in this culture confirm the presence of *Staphylococcus* spp. on sampled items, including mobile phones, makeup brushes, and handbag interiors, emphasizing their role as common skin-associated bacteria capable of persisting on frequently handled personal belongings.

Figure 3: Microbial Culture: Staphylococcus spp.

The growth of bacterial colonies on blood agar and MacConkey agar demonstrated distinct morphological characteristics, including variations in shape, color, size, and texture. The observed diversity in colony appearance indicates the presence of multiple bacterial species, reflecting a complex microbial community within the sampled handbags and their contents (Table 1).

Table (1): bacterial contamination on sample surfaces

Sample Type	Bacterial Contamination
handbag interior surfaces	*E.coli / Streptococcus spp.*
Mobile phones	*E.coli*
Makeup sponges	*Streptococcusspp., Staphylococcusspp.*
Makeup brushes	*Streptococcus spp., Staphylococcusspp.*
bank cards	*Streptococcus spp.*
Paper currency	*E.coli*
Coins	*E.coli*

A total of 100 samples were collected from women's handbags and their commonly used contents to assess bacterial contamination. Out of these, 98 samples were found to contain bacterial colonies, with two bacterial species, *Escherichia coli* and *Staphylococcus* spp., being the most frequently identified (Mohamad & Noorain, 2014). Among the 85 mobile phone samples, *Staphylococcus* spp. was the predominant bacterium detected (Ulger

et al., 2009). Makeup brushes and sponges were contaminated with both *Streptococcus* spp. and *Staphylococcus* spp. in 73 samples (Behravan et al., 2005; Tharmila et al., 2012). *Escherichia coli* was identified on the surfaces of 50 bank card samples (Kalita et al., 2013). Furthermore, all samples of paper currency and metallic coins (100 samples) tested positive for *E. coli*, highlighting the high potential for bacterial transfer through commonly handled items (Ahmed et al., 2010; Vriesekoop et al., 2010). These results indicate that women's handbags and their contents serve as reservoirs for diverse bacterial species, emphasizing the need for improved hygiene practices.

9. DISCUSSION

The present study investigated bacterial contamination of women's handbags and their commonly used contents in Ajilat City, Libya. The findings revealed a high prevalence of bacterial contamination, with *Escherichia coli*, *Staphylococcus* spp., and *Streptococcus* spp. isolated from handbag interior surfaces and frequently handled personal items. These results confirm that women's handbags can act as potential fomites and contribute to the transmission of microorganisms in community settings.

The isolation of *Staphylococcus* spp. from mobile phones, cosmetics, and handbag interiors is consistent with previous studies reporting the persistence of Gram-positive bacteria on frequently touched surfaces (Ulger et al., 2009; Odoya et al., 2015). *Staphylococcus* spp. are part of the normal skin flora and are easily transferred through direct hand contact, which explains their high occurrence on personal items that are regularly handled. Their ability to survive under dry conditions further increases their persistence on inanimate surfaces (Tagoe et al., 2011).

The detection of *Escherichia coli* on bank cards, paper currency, and coins suggests fecal contamination and indicates poor hand hygiene practices. Similar findings have been reported in studies examining microbial contamination of money and credit cards, highlighting their role as reservoirs of enteric bacteria (Ahmed et al., 2010; Vriesekoop et al., 2010; Curtis, 2012). The presence of *E. coli* on these items raises public health concerns, as it may facilitate the transfer of pathogens to food, the mouth, or other body parts.

The contamination of makeup brushes and sponges with *Streptococcus* spp. and *Staphylococcus* spp. is particularly concerning due to their direct contact with facial skin. Previous studies have shown that cosmetic tools can harbor pathogenic bacteria and pose risks of skin and eye infections when hygiene practices are inadequate (Behravan et al., 2005; Tharmila et al., 2012). The warm and moist environment inside handbags may further support bacterial survival and growth on cosmetic items.

Environmental exposure and storage conditions likely played a significant role in the observed contamination levels. Handbags are frequently placed on public surfaces such as floors, chairs, and tables, which are known to harbor bacteria (Bright et al., 2010; Reynolds et al., 2005). In addition, the lack of regular cleaning of handbags and prolonged use over time may increase microbial accumulation, as reported in earlier studies on handbags and personal belongings (Dotan et al., 2009; Biranjia-Hurdoyal et al., 2015).

Overall, the findings of this study are consistent with international research demonstrating that everyday personal items can serve as vehicles for bacterial transmission. However, this study provides important local evidence from Libya, where limited research has been conducted on microbial contamination of personal belongings. The results emphasize the need for increased public awareness regarding hygiene practices and routine cleaning of handbags and frequently used items to reduce the risk of bacterial spread in the community.

10. LIMITATIONS OF THE STUDY

This study has several limitations that should be considered when interpreting the findings. First, the research was conducted in a single geographic location, Ajilat City, Libya, which may limit the generalizability of the results to other regions with different environmental conditions, hygiene practices, or population characteristics. Expanding the study to include multiple locations would provide a broader understanding of bacterial contamination patterns.

Second, the identification of bacterial isolates was based on conventional bacteriological methods, including colony morphology and microscopic examination. Although these techniques are widely used and effective for preliminary identification, they lack the precision of molecular methods, which can provide more accurate species-level identification (Mohamad & Noorain, 2014). The absence of molecular confirmation may therefore limit the detailed characterization of the isolated microorganisms.

Additionally, antibiotic susceptibility testing was not performed in this study. Assessing antimicrobial resistance patterns is important for evaluating the potential health risks associated with contaminated personal items, particularly in the context of emerging resistant strains (Ulger et al., 2009). The lack of such analysis restricts the ability to determine the clinical significance of the isolated bacteria.

Finally, the study did not examine factors such as frequency of handbag cleaning, duration of use, or material type, which may influence levels of bacterial contamination. Despite these limitations, the study provides valuable

baseline data on bacterial contamination of women's handbags in Libya and highlights the need for further research using advanced identification techniques and broader study designs.

11. RECOMMENDATIONS AND PREVENTION MEASURES

Based on the findings of this study, several recommendations are proposed to reduce bacterial contamination of women's handbags and their commonly used contents. First, regular cleaning and disinfection of handbags, as well as items stored within them, should be strongly encouraged. Cleaning can include wiping surfaces with disinfectant wipes or using mild detergents for internal compartments, which may help reduce microbial load and limit the risk of cross-contamination.

Second, public awareness campaigns should emphasize the importance of proper hand hygiene, especially after handling money, mobile phones, or other frequently used personal items (Reynolds et al., 2005; Bright et al., 2010). Individuals should be educated on the risks associated with contaminated handbags and instructed to wash hands thoroughly before eating, touching the face, or preparing food.

Third, proper handling and storage practices should be promoted. For example, placing handbags on clean surfaces rather than on floors, avoiding overcrowding of items inside the bag, and limiting direct contact with unclean public surfaces can significantly reduce bacterial exposure.

Finally, future research should focus on determining antimicrobial resistance patterns of bacteria isolated from handbags and other personal items. Advanced molecular identification techniques should also be employed to provide a more comprehensive understanding of microbial diversity and pathogenic potential (Messina et al., 2013). Such studies will strengthen public health strategies and inform evidence-based guidelines for reducing the spread of pathogenic bacteria in community settings.

12. CONCLUSION

This study demonstrated that women's handbags and their commonly used contents are significantly contaminated with various bacterial species, including *Escherichia coli*, *Staphylococcus* spp., and *Streptococcus* spp. The findings confirm that handbags can act as potential fomites, facilitating the transmission of bacteria between contaminated surfaces and the human body. The isolation of pathogenic and opportunistic microorganisms from items such as mobile phones, cosmetics, bank cards, and currency highlights the role of everyday personal belongings in community-based microbial spread.

The results of this study are consistent with previous research conducted in different settings, emphasizing that bacterial contamination of personal items is a widespread public health concern. Environmental exposure, frequent handling, and inadequate cleaning practices appear to be key factors contributing to microbial persistence on handbags and their contents. Although the study was limited to a single geographic area and relied on conventional identification methods, it provides valuable baseline data for future investigations in Libya.

In conclusion, increased public awareness of personal hygiene practices, regular cleaning of handbags, and proper handling of frequently used items are essential measures to reduce the risk of bacterial transmission. Further studies incorporating molecular identification techniques and antimicrobial susceptibility testing are recommended to better assess the health risks associated with contaminated personal belongings.

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