

Bacteriuria Investigation among Female Cohorts in Community Healthcare Facility

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ABSTRACT

Bacteriuria is the indication of bacteria in the urine which has currently been reported to affect about one hundred and fifty (150) million people worldwide, each year, either presenting as symptomatic or asymptomatic cohorts. Asymptomatic cohorts generally do not indicate symptoms as against their symptomatic counterparts. This prevents the infections in the former group to be recognized and given the appropriate attention. The symptoms that may be presented by an infected individual serve as the primary indicator of an infection. Women are three times more likely to develop urinary tract infections compared to their male counterpart due to their natural anatomical structure and certain activities they go through as part of their bodies' make-up such as narrower urethras, sexual activity, pregnancy, distance between faecal flora passage and the urinary tract and sometimes rapid hormonal fluctuations. The purpose of this study was therefore to determine the prevalence of asymptomatic bacteriuria in females. A cross-sectional study design was employed where fifty (50) participants were recruited from a health center in one of the suburbs in the Kumasi Metropolis. The study involved administration of pre-tested questionnaires and the collection of mid-stream urine samples from participants to conduct macroscopic and microscopic investigations. A large proportion of forty-six percent (46%) of the females recruited for the study presented asymptomatic bacteriuria with ages between fourteen and nineteen (14 and 19), indicating the highest risk. This could result in some unhealthy practices, which were established to be carried out by the participants recruited for the study such as douching, poor sanitary pad modification, and a general disdain for hygiene norms among this age group. It is therefore recommended that appropriate fora be established for education against these practices and awareness on the causes and effect of Urinary Tract Infection (UTI) be created.

Keywords: Bacteriuria, Asymptomatic, Healthcare, Females and community

1.0 INTRODUCTION

Bacteriuria is one of the common infections that are normally associated with women. This can present symptoms where the individual is referred to as Symptomatic. On the contrary, there may be no symptoms at all where the individual is referred to as Asymptomatic (Crader et al., 2023). The urinary tract infection that causes symptomatic bacteriuria is often caused by a single organism (Price et al., 2016). These may result in cystitis and prostatitis which

are considered as the lower urinary tract infections (UTIs), whereas pyelonephritis and pyonephrosis constitute the upper UTIs. Because the bacteria that cause these infections can be isolated from healthy individuals, most UTIs are regarded as uncomplicated (Ngong *et al.*, 2021). However, People with these same infections that exhibit symptoms can result in complications which may sometimes be deadly. This situation may sometimes create fear and panic when infected individual fail to respond to therapy as the treatment regime has been appropriately designed (Yun *et al.*, 2024). These are frequently observed in individuals with urinary tract abnormalities or obstructions of the urinary tract, immunocompromised individuals among other underlying conditions (Drekonja *et al.*, 2021). In case bacteriuria results in UTI, an individual's vital organs such as the kidney, bladder and the urethra may be affected leading to pyelonephritis, cystitis, and urethritis respectively (Flores-Mireles *et al.*, 2015). Uropathogenic *Escherichia coli*, which is a gram negative, rod-shaped facultative anaerobe is considered as the primary bacteria in the case of urinary tract infections, accounting for 75% of cases (Chan and Lewis, 2022). However, studies conducted in Ghana, Nigeria, and China have identified other bacteria, such as *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Proteus mirabilis*, and *Enterococcus faecalis*, as culprits for bacteriuria. (Yuan *et al.*, 2021). A study conducted in Ghana indicated 9.9 % bacteria growth, after a urinalysis was carried out among asymptomatic prenatal UTI cohort (Asafo-Adjei *et al.*, 2018). UTIs or bacteriuria in asymptomatic individuals, without given attention can result in functional abnormalities in the urinary Tract anatomical structure, which may sometimes end up in renal failure and the indication of calculi (Woolf and Ashley, 2022). The burden of UTI though subtle, have huge negative impacts on an individual and generally, the economy, resulting in an undesirable quality of life (Naber *et al.*, 2022). It is estimated that, in the United States, recurrent burden of UTI as a result of bacteriuria on the economy is more than \$ 5 billion annually (McCann *et al.*, 2020). Considering the fact that, the lower urinary tract where urine is excreted serves as the primary habitat for bacteriuria, urine should be regularly screened in order to actively disrupt the biofilm process within the habitat and ultimately prevent the burden of the bacteria. (Amar *et al.*, 2023).

High prevalence of bacteria infections are mostly recorded in the sub-Saharan Africa; Ghana is not an exception. This may hugely be due to absence or limited opportunities for screening, health education and awareness, coupled with irregular attendance to hospital in case of ill health (Melariri *et al.*, 2024). Individuals with asymptomatic status are not diagnosed at all or may be diagnosed when they are critically ill or at the later stage when other conditions have set in (Hanmer *et al.*, 2019). Though uncomplicated UTIs may be mild and sometimes short-lived, if left untreated at the early stages, they can result in complications (Tan and Chlebicki, 2016). This may lead to conditions such as hypertension, renal scarring, and end up in renal diseases which may be life threatening (Geerlings, 2016). Early screening and urinalysis are therefore encouraged in order to prevent the burden of urinary tract bacteria and urinary tract infections. Therefore, the goal of this study was to assess the frequency of asymptomatic bacteriuria and its underlying causes among female patients who visited a medical facility in a Kumasi suburb.

2.0 MATERIALS AND METHODS

2.1 Study Site

The study was carried out in a well-resourced microbiology laboratory within a community-based hospital in the Kumasi Metropolitan Area. An estimated population of 191,402 (GSS, 2021) from a major Municipal District in Ghana is served by this healthcare facility. An initial survey conducted established that approximately, hundred (100) adult females visit the facility seeking for healthcare monthly. The medical facility is situated in the heart of Kumasi, the second largest and populous city in Ghana which provides 24-hour service to its clients. It's robust state of the art equipment and laboratory facility makes the place the right choice for individuals seeking medical attention.

2.2 Sample Size

The sample size was determined using Cochran's sample size estimation formula, taking into accounts the number of women visiting the facility during the study period, as well as the inclusion and exclusion criteria.

Cochran Sample Size Determination formula

$$n = \frac{Z^2 * P(1-P)}{e^2} \div \frac{1+Z^2 * P(1-P)}{e^2 * N}$$

Where: n = sample size

Z α = Z score of the Gaussian distribution

N = Study population

P = Percentage proportion or prevalence

e = Margin of error (precision level)

Z = 95 = 1.96, P = 0.5, e= 0.05, N = 100

$$n = \frac{1.96^2 * 0.5(1-0.5)}{0.05}$$

$$\frac{1+1.96^2 * 0.5(1-0.5)}{(0.05)^2 * 100}$$

$$n \text{ (sample size)} = 50$$

2.3 Sample Collection

Ten milliliter (10 ml) of an early-morning clean catch mid-stream urine samples were collected from fifty (50) participants who were recruited for this research. These were recruited out of population of females seeking medical care from the health facility where the study was carried out after informed consents were sought from them. Female study participants were given questionnaires to complete in order to gather data on their demographics, hygiene status (including menstrual behaviour, pad use, bathing habits, and douching), and featured in the correlation analysis. Samples were collected into a sterile universal container for bacteriuria analysis. Before the participants were made to provide the samples, they were taken through the ethics of the research and the appropriate aseptic protocols on the collection of the urine

samples. Samples were appropriately labelled after collection and analyzed immediately without delay at the microbiology section of the facility.

2.4 Laboratory Investigation

Urine samples were preliminarily analyzed for bacteriuria and for that matter UTI by using COMBI 10 urine test strips. This was carried out immediately after sample collection. According to the manufacturer's instructions, each strip was dipped in the urine sample and observed. A positive test for leukocyte esterase and/or nitrite is usually indicated as the presence of bacteriuria and a negative test is indicated for the absence of bacteriuria. After the primary macroscopy with COMBI 10 screening, microscopy was conducted. Five milliliters (5ml) of well mixed urine was centrifuged to concentrate its substances at the bottom of the tube. The supernatant was discarded leaving the sediment after the centrifuge. The sediments were then microscopically observed for pus cells, epithelial cells and other motile bacteria presence.

2.5 Ethical Consideration and Inclusion Criteria

2.6. Permission for the study was sought from the health facility before embarking on this research, though, it indicated to researchers that, the medical facility, together with their clients' details should not be disclosed before, during and after the research. The research team conducted a focus group discussion with those recruited for the study. They were taken through the import of the research. They were assured of the high-profile confidentiality of their bio-information. Under no circumstance would they be required to provide their names or any sensitive information that will result in tracer study to any field personnel, technician or any of the research team. Opting out was optional and easy, and that only those who consented to be roped into the study were involved. Only females from age fourteen (14) years, who sought medical care at the facility at the time the research was been conducted, were considered as cohort for the study.

2.7 Statistical Analysis

Data generated from the laboratory investigations were inputted in Statistical Package for Social Sciences 20 (SPSS) version 22 and Excel data sheet through which analyses were conducted. Outputs were presented in the form of figures, tables, charts and graphs with their descriptive statistics.

3.0 RESULTS

3.1. Socio-Demographic Outcomes of Respondents

The established information on demographic characteristics include age, marriage, educational, and occupation status is indicated in Table 1.

Table 1: Demographic Information of Respondents

Parameter			Percentage (%) Frequency
Age Range (yrs.)	14-19		22 (44%)
	20-25		9 (18%)
	26-31		10 (20%)
	32-37		8 (16%)
	38-43		1 (2%)
Marital Status	Single		41 (82%)
	Married		9 (18%)
Educational Background	No education		10 (20%)
	JHS		18 (36%)
	SHS		15 (30%)
	Tertiary		7 (14%)
Occupation	Student		33 (66%)
	Teaching		2 (4%)
	Trading		15 (30%)

3.2 Macroscopic Urinalysis

Macroscopic Urinalysis Investigation indicated in Figure 1.

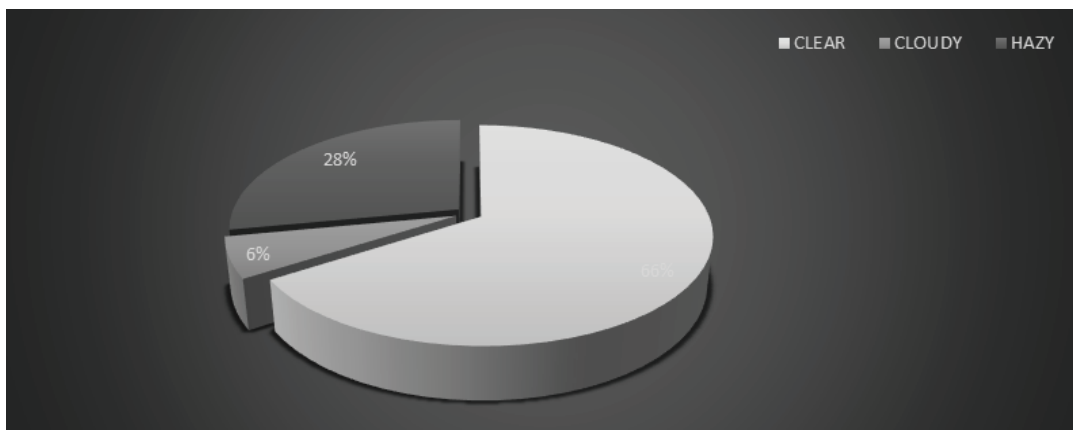


Figure 1: Outcome of macroscopic analysis of urine

3.3 Distribution of Leukocytes among Respondents

Leukocytes distribution trends among the fifty (50) asymptomatic female respondents indicated in figure 2.

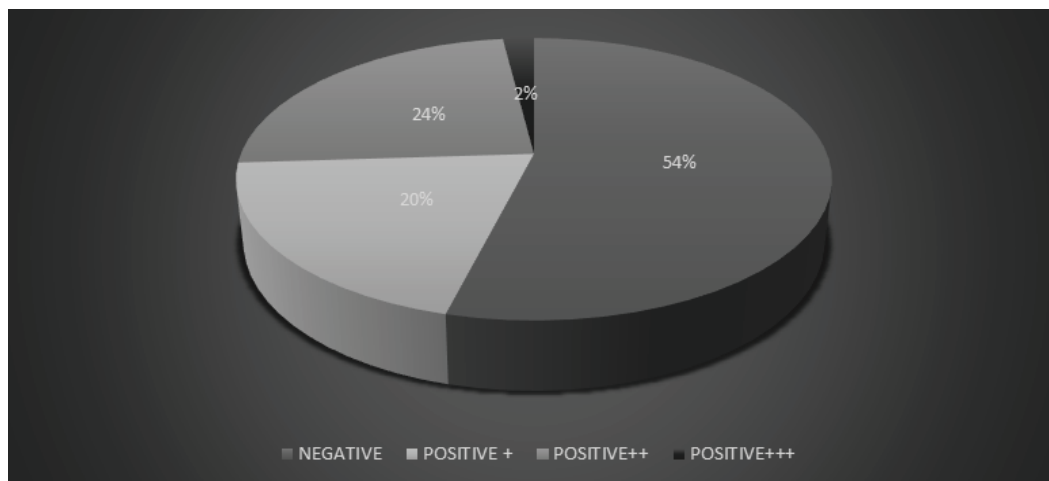


Figure 2: Leukocytes distribution in asymptomatic female respondents

Red Blood Cells (RBC’s) Distribution and Ph Levels in the Urine Samples of Respondents

Macroscopic and microscopic investigation revealed the following trends of pH and RBC distribution of respondents (Table 2).

Table 2: Descriptive Analysis of the mean, median, modes and Standard deviation of the pH and RBC of the Respondents

Variable	Mean	Median	Mode	Standard deviation
pH	1.16	6	5	1.04
RBC	1.84	0	0	5.41

3.4 Level of Nitrite in Urine of Respondents

Figure 3 indicates the outcome of the levels of nitrite among the asymptomatic female respondents involved in the study.

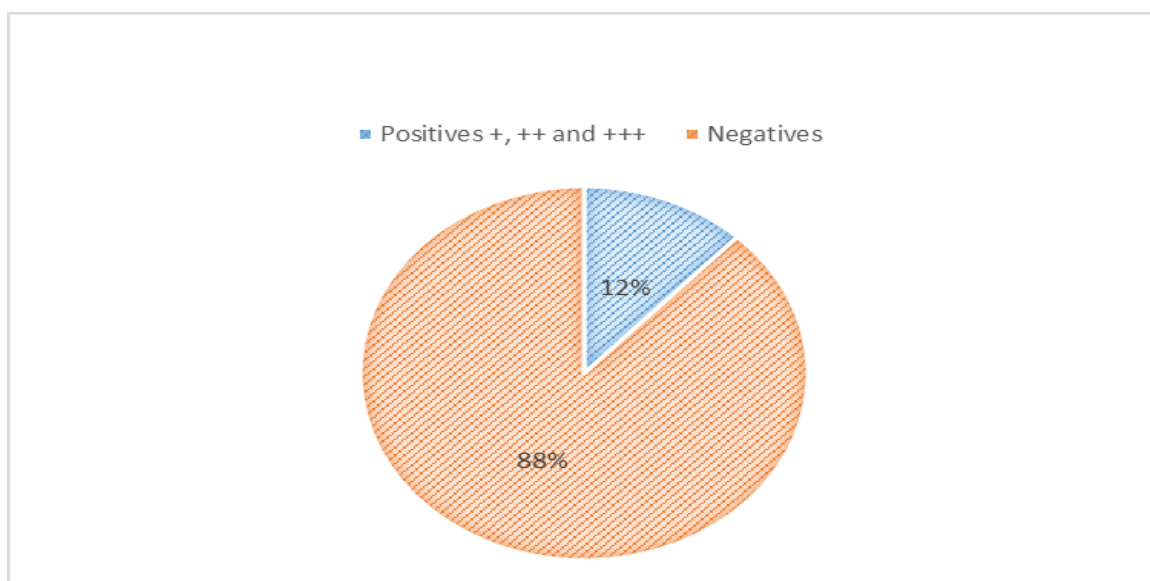


Figure 3: Levels of Nitrite in Asymptomatic Bacteriuria females

3.5 Distribution of Pus Cells and Leukocyte Esterase (LE) among Respondents

The measure of the number of Leukocyte Esterase (LE) counted in high-power field (HPF) and the number of Pus Cells among the respondents indicated in Table 3 as means, median, mode with the standard deviation.

Table 3: Descriptive Analysis indicating the mean, median, mode and Standard deviation of the number of leukocytes esterase and Pus cell Distribution of Respondents.

Variable	Mean	Median	Mode	Standard deviation
Pus cells	8.02	5.50	3	5.74
LE	5.98	3.50	2	5.43

3.6 Personal Hygiene Pattern of Respondents

Displayed in Table 4, indicates hygiene pattern of the respondent during menstruation.

Table 4: Hygiene Behavioral Pattern of Respondents

Parameters		Percentage (%)	Frequency
Menstrual Status	Menstruating	3(6)	
	Not menstruating	47(94)	
Pad Changing Pattern	(0-5) hours	16(32)	
	(5-10) hours	15(30)	
	(10-15) hours	19(38)	
Douching Behaviour pattern	Yes	50(100)	
	No	0	

3.7 Percentage Frequency of Pad and Douching status in relation to age range

Results indicating the percentage frequency of douching status in relation to age range represented in Table 5.

Table 5: Age Range Per Percentage Frequency of Hygiene Practice (Douching)

Age range	Percentage (%) frequency of Douching
14-19	20(40)
20-25	13(26)
26-31	8(16)
32-37	6(12)
38-43	3(6)

3.8 Results indicating age range per percentage frequency of hygiene practice (Pad changing) within a specific time range in hours represented in Table 6.

Table 6: Age range per percentage frequency of hygiene practice (Pad changing) within a specific time range in hours

Age range	Percentage (%) Frequency of Pad changing with time duration		
	(0-5) hours	(5-10) hours	(10-15) hours
14-19	4(8)	6(12)	12(24)
20-25	2(4)	6(12)	6(12)
26-31	4(8)	2(4)	1(2)
32-37	3(6)	1(2)	0
38-43	3(6)	0	0

3.9 Correlation Analysis of Personal Hygiene Status

The outcome of correlation of personal hygiene practices of Respondents was established in Pearson correlation analysis in Table 7.

Table 7: Correlation of Hygienic of practices of Respondents

		Bath	Pad Changing Behavior	PH	RBC
Bath	Pearson Correlation	1	-0.173	0.111	-0.124
	<i>P-values</i>		0.228	0.442	0.392
	N	50	50	50	50
Pad changing	Pearson Correlation	-0.173	1	0.463**	0.387**
	<i>P-values</i>	0.228		0.001	0.005
	N	50	50	50	50
PH	Pearson Correlation	0.111	0.463**	1	0.166
	<i>P-values</i>	0.442	0.001		0.251
	N	50	50	50	50
RBC	Pearson Correlation	-0.124	0.387**	0.166	1
	<i>P-values</i>	0.392	0.005	0.251	
	N	50	50	50	50

4.0 DISCUSSION

Asymptomatic bacteriuria can potentially lead to Hospital-Acquired Infections (HAIs), particularly; Urinary Tract Infections (UTIs) which may progress to become symptomatic, commonly found in HAI. In other cases, indwelling urinary catheters increase the risk of bacteriuria and subsequent UTIs (De Simone *et al.*, 2021). This study, through its investigations observed some levels of leucocyte esterases and nitrites in the urine samples collected for

the study indicating bacteriuria, therefore, UTI among these cohorts. Though culture was not conducted to further investigate the particular organisms, research indicates that bacteria from the urinary tract can enter the bloodstream and can also colonize surgical sites leading to sepsis or bacteremia and post-operative infection, respectively, if attention is not given (Vierra *et al.*, 2024). In this current investigation, the outcome revealed that teenage females are likely to indicate the highest rate of markers for asymptomatic bacteriuria than those advanced in age (Edwards *et al.*, 2023), therefore, more likely to develop bacteriuria and subsequently UTI which agrees with the study conducted by Abu *et al.* (2021). The reason could be linked to the fact that they tend to be more sexually active, with the majority of teenagers having several sex experiences (Irwin and Shafer, 2021). This therefore indicates that understanding of bacteriuria and for that matter, UTIs through investigations such as this current study is essential to the public and must be encouraged (Mansfield *et al.*, 2022). Minimal markers of bacteriuria or UTI were observed to occur among women who are in their early forties which may suggest that they may have some education before or life experiences and could be much more careful as opposed to the teenage cohorts (Advani *et al.*, 2024). According to a similar research conducted in Nigeria, about 30% of teenage girls screen positive to UTI, which is an indicative of a high prevalence of UTI, and this was attributed to improper hygiene practices and ignorance (Eremenko *et al.*, 2020). In this study, douching was quite common among the teenage girls who were found to be so ignorant about the consequences of the act of douching. Research reports on this practice have indicated that douching in any form exposes the female to different kinds of infections, which may result in serious complications (Peterkio and Albert, 2015). During focus group interactions with the females recruited for the study, it was realized that about one-third believed that douching serves as a means to take away odour, stop pregnancy among others which fit into a research outcome by (Graziottin, 2024). This research outcome indicated less frequency of female within the lower age group involving in keeping the same sanitary pad for a prolonged period before changing (Achuthan *et al.*, 2021). Majority in the category were noticed to change their sanitary pad in the evening hours, probably during bathing hours (Jayaraj and Sinha, 2020). In no doubt, this may be a marker for development of odour and the proliferation of bacteria in the surroundings of the vagina increasing the chance of bacteriuria and UTI (Eremenko *et al.*, 2020). The extent of hydration, a medical condition, urobilinogen and intake of certain medications are just a few of the numerous markers that can result in a noticeable abnormal urine colour of an individual (Kabugo *et al.*, 2016). With the application of macroscopic investigation, more than half of the investigated cohort samples revealed normal urine appearance suggesting no visible abnormalities and low likelihood of infection or inflammation. However, this could be attributed to other factors early on evaluated (Mantula, 2021). One-third of the cohorts indicated turbid or opaque urine appearance, suggesting the presence of bacteria, leukocytes, or epithelial cells and therefore the probability of urinary tract infection which is in tandem with another study conducted by Van, (2022). This could also be a marker for inflammation or infection in the kidneys or urinary tract with high pH levels leading to acute or chronic UTI (Herrera-Espejo *et al.*, 2024). Among the last 10% of the cohort recorded slightly cloudy or murky urine appearance reflecting mild infection or inflammation as a result of probably few presence of bacteria, leukocytes, or epithelial cells, early stages of UTI or kidney disease (Cashy *et al.*, 2020). There are variations in similar studies in relation to asymptomatic bacteriuria, some results revealed significant deviations from the norm in the appearance of the urine, which may be related to dehydration or an existing infection or bacteriuria

(Amaeze *et al.*, 2013). The primary role of leukocytes is to fight infections, and in the case of UTI, leukocytes perform admirably (Chlebowski, 2022). Leucocyte and nitrite chemistry in this research findings were both in elevated levels. Enterobacteria in bacteriuria transform urine's nitrate into nitrites. Nitrite levels that are positive in the urine are both suggestive and conclusive of bacteriuria (Liou *et al.*, 2017). It may also be inferred that the body is battling an infection in the bladder or urethra resulting in rise in pus cells during microscopic examination of the urine. This therefore confirms a study conducted in Kumasi indicating an increase in pus cells during bacteriuria (Abubakari *et al.*, 2016). It was discovered through the correlation analysis of the different variables that bathing had a negative association with RBC count. This shows that the amount of red blood cells found in the respondents' urine lowers when regular bathing was done to enhance hygiene status (Sitkowski *et al.*, 2022). Bathing is regarded as a fundamental step in the prevention of bacteria development in and around the genitals (Goto *et al.*, 2018). The correlation between pad modifications and pH also turned out to be beneficial in the sense that hygienic practice during menstruation is routine sanitary pad replacement (Madhu and Patel, 2024). Regular sanitary pad change raises the vaginal pH, making the area around it more acidic. The vagina's acidity acts as a bacterial defense since most bacteria cannot thrive in an acidic environment (Al-Mugdadi *et al.*, 2022). Females are encouraged to routinely bath and replace their sanitary pads at intervals possible in order to keep a healthy vagina and get rid of bacteria, and for that matter, bacteriuria and it's related challenges (Haya *et al.*, 2014). With the knowledge and experiences gathered, one may want to further state that, more education on the awareness of the relationships between these markers and acute and chronic infections should be advanced especially to the teenage girls. Tailored hygiene practices should be discussed more often in schools, camps and workshorps. Since the female cohort of the human race especially within the Sub-Saharan Africa, predominately manages the affairs of the home, education should be enforced in any available space possible on their reproductive and personal hygiene to build a healthy society.

5.0 CONCLUSION AND RECOMMENDATION

5.1. Conclusion

General disregard for hygiene, as a result of douching, improper sanitary pad modification among others, contribute to prevalence of markers for bacteriuria and UTI conditions. These were observed more among the lower aged female cohorts as against the older cohorts.

5.2 Recommendation

Microscopic urinalysis and urine culture should be carried out to confirm infections. Further testing could be conduct such as imaging studies after urine chemistry, if necessary. Patient symptoms, medical history, and physical examination could also be conducted for specific findings and approvals. Futher research could be carried out, targeting wide range of cohort with representative sample size for comparative analysis. Finally, in an attempt to prevent the evolution of asymptomatic infection into a symptomatic UTI, routine screening and regular health education on the risk of asymptomatic infectious diseases should be carried out.

Authors Contribution

Mina Ofosu, Ruhiyat Shaibatul Hamdi and Daniel Odei were involved in the conceptualization and design of study, developing the research question, hypothesis, and study design.

Ruhyat Shaibatul Hamdi, Daniel Odei and Linda Opponbea Amoani were involved in data acquisition, sampling and questionnaire administration and experimental surveys.

Opoku Bempah, Solomon Wireko, Herbert Ekoe Danklivi and Abena Kyeraa Sarpong were involved in data entry, cleaning and initial analysis and interpretation.

Mina Ofosu, Ruhyat Shaibatul Hamdi and Daniel Odei were involved in drafting the manuscript.

All authors were involved in critical revision, final approval and consent for submission of manuscript.

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Informed consent statement

Informed consent were sought from the female participants recruited for the study as well as the health facility where the study was carried out. All aseptic protocols were duly followed.

Conflict of Interest

Authors declare no conflict of interest.

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