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EXAMINATION OF MICROBIAL LEVELS IN STUDENTS' BED LINENS

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ABSTRACT

Purpose: This paper determined the microbial content of bed linens used by students based on period of usage, gender of user and types of fabrics.
Design/Methodology/ Approach: Laboratory tests were conducted on bed linens used by students. Purposive and convenience sampling techniques were employed to select 32 each male and female participants living alone for the study. 32 pieces of bed linens, each 100% cotton and cotton/polyester blend, were used for the experiment. Two categories of gender (male and female) and two different periods of usage (one week and two weeks) were also employed. The statistical software employed to analyse the data collected was the Statistical Package and Service Solution (SPSS) for Windows version 26. Means and standard deviations of microbial load of bed linens were determined. Independent samples *t*-test and analysis of variance were employed to determine if differences existed between and among the variables studied.
Findings: The study found no difference in microbial load in terms of duration and gender of the user. The results also showed more bacteria load on 100% cotton bed linen than on cotton and polyester blends.
Research Limitation: The study's sample was confined to a specific group of students at one university, limiting the generalizability of the findings to a broader student population or diverse living conditions.
Practical Implication: The study's outcome is significant for public health and daily hygiene practices. The Ghana health service can use the information to educate individuals on the dangers they will likely be exposed to using bed linens for an extended period without washing and raise awareness about the often-overlooked issue of microbial contamination in everyday environments.
Social Implication: The study highlights the need for increased awareness and responsibility regarding personal hygiene within living environments.
Originality/Value: This study advances the understanding of microbial contamination in students' bed linens by identifying the roles of usage period, user gender, and fabric type.

Keywords: *Bed linens. hygiene. microbes. usage period. user gender*

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INTRODUCTION

The spread of infections in the environment to people has mainly been studied. As Salla and Scott (2020) opined, microbes thrive in hybrid settings frequently shaped partly by human preferences. Marco (2021) added that "microbes" refers to the many trillions of bacteria, viruses, fungi, and other tiny organisms that have made the human body their home.

Globally, public health has significantly influenced how germs are seen, propagated, and eliminated. According to the germ hypothesis of sickness, microorganisms are the enemies of the human body. As Binns and Low (2014) suggested, the necessity to control infectious illness gave rise to epidemiology and public health. They further established that since infections continue to pose a danger to global health and although chronic diseases now account for a greater proportion of fatalities, infectious diseases might at any time overtake them as the leading cause of death. Pandemic risks from infectious diseases, antibiotic resistance, and an increase in the number of people with weakened immune systems have all increased; taken together, these illnesses take a heavy toll on health and prosperity (Quao et al., 2024; Strachan, 2000).

According to Scott, Bruning and Ijaz (2020), the house contains a sizable cross-section of the human population regarding age, health, nutritional state, and susceptibility to infectious agents. So far as the need for sanitary practices is concerned, the house serves as a model for many other communal contexts. The dynamics between the home and other communal contexts, such as daycare, work, school, travel, leisure, and healthcare, are constant. As Abney, Khalid Ijaz, McKinney, and Gerba (2021) indicate, most microorganisms found in clothes come from human skin, physiological faecal matter and discharges.

Operations like cooking, eating, being outside, and working can affect the distribution of microbial flora on the epidermis and bodily excrements. Bed linens, sponges, kitchen and bath towels can all contain distinctive microflora. The properties of textiles, such as the fabric type used and pollution content, can also affect the presence of pathogens and bacteria (Abney et al., 2021; Owen & Laird, 2020). As stated by Gao and Cranston (2008), most fibres are known as being susceptible to microorganisms' growth, such as bacteria and fungi, which can be found almost everywhere and can swiftly double, depending on the moisture, nutrients and temperature levels due to their enormous surface area and capability to retain moisture. They further confirmed this by opining that natural fibres such as cotton, hemp, flax, wool, mohair, and silk, among others, provide nutrients and energy sources for microbes in the form of carbohydrates or proteins.

Epidemiological investigations have highlighted the significance of textiles in transferring viral diseases in institutions. Before laundry, some microorganisms were detected in textile materials, and most pathogens linked to human sickness were probably present in garments and several other textiles. Bloomfield et al. (2011) and Bockmühl, Schages and Rehberg (2019) added that most sickness occurrences have been linked to healthcare personnel and institutions, and fabrics infected with viruses, germs, and fungus have also been implicated.

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Mitjà et al. (2015) and Ghinai (2010) raised the concern that since infections could be able to persist on substrates for times varying from a couple of minutes to many hours, it is possible that microorganisms coexist in biological storage and textiles serve as reservoirs for germs (Neely & Maley, 2000; Neely, 2000). Many studies have shown evidence of hospital-acquired infections caused by microbes transmitted through bed linens (French et al., 2004; Drees et al., 2008; Huang & Platt, 2003). Subsequently, beds can be the grounds for various bacterial species. A study on microbial assessment of bed linens conducted by Olowomofe, Oluyege, Ogunlade and Makinde (2020) in Nigeria proved that bed linens can serve as a reservoir and route of microbial dissemination in disease outbreaks. According to Kampf (2020), contaminated linens or materials could serve as a transmission source for weeks.

Microbes may cause infections in a domestic environment by spreading from one individual to another while living on textiles for one to ninety days (Gupta et al., 2017). The sex of the textile user might also influence the bacterial count. A study by Smith, O' Driscoll and Lamb (2020) showed that gender is a significant factor in the bacterial pollution of cloth surfaces. Their study revealed that male bacterial spread rates are higher than female peers. According to Ying et al. (2015), males' spread of bacteria or load is higher because they have greater sebum secretion that remains stable with ageing.

Numerous research concentrates exclusively on looking for bacteria that are significant for Hospital Acquired Infections, primarily Staphylococcus aureus or Enterococci (Andrade, Angerami & Padovani, 2000; Okareh, 2016; Perry, Marshall & Jones, 2000; Schneider et al., 2021; Pinon et al., 2013). However, the issues with bedding materials and their potential to worsen people's health are relevant to the hospital environment and households (Fallon, 2013). Hence, this study is needed. Studies on the microbial load on household bed linens, especially those used by students, have not received much scholarly attention. Therefore, this study sought to determine the microbial load of bed linens of students from the University of Cape Coast since this can considerably impact students' health. According to Gillen and Oliver (2009), bacteria, fungi, viruses, protozoa, and other microorganisms cause several illnesses, including influenza, chickenpox, and pneumonia. The study aimed to assess the microbial load of bed linens used by university students of Cape Coast based on the usage period, gender of user and types of fabrics.

THEORIES UNDERPINNING THE STUDY

Microbial Ecology

Microbial ecology refers to studying microorganisms and their environmental interactions. The term "ecology" is derived from the Greek word *oikos* (household or home) and was first coined by German zoologist Ernst Haeckel to describe the relationship between organisms and their environment (Panikov, 2010). Microorganisms adapt to their surroundings by utilising available nutrients to support their growth, reproduction, and development through metabolic processes (Barton & Northup, 2011). In response to environmental stimuli such as temperature, pH, and salinity, these adaptations can evolve new microbial species with unique traits (Barton & Northup, 2011).

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Germ Theory of Disease

The germ theory of disease, first proposed by Louis Pasteur, states that microscopic organisms, such as bacteria, viruses, and fungi, are responsible for causing certain diseases (Britannica Encyclopedia, 2022). Before its discovery, ancient Greeks believed disease was spread through infectious seeds in the air and food (Gillen & Oliver, 2009). The acceptance of germ theory led to the development of immunology and vaccines for diseases like rabies and smallpox (Ernst, 1995). Understanding that microorganisms transmit infections has influenced public health practices, including personal hygiene, sterilisation, and disinfection (Casanova & Abel, 2013). Molecular biology approaches, such as identifying microbial sequences, have improved infection control (Smith, Venter & Glass, 2009; Maloy & Schaechter, 2006). Additionally, textiles in the home, such as towels and linens, transmit microorganisms influenced by fabric type and use (Abney et al., 2021).

Targeted Hygiene

Targeted hygiene focuses on preventing the spread of harmful microbes by addressing key transmission points, primarily through infected individuals and carriers, rather than just dirty surfaces (IFH, 2002; Stanwell-Smith & Bloomfield, 2004). Homes and everyday environments like schools and workplaces are critical for hygiene practices to reduce the risk of gastrointestinal, respiratory, and skin infections (Bloomfield et al., 2009). Although investments in hygiene education dropped with the rise of vaccines and antibiotics, hygiene remains essential in infection prevention and reducing antibiotic resistance (Fauci, 2001; WHO, 2018). Targeted hygiene includes proper cleaning of hands, surfaces, and fabrics through physical removal, disinfection, or a combination of methods (Kampf, 2018). This approach not only maximises infection prevention but also addresses environmental and health safety concerns (Rook et al., 2017).

Conceptual Base of The Study

This section examines textiles as reservoirs for pathogens, focusing on factors like fabric type, usage duration, and user gender that influence microbial diversity in textiles. Due to their large surface area and moisture retention, natural fibres are susceptible to microbial growth, providing nutrients for bacteria and fungi (Gao & Cranston, 2008). In contrast, synthetic fibres, being hydrophobic and resistant to microbial attack, degrade less due to their low moisture absorption (Siracusa, 2019; Pathak, 2017). Fabric characteristics such as weave, thickness, and fibre blends also affect microbial retention, with natural-synthetic blends more resistant to microbial adhesion than purely natural fibres (Sauperl, 2016; Gupta & Bhaumik, 2007).

Textiles can harbour various microorganisms for different durations, with some bacteria like *Staphylococcus aureus* surviving up to two weeks on terry fabric and fungi like *Candida albicans* lasting a month on textiles (Gupta et al., 2017). Studies show that prolonged use of textiles before washing increases the microbial load, with linens accumulating significantly more bacteria than common surfaces like toilet seats (Salla & Scott, 2020). The microbial burden on textiles may also differ by gender, with men generally dispersing more bacteria than women, though these differences are not always statistically significant (Smith, O'Driscoll, & Lamb, 2020).

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METHODOLOGY

The study employed the experimental design using laboratory testing to assess the microbial load of bed linens used by students. Kadolph (2007) stated that laboratory tests are well organised, systematic and carefully planned, hence meeting the standards for research studies to be reliable and acknowledged by other researchers. A 2×2×2 factorial design was employed for the study, which included two categories of gender (male, female), two different fabric types (100% cotton and cotton/ polyester blend) and two different periods of usage (one week and two weeks). According to Amedahe (2002), a factorial design is necessary when two or more independent variables are included in a study, whether an actual experiment or a quasi-experiment.

Population

The study's population consisted of regular undergraduate students at the University of Cape Coast who stayed in the diaspora.

Eligibility Criteria

1. Participants for the study should be undergraduate students of the University of Cape Coast who are staying alone. (Single occupancy).
2. A volunteer should sleep alone on his or her bed.

Sample and Sampling Procedure

The study utilised a sample size of 64 participants, comprising 32 males and 32 females. The initial sample size of 364 participants was determined using the Krejcie and Morgan (1970) table of sample determination (as cited in Ahmad & Halim, 2017) based on a population of 16,848. Kane's Sample Size Calculator for clinical tests (2019) was employed to refine this number, leading to the final sample size of 64 participants.

This adjustment ensured the selection of participants who were fully prepared and committed to meeting the research requirements, as the study necessitated strict adherence to its protocols. Pourhoseingholi, Vahedi, and Rahimzadeh (2013) emphasised that in medical research, sample size refers to the number of participants or units included in the study. It is critical to address the research hypothesis while balancing ethical considerations. They further note that practical constraints, including cost, participant convenience, and logistical challenges, often limit sample sizes in clinical or medical studies, underscoring the importance of careful participant selection.

Purposive and convenience sampling techniques were used to select participants (32 males and 32 females) staying alone. According to (2011), in a purposive selection process, the researcher selects the sample based on who they believe would be suited for the study. Purposive sampling (single student occupants) was used to reduce or eliminate any statistical mistakes that could alter the conclusions of the study's results and findings, such as cross-contamination of the bed linen by roommates, which can lead to wrong conclusions. The participants were asked to ensure they slept on the bed linen alone throughout the study.

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Materials

Sixty-four (64) pieces of bed linens (bed sheets 55'' by 92'' and pillowcases 27'' by 18'') in two distinct fabric kinds (32 pieces of 100% cotton and 32 pieces of cotton and polyester blend 65% polyester / 35% cotton) were bought from the market. These two kinds of bedding were chosen because they are widely available and utilised mainly by individuals. Nutrient agar (NA), Eosin Methylene Blue (EMB), Plate Count Agar (PCA) and Potato Dextrose agar (PDA) were used to cultivate and enumerate the microorganisms from swab sticks.

Data Collection Instruments

A test tube was used to store water for sterilisation.
A colony counter was used to estimate the liquid culture's density of microorganisms by counting individual colonies on the agar plate.
An incubator was used to support the growth and maintain *microbiological* cultures or cell cultures.
Petri dish was used to grow the microorganisms in the sample.
Sterilised swab sticks with tubes were used to pick specimens from the bed linens samples for testing.
An autoclave was used to sterilise water in the test tube for culturing.

Data Collection Procedure

The data collection process spanned three months.

Labelling of samples

Labels for Bed linens

Before treatment was assigned, the participants' bed linens were tested for any microbial load to determine whether there were any microbes. Labels were assigned to the bed linens for easy identification.

Labels for Petri Dishes

The Petri dishes were labelled using the same procedure as the bed linens for easy identification.

Media and Media Preparation

Nutrient Agar (NA)

11. 2g of dehydrated Nutrient Agar was suspended in 400 ml of distilled water in a 500 ml conical flask. The agar was melted in a microwave to dissolve in the solution. The conical flask was corked tightly with cotton and wrapped with aluminium foil. This quantity was prepared for each treatment as the same sample size was used in all the treatments.

Eosin Methylene Blue (EMB) Agar

14.38g of dehydrated EMB Agar was weighed on a balance and suspended in 400 ml of distilled water in a 500 ml conical flask. The agar was melted in a microwave to dissolve in the solution. The conical flask was corked tightly with a cotton plug and wrapped with aluminium foil. (This quantity was prepared for each treatment).

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Plate Count Agar (PCA)
9.4 g of the Plate Count Agar was weighed and suspended in 400 ml of distilled water in a 500 ml conical flask. The agar was melted in a microwave to dissolve entirely in the Solution. The conical flask was corked tightly with a cotton plug and wrapped with aluminium foil. (This quantity was prepared for each treatment).

Potato Dextrose Agar (PDA)
15.6g of the dehydrated PDA war weighed on a balance and suspended in 400ml of distilled water in a 500ml conical flask. The agar was melted in a microwave to dissolve in the solution. The conical flask was corked tightly with a cotton plug and wrapped with aluminium foil. (This quantity was prepared for each treatment).

Specimen Collection and Testing Procedures
Isolation and Culturing
Bed linens
For testing the bed linens, sterile swab sticks moistened in normal saline were used to pick specimens from them. The swab sticks were immediately transported in a refrigerated box to the laboratory for microbial analysis. The bed linens were swapped after a week and two of usage.

The pour plate method was used to isolate and cultivate the samples. Three hundred eighty-four (384) test tubes were filled with 9 ml of distilled water each. The test tubes were then corked tightly with a cotton plug and wrapped with aluminium foil. The media prepared, the 384 test tubes containing the distilled water, and a pipette rack containing pipet tips were autoclaved in a YX—24LM Eoral pressure steam autoclave for 15 minutes at 121°C.

One sterile culturing swap stick was dipped in sterile distilled water and swapped on the bed linen. The swab stick was dipped back into the sterile distilled water and swapped again on the bed linen. This process was repeated about 4 times on each bed linen (Swaps were taken from different portions of the bed linen). Specimens were taken from the rest of the bed linens using the same process.

The Petri dishes were labelled with the names of the media and the labels on the bed linens. According to the labels, 1 ml of each specimen was pipetted into the various dishes. The various media were soft melted, poured into the Petri dishes, and swirled to mix properly with the specimen. After solidifying, the Petri plates were packed and incubated for 24 to 72 hours.

After incubation, developed colonies on the plates were counted and recorded. Colonies were recorded as total bacteria count (CFU/ml). After the specimens had been taken from the bed linens, those with microbes were disinfected with Clorox's hydrogen peroxide cleaner and disinfectant to ensure they were free from microbes before assigning treatment. The labelled samples were given to each volunteer in each group (male/ female) to be used for a period based on the groupings (1 week/ 2 weeks), and each packaged sample was kept in a disinfected

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sack and transferred to the lab for testing. The duration for data collection was eight weeks, and participants were to use the bed linen alone and package them in the bags they came in after usage to make collection easy and avoid cross-contamination.

Data Analysis

Readings were recorded for microbial load. The statistical software used to analyse the data collected was the Statistical Package and Service Solution (SPSS) for Windows version 26. Means and standard deviations of the microbial load of bed linens were determined. Inferential statistics (independent samples t-test and analysis of variance) were employed to determine if differences existed between and among the variables studied.

Ethical Considerations

Before commencing this study, ethical approval was sought from the Institutional Review Board, University of Cape Coast (UCC, IRB). The researchers sought the participants' consent, informed them about the nature and purpose of the study, and guaranteed the confidentiality and anonymity of the information acquired. Participation in the research was, therefore, voluntary. Those who were purposively or randomly selected but unwilling to participate in the study were allowed to withdraw.

RESULTS AND DISCUSSION

Demographic information of participants

The study utilised a sample size of 64 participants, consisting of 32 males and 32 females, all of whom were regular undergraduate students at the University of Cape Coast. The participants' ages ranged from 18 to 28 years. Since gender was one of the variables of study, an equal gender distribution was ensured to allow for a balanced representation of male and female students, enabling an analysis of the impact of gender on microbial levels in bed linens.

Differences between period usage (a week and two weeks) to microbial load of bed linens

Results in Table 1 indicate that there was no statistically significant difference in microbial load of bed linen used by students for periods of usage for one week and two weeks for both E. coli (t= -.202, df= 62, p= .903) and Klebsiella aerogenes (t= .417. df=62, p= .787) respectively. However, a look at the mean values presented in Table 1 shows that for both E-coli and Klebsiella aerogenes, the load increased slightly with the 2-week samples.

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Table 1: Mean, Standard Deviation, P-value, and T- values for Bacteria load by Period of Usage

Bacteria load	Period of usage	M(c/fu)	S.D	Df	*t*- value	*p*- value
E. coli	1 week	0.6128	1.32999	62	-.202	.903
	2 weeks	0.6784	1.26760			
Klebsiella aerogenes	1 week	1.0563	1.35814	62	.417	.787
	2 weeks	0.9175	1.29976			

The independent samples *t-test* in Table 1 showed no significant difference in the usage period (one week and two weeks) on the microbial load of bed linens used by students. Therefore, the researchers failed to reject the null hypothesis, which states that there is no statistically significant difference in the microbial loads of bed linens to the usage period. The results are dissimilar to Hales (2022). He observed that fungus and bacteria grow in bedding and linens over time, and there will be 24,631 times more bacteria than in the restroom doorknob in a week.

The finding contradicts Hyde (2021), who found a significant difference. His findings showed that after one week, pillowcases and sheets contained between three million and five million CFUs (colony-forming units) per square inch. By the fourth week, both areas of bed linen had almost 12 million CFUs. Additionally, bedsheets had more germs after one week than a restroom doorknob, which increased to more germs than a pet toy in just two weeks (Knight, 2022). The significant difference observed in their finding could result from the different participants used since the sample for these studies might be households with children and probably an animal as a pet. This study's finding, therefore, might be the first to establish that no difference exists in the microbial load found on bed linens in the school setting in terms of duration of usage for a week or two.

Differences between genders (male and female) in microbial load of bed linens used by students

The results in Table 2 show that there was no difference in microbial load in relation to gender of the user for both E. coli (*t*= .983, df =62, p= .178) and Klebsiella aerogenes (*t*= -1.001, df= 62, p= .293).

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Table 2: Mean, Standard Deviation, P-value, and T- values for Bacteria load by Gender of User

Bacteria type	Gender	M (c/fu)	S.D	Df	*t*- value	*p*- value
E. coli	Male	0.4872	1.15251	62	.983	.178
	Female	0.8041	1.41343			
Klebsiella aerogenes	Male	0.8216	1.18086	62	-1.001	.293
	Female	1.1522	1.44747			

The independent samples *t-test* results in Table 2 showed no significant difference in the microbial loads of bed linens used by male and female students. The finding does not support studies conducted, such as those by Smith, O'Driscoll, and Lamb (2020), which showed that bacterial levels on garments worn by male operators are almost always over those worn by females at all tested sites. Ying et al. (2015) also confirmed that males have a higher bacteria load, which is higher because they have greater sebum secretion that remains stable as they age. Surprisingly, scrutiny of the mean values in Table 4 shows that female bed linens reordered slightly higher loads for microbes than males in this study. The differences identified in previous studies and that of the current study could be because of the population used. The population used in the current study is tertiary students with excellent knowledge of personal hygiene.

Differences between fabric types (100% cotton and Cotton/polyester blend) to microbial load of bed linens used by students

Table 3 indicates a statistically significant difference in microbial load concerning fabric type for E. coli (*t*= 1.309, df =62, p= .004). A comparison of the mean scores presented in Table 3 revealed that 100% cotton had a higher bacteria load (M=3.5556, SD= 0.95795) than the cotton/polyester blend (M=2.8784, SD= 0.82400). In addition, the study found that there was a statistically significant difference in microbial load for Klebsiella aerogenes concerning fabric type (*t*= 1.235, df =62, p= .000). A comparison of the mean scores presented revealed that 100% cotton (M=3.4209, SD=0.92791) had a higher bacterial load than cotton/polyester blend (M=2.8059, SD= 0.76824).

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Table 3: Mean, Standard Deviation, P-value, and T- values for Bacteria load by Type of Fabric

Bacteria load	Type of fabric	M (c/fu)	S.D	Df	*t*- value	*p*- value
E. coli	100% cotton	3.5556	.95795	62	1.308	.004
	C/P blend	2.8784	.82400			
Klebsiella aerogenes	100% cotton	3.4209	.92791	62	1.235	.000
	C/P blend	2.8059	.76824			

The microbial load difference for the two fabric types was compared for both E. coli and Klebsiella aerogenes (Table 3). The study found a statistically significant difference in both E. coli and Klebsiella aerogenes for both 100% cotton and cotton/polyester blend. A comparison of the mean scores in Table 3 revealed that 100% of cotton had a higher E. coli and Klebsiella aerogenes cotton/polyester blend. This shows more bacteria load in the 100% cotton fabric than in the cotton/polyester blend. The study confirms the findings of Gao and Cranston (2008), which showed that natural fibres can provide nutrients and energy sources for microbes in the form of carbohydrates or proteins. This is because they tend to have high moisture retention properties, and their polymer linkages can be more easily gained access to by microbial enzymes, as Gupta and Bhaumik (2007) asserted. 100% Cotton had a higher microbial load because it is a vegetable fibre which can serve as a nutrient source for microbes. The cotton/polyester blend had a lower bacteria load as compared to the 100% cotton because the blend has some presence of synthetic fibre, which is the polyester and microbial enzymes tend not to be able to break synthetic carbon linkages due to their hydrophobic nature and poor adsorbing capacity (Siracusa, 2019; Gao & Cranston, 2008; Pathak, 2017).

The findings again confirm studies by Gopalakrishnan and Nithiyakumar (2008) and Gopalakrishnan (2016), which showed that cotton has properties such as porosity, absorbency and high heat conductivity. Most studies have shown textile surfaces exhibiting a potential role in microbial adhesion and transfer (Bajpai et al., 2011), and cotton is one of them. Cotton's absorbency and moisture come from the fibre's surface, which strongly attracts water. According to Oh et al. (2018), microorganism interaction with textiles is based on various factors, such as the type of microorganism, surface characteristics of the textile, and environmental factors (physical and chemical). The higher microbial load on 100% cotton can be attributed to these properties since microbes must adhere to a surface and grow on some nutrients, moisture and temperature.

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Influence of Gender, period of usage and fabric type on the microbial load of bed linens used by students

The result presented in Table 4 shows no significant influence of the three independent variables combined on the dependent variable, microbial load (p= .516).

Table 4: 3-Way Analysis of Variance on the Influence of Gender, period of usage and fabric Type on the microbial load of Bed linens used by Students.

Source	Type III sum of squares	Df	Mean (c/fu)	F	*P*-value
gender * perio-dofusage	.002	1	.002	.001	.973
gender * typeoffabric	.397	1	.397	.228	.635
periodofusage * typeoffabric	1.501	1	1.501	.861	.357
gender * perio-dofusage * typeof-fabric	.744	1	.744	.427	.516

The 3-way analysis of variance results (Table 4) shows that the three independent variables (period of usage, gender and type of fabric) combined had no significant influence on the microbial load of bed linens used by students. The finding was consistent with the null hypothesis, so the researcher failed to reject the null hypothesis. None of the reviewed works examined the interaction of gender, usage period and fabric type on the microbial load of bed linens. Therefore, no comparison could be made with the reviewed literature. This study could be the first to determine that there is no significance in the influence of period of usage, gender, and fabric type on the microbial load of bed linens used by students.

CONCLUSION

The study revealed that the bed linens of students could harbour microbes. Also, new bed linens can contain varying microorganisms and will increase after usage. There was no statistically significant difference in the microbial load of bed linens used by students in terms of the period of usage or the gender of the user. Conversely, there were statistically significant differences in microbial load based on the type of fabric used for the bed linen. There was more bacteria load on 100% cotton bed linen than cotton/polyester blend. However, the interaction of the period of usage, the gender of the user and the type of fabric do not influence the microbial

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African Journal of Applied Research
Vol. 11, No. 1 (2025), pp. 84-100
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load of bed linens used by students. The microbial load on used bed linens contained more than 10^5 CFU/ml or 2.5 cfu/cm of microbes, deemed too high to cause health issues and raise concerns. Users of bed linens need to wash new ones when they purchase them. Frequent washing of bed linens is also advisable to prevent an increase in microbial load, which can cause infections.

Implications For Research, Practice, and Society

By exploring the microbial content of bed linens used by students, the research findings can positively impact research methodologies, practical guidelines, and societal well-being. The study outcome demonstrates the value of combining microbiology, textile science, and public health perspectives. It can help develop evidence-based policies for public health organisations, student housing, and University laundry services. Textile manufacturers may use the results of this study to create bed linens that have been treated with antimicrobials. In addition, the research findings will help educate students about the value of maintaining clean bed linens. They would encourage them to practice good hygiene, improving their health by lowering microbiological transmission through bed linens and curbing the spread of illnesses.

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