

**SCHOOL OF PUBLIC HEALTH
COLLEGE OF HEALTH SCIENCES
UNIVERSITY OF GHANA**



**ASYMPTOMATIC BACTERIURIA AMONG PREGNANT WOMEN
ATTENDING ANTENATAL CLINIC AT AKWAPIM NORTH
MUNICIPALITY**

BY

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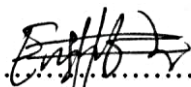
DECLARATION

I, Eli Dzandu, hereby declare that with the exception of cited references to other people's work which has been duly acknowledged, this work is the result of my own research work done under supervision and has neither been presented elsewhere either in part or whole for another degree.


.....

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DEDICATION

I dedicated this work to my family for their unflinching support and encouragement throughout my education. Their constant support is the result of this work.

ACKNOWLEDGMENT

I thank Almighty God for guiding me through this course successfully. Walder Emerson said, “T’ is the good reader that makes a good book”. I was fortunate to have Dr Ernest Kenu as my supervisor whose corrections, comments, suggestions and contributions greatly influenced the output of this work.

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ABSTRACT

Introduction: Asymptomatic bacteriuria (ASB) is a condition in which urine culture reveals the presence of more than 10^5 bacteria per millilitre but without the patient showing signs and symptoms of urinary tract infection (UTI). It is a common problem in pregnant women, which usually results in maternal and fetal complications. The objective of this study was to determine the proportion of ASB among pregnant women attending antenatal clinic at Akwapim North Municipality in the Eastern Region of Ghana.

Methods: A cross sectional study conducted between May-July 2019 at six selected health facilities in the Municipality. Routine urine examination was performed to screen for pregnant women and random sampling method was used to select the participants. In total, 134 participants who consented were part of the study. Sterile urine containers were given with instructions in order to produce urine specimens devoid from contamination. Urine culture was performed to identify bacteria present in the urine and sensitivity testing on the isolated bacteria was done.

Results: The age range of the participants was 17 years to 43 years with mean age of 29.9 years (SD ± 6.3). Permission was sought from the parents of the 17 year lady. Majority of the participant were in the age range of 25 years to 34 years and all the participants had basic education. Out of the 134 sterile urine samples cultured, 11 of the participants had bacteria isolated from their urine given a prevalence of 8.2%. *Escherichia coli* were 63.6%, Nitrofurantoin was 81.8% sensitive to all bacteria isolated and Cotrimoxazole was the most resistant antibiotics with 72.7%. Factors associated with ASB in Akwapim North Municipality were toilet facility, multiple pregnancy and any medical condition, which were statistically significant at the bivariate analysis level. After adjusting these factors with the multiple logistics regression, only multiple pregnancy was statistically significant.

Conclusion: The study revealed 8.2% prevalence of ASB among pregnant women with *E. coli* the predominate bacteria with 63.6%. Nitrofurantoin, 81.8% sensitive and Cotrimoxazole was the most resistant antibiotics with 72.7%. Multiple pregnancy were associated with ASB among pregnant women at Akwapim North Municipality.

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LIST OF ABBREVIATIONS

%	Percentage
<	Less Than
>	Greater Than
ANC	Ante-Natal Clinic
ASB	Asymptomatic Bacteriuria
C/S	Culture and Sensitivity
CBR	Crude Birth Rate
CFU	Colony Forming Unit
CLED	Cystine Lactose Electrolyte Deficient
CLSI	Clinical Laboratory Standard Institute
DHIMS	District Health Information Management System
<i>E. coli</i>	<i>Escherichia Coli</i>
GFR	General Fertility Rate
HIV	Human Immunodeficiency Virus
Kg	Kilogram
mL	Millilitre
PHC	Population and Housing Census
PROM	Premature Rupture of Membrane
RUE	Routine Urine Examination
rUTI	Recurrent Urinary Tract Infection
SD	Standard Deviation
SOP	Standard Operation Procedure
spp	Species
Sq.	Square
Staph. aureus	Staphylococcus Aureus
STI	Sexually Transmitted Infection
UV	Ultra Violet
TFR	Total Fertility Rate
ULAN	Unique Laboratory Assessing Number
UTI	Urinary Tract Infection
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Background

Asymptomatic bacteriuria (ASB) is a condition in which urine culture reveals the presence of more than 10^5 colony forming unite of bacteria per millilitre (CFU/mL) but the client showing no signs and symptoms of urinary tract infection (UTI) (Szweda & Jóźwik, 2016).

To Samuel, Victoria, and Ifeanyi (2016) it is recognised that bacteria greater than 10^5 CFU/mL of bacteria in the urine is significant whether the patient is asymptomatic or symptomatic. This is common during pregnancy and if untreated could lead to serious complications. Untreated ASB is an associated factor for acute cystitis (40%) and pyelonephritis (25-30%) in pregnancy (Nasiri & Muhi, 2019).

According to Whalley and Cunningham (2000), ASB accounts for about 2%-10% pregnancies in developed countries as compare to the condition that is much more in under-developed and developing countries. ASB is a major risk factor for developing UTIs during pregnancy. The bacteria's toxins initiate a complex immunological, endocrinological and biochemical processes that result in an adverse maternofoetal outcome (Rao, Venkatesh, & Rao, 2018).

Early study by Scott et al (1990) revealed that the apparent reduction in immunity of pregnant women appears to encourage the growth of both commensal and pathogenic microorganisms. During pregnancy, there is physiological increase in plasma volume and the decrease in urine concentration up to about 70% that developed glycosuria which

encourages bacteria growth in the urine (Ortega-González & Castro-Diaz, 2014). Again, in their study, although all women are prone to the development of UTIs, pregnant women are at increased risk, this is because of the numerous changes in the woman's body that are caused by pregnancy. In support of Ortega-González and Castro-Diaz (2014) findings, Samuel et al. (2016) also came out that pregnant women have hormonal and anatomical changes that contribute to ureteral dilatation and urinary stasis. These changes include shortness of the urethra and difficulty with hygiene due to a distended belly that increases the frequency of UTI in pregnant women.

To Akerele and Gynaecology (2001), women with ASB show a variable degree of local urinary immune response. This is almost one third to half of elderly women with ASB having elevated antibody levels compared with non-bacteriuria women. Further findings of Akerele and Gynaecology (2001) revealed that ASB which is urinary cytokines have been shown to be more frequently present in women when become pregnant. In Africa, Ugbogu (2007) reported that the prevalence of ASB among pregnant women and their effect on the reduction in immunity has led to the increased of risk factors such as infection of the foetus.

In Ghana, Labi, Yawson, Ganyaglo, and Newman (2015) reported that the prevalence of ASB was associated with sexual activity during pregnancy, but not with sexual frequency. Labi et al. (2015) also disagree that urinary infection does not affect the foetus being carried but reported that the commonest organism isolated was *Enterococcus* spp, although the *Enterobacteriaceae* formed the majority of isolated organisms. Labi et al. (2015) also contended that nitrofurantoin was the antibiotic with the highest sensitivity to all the isolated organisms.

Blomberg et al. (2005) and Kirkham, Harris, and Grzybowski (2005) in their studies, mentioned that pregnancy increases the progression from asymptomatic bacteriuria which could lead to pyelonephritis and obstetric outcomes such as prematurity, low birth weight and higher foetal mortality rates. Blomberg et al. (2005) again added that the adverse effects of undiagnosed ASB on mother and child have made researchers to recommend routine urine culture for all pregnant women attending antenatal clinic to prevent mother and child from any form of complication that may arise due to infection.

Briefly, extensive work has not been done when it comes to ASB and its associated factors in the study area of Akwapim North Municipality. Therefore, the goal of this study is to screen for ASB and its antibiotic susceptibility patterns of the isolated bacteria among antenatal women that visited the health care facilities at the Akwapim North Municipality.

1.2 Problem statement

In spite of the much attention being given to antenatal screening, there is still an increase of urinary tract related infections among pregnant women in developing countries.(Villar et al., 2001). According to World Health Organization (WHO), every pregnant woman and her new-born should receive quality health care throughout the pregnancy, childbirth and the postnatal period. (Tunçalp et al., 2015)

Laboratory investigations play a pivotal role in delivering quality health care and these are to confirm diagnosis and give more detailed information on the state of the client (Cheesbrough, 2006a).

According to Etminan-Bakhsh, Tadi, and Darabi (2017), UTI is one of the medical conditions that affects both sexes, all ages but pregnant women are most vulnerable. To Gilstrap III, Ramin, and America (2001) it is the second common complications in pregnancy after anaemia. Pregnant women with ASB often do not show signs and symptoms, therefore usually go undiagnosed resulting in complications. This is because of the laboratory technique, which is routinely employed in diagnosing UTI (ASB) among pre-natal clients. Routine urine examination (RUE) is not sensitive and does not include bacteria culture and sensitivity. A review of the report of the antenatal attendance and cases at Akwapim North Municipality indicates urinary tract related complications among pregnant women in the municipality is still on the increase regardless of the many that go undetected.

From District Health Information Management System, (DHIMS) 2, in 2017, Ghana recorded 643,590 live births and pregnancy complications were 189,202. Maternal death and stillbirth recorded 948 and 9808 respectively. Babies born with birth weight less than 2.5kg was 60,999.

Regular screening with a more sensitive laboratory technique and treatment will reduce the incidence of bacteriuria and its consequences among pregnant women in the Municipality.

UTI is found in 2% of sexually active women and is more common up to 80% during pregnancy. According to Hagos et al (2015), this infection refers to persistent, actively multiplying bacteria within the urinary tract in asymptomatic women. Earlier study by

Garingalo-Molina (2000) also shows that the “prevalence depends on parity, race, and socioeconomic status.

It is also confirmed by similar research conducted in Ghana by (Obirikorang et al., 2012) at University Hospital in Kumasi, that ASB is common among antenatal women. Many clinicians opt for RUE which is the current technique employ to screen for UTI among pregnant women.

The presence of protein, nitrite, leucocyte esterase, blood and pus cells are looked for in diagnosing UTI. (Yadav & Yadav, 2018) but with this current laboratory technique which is the RUE, with low levels of concentration of the parameters, these parameters cannot be detected in urine.

A pregnant woman with a condition of ASB will show a normal result with RUE test since the technique lacks appropriate sensitivity and specificity. The pregnant woman will also not show signs and symptoms of UTI where by the clinician will suggest a further and more sensitive test for the client to perform. This condition will therefore be left unattended. In non-pregnant women, ASB rarely causes serious problems, however in pregnancy, if this condition is left untreated, about 30% of the pregnant women will develop serious complications (Schnarr & Smaill, 2008).

The failure of treating ASB in pre-natal clients will later have several detrimental complications for both mother and unborn child. In developing countries including countries in Africa, ASB is common with its prevalence as high as 35% but it varies from one country to the another (Siakwa et al., 2014).

Some of these consequences of untreated ASB in pregnant women may lead to pyelonephritis, low birth weight, premature labor, eclampsia, premature rupture of the membrane, mental retardation, fatal death, pregnancy-induced hypertension, anaemia etc., (Mohamed, Omar, & Abd-Allah, 2017).

The ideal technique for diagnosing and confirming ASB among pregnant women is urine culture and susceptibility testing. However, there are modern and other accurate methods of diagnosing ASB but urine culture and susceptibility testing still remains the gold standard in under developed and developing countries. The advantage of this method is that the organism causing the infection will be identified and its susceptibility pattern will be known. This will help the clinician not to prescribe broad-spectrum antibiotics for the clients since antimicrobial susceptibility testing can be done with the ideal technique but not with the current method that is being employed in most of the facilities in Ghana.

It is evident that, urine specimen cannot be fully assessed as the urine strip cannot quantify the extent of infection in clients as well as provide antimicrobial therapy which is usually seen in the case of the ideal technique (urine culture). Furthermore, in most health centres in Ghana, the attention of clinicians and health care providers is usually on the presence of glucose and protein in urine specimens with less attention on possible ASB. Against this background, this work is aimed at determining ASB among pregnant women attending antenatal clinic at Akwapim North Municipality.

Conceptual framework on ASB among pregnant women at Akwapim North Municipality

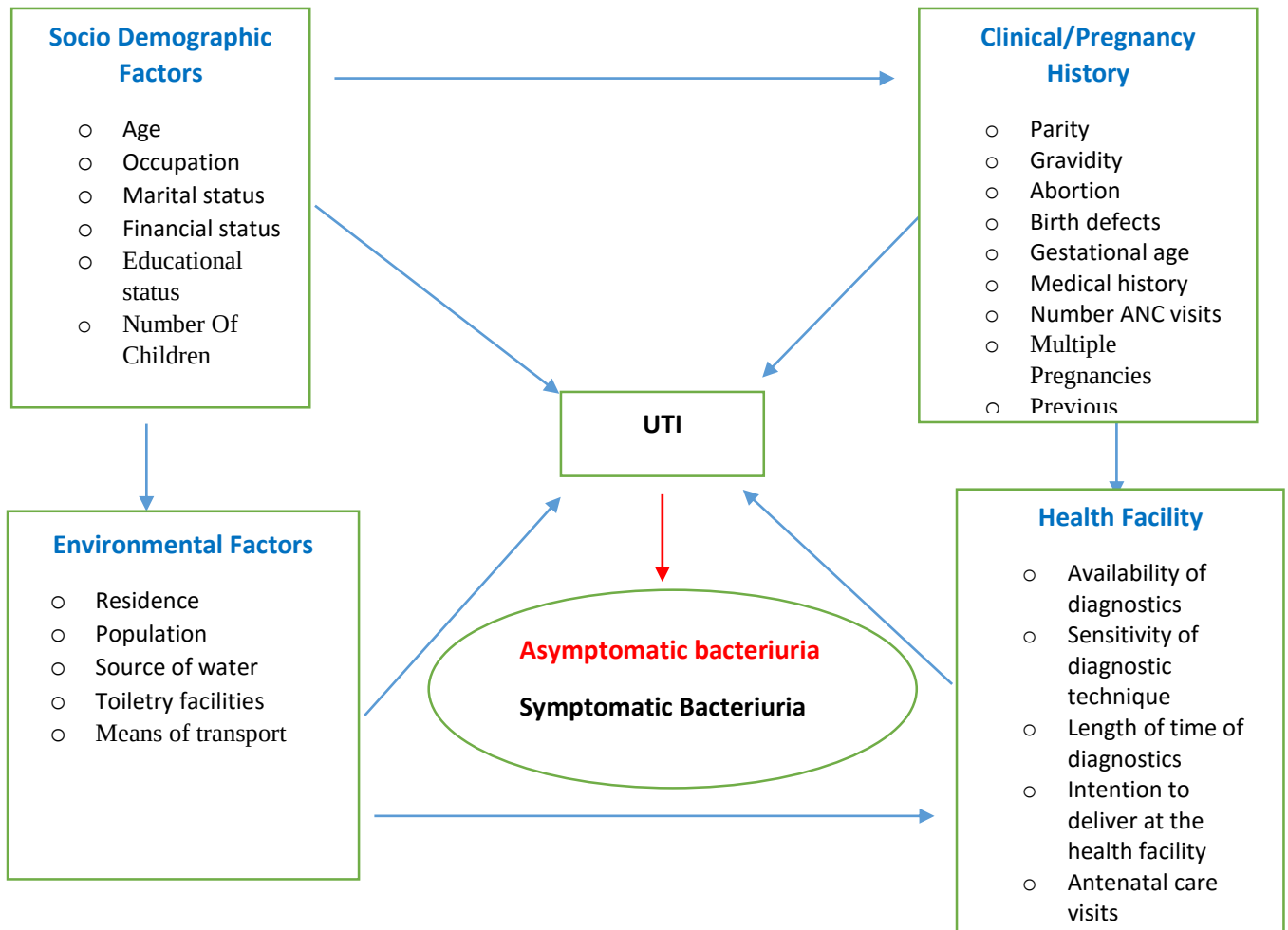


Figure 1: Conceptual framework of ASB among pregnant women

1.3 Narration of the conceptual framework

The conceptual framework above attempts to explain how the associated factors independently affect the dependent variable and how some of the independent variables inter-relate. The interplay of the independent variable with the arrow indicating the direction of interaction or influence between the factors that contribute to the dependent variable.

The factors are categorized into sociodemographic, environmental, clinical/pregnancy history and health facility as the independent factors while the dependent factor is asymptomatic bacteriuria, (UTI can lead to either asymptomatic or symptomatic bacteriuria but the focus of the study is on asymptomatic bacteriuria)

Pregnant women are at risk of acquiring UTI due to the factors related to sociodemographic, environmental, clinical/pregnancy history and health facility. Usually these are among the contributing factors to disease occurrence in an environment.

Sociodemographic factors have influence on the clinical/pregnancy history as well as the environmental factors. Sociodemographic factors such as age, marital status, financial status and number of children are all factors that contribute to increase the chance of a pregnant woman becoming vulnerable to an infection.

According to Dafnis and Sabatini (1992) the incidence of infection is higher among sexually active women or women in their reproductive age and the possibilities of encountering infection after a sexual intercourse is higher.

Marital and financial status all have direct effects on parity, gravidity, number of antenatal visits and previous complication thereby increases or decreases the chances of getting UTI. The number of intercourse per week can also be a factor associated with UTI in pregnant women. An earlier research conducted by Kunin and McCormack (1968) came out that UTI was found more common among women who engaged in sexual activity than women who do not, such as the Roman Catholic nuns.

Women who are more educated tend to have fewer children, the use of contraceptives to prevent pregnancy leads to increased risk of UTI. Application of spermicides favours the occurrence of infection that leads to recurrent infection (Fihn, 2003).

Parity, age of the woman and a disease condition predispose the woman of contracting UTI easily. A woman who has recessive sickle cell anaemia (haemoglobin SS), (Human immunodeficiency virus (HIV), diabetes increase the risk of UTI when she becomes pregnant.

According to Andabati and Byamugisha (2010), women who are 35 years of age or older are likely to have many children before the present pregnancy and this has been reported that multiparity itself contribute to risk of ASB.

The environment in which the pregnant woman stays may also increase or decrease her chances of acquiring UTI. She will then visit the health facility for treatment. UTI causes about 40% of all hospital-acquired infections. The vast majority are associated with catheterization and other manipulations of the urinary tract that occur during hospitalization (Kunin, 1997). The decision of a pregnant woman to use a particular health facility directly and indirectly affect her medical condition, accessibility and availability of the services and perception of the pregnant woman on the need for the service.

1.4 Justification of the Study

It is recognized that more than 75% of pregnant women experience frequent UTI during their gestational period and about 30% of them later develop serious complications.

In many of the health care facilities in Ghana, routine screening for ASB among pregnant woman is not done despite overwhelming evidence clearly demonstrating its benefits in preventing UTI and the associated adverse pregnancy outcome. However, routine urine examination is done for every pregnant woman that alone is not enough to include pregnant women with ASB.

Clinicians look out for the presence of nitrite, protein leucocyte esterase, and blood and pus cells greater than six (6) per high field (HPF) from the RUE results to diagnose bacteriuria and administer antibiotics of their choice preferably or a broad-spectrum antibiotic. These parameters cannot be detected in low concentration and bacteria such as *Enterococcus faecalis*, *Pseudomonas species*, *Staphylococcus species* and *Candida*. These organisms cannot reduce nitrate in urine to nitrite that will then be detected by the urine strips. If any of these uropathogens are present, the result of the test will be negative for nitrite.

Because ASB does not cause signs and symptoms it is important to know what factors are associated with the infection. In non-pregnant women, ASB rarely causes serious problems. However, in pregnant women this infection can progress upwards causing acute urethritis, acute cystitis and acute pyelonephritis. Bacteriuria can lead to adverse pregnancy outcome such as low birth weight, and preterm labour. Preterm labour is the most common cause of serious complications including death in new-born babies. According to WHO up to 45% of pregnant women with untreated ASB will develop pyelonephritis, a kidney infection that can also lead to acute respiratory distress syndrome (ARDS) or sepsis.

Early detection and treatment of ASB among pregnant women may prevent the client from spending huge sums of money for therapy either on themselves, their unborn or born babies or both when the complications are far advanced.

Screening for ASB has been shown to be cost effective when compared with treating UTI, pyelonephritis and other complications (Rouse, Andrews, Goldenberg, Owen, & Gynecology, 1995); (Abdullahi & Thairu, 2015). Enough studies have not been done in the area of ASB and this study will provide an epidemiological data on ASB among pregnant women and its antibiotics pattern in the Municipality. This will help stakeholders to come out with policies towards diagnosis of UTI among pregnant women, its effective management and irrational administration of antibiotics. Data from the study will also help to plan better control and prevention strategies in the municipality.

1.5 Objective of the study

The main objective of this study is to determine the proportion of ASB and associated factors among pregnant women attending antenatal clinic at Akwapim North Municipality.

1.5.1 The specific objectives are:

- To determine the proportion of ASB among pregnant women attending antenatal clinic at Akwapim North Municipality.
- To determine the bacteria present in the urine and its antibacterial susceptibility patterns to the bacteria isolated from the pregnant women in Akwapim North Municipality.

- To determine the factors of demographic, environmental, clinical & pregnancy history as well as the health facility factors that are associated with ASB among pregnant women in Akwapim North Municipality.

1.6 Research Questions

1. What proportion of pregnant women are in Akwapim North Municipality
2. What is the antimicrobial susceptibility pattern of bacteria among pregnant women in Akwapim North Municipality
3. What are the associated factors responsible for ASB among pregnant women in Akwapim North Municipality

CHAPTER TWO

LITERATURE REVIEW

2.1 Asymptomatic Bacteriuria

ASB refers to a condition in which urine culture reveals a significant growth of pathogens that is greater than 10^5 CFU of bacteria/ml, but without the patient showing signs and symptoms of UTI and this is common during pregnancy (Imade et al, 2010). ASB in pregnancy according to Akinloye, Ogbolu, Akinloye, and Terry Alli (2006), is the major risk factor for developing symptomatic UTI during pregnancy. ASB is common with a prevalence of 10% during pregnancy.

Early study conducted by Gratacós, Torres, Vila, Alonso, and Cararach (1994) found that routine screening for bacteriuria is encouraged. Delzell and Lefevre (2000) came out that pregnant women are at increased risk for UTI. From the sixth week of pregnancy to a peak during weeks 22 to 24, about 90% of women develop ureteral dilatation, which will remain until delivery (hydronephrosis of pregnancy). Another early study by Patterson and Andriole (1997) also found that there is increased in bladder volume and decreased in bladder tone along with decreased ureteral tone when women becomes pregnant which contribute to increased urinary stasis and ureterovesical reflux.

Again, another early study by Campbell-Brown, McFadyen, Seal, and Stephenson (1987) also found that in pregnancy, 13–27% of untreated women with ASB develop pyelonephritis, usually requiring hospitalization for treatment. In similar study by Schieve et al (1994), it was also found that bacteriuria in pregnant women increases the risk for preterm delivery and low birthweight by about 1.5–2-fold and may increase the risk of foetal and perinatal mortality. According to Akinloye et al. (2006), bacteriuria occurs in 2–

7% of pregnant women. Thus, of those who are not infected with bacteria at initial screening, 1–2% will develop bacteriuria later in pregnancy.

Thorough screening for ASB and treatment during pregnancy will decrease the annual incidence of complications caused by bacterial infection. Explaining further, Imade et al, (2010) stated that ASB is the significant presence of bacteria in the urine of an individual without symptoms. In pregnancy, the apparent reduction in immunity of pregnant women tends to encourage the growth of pathogens.

To Connolly and Thorp (1999) pregnancy enhances the progression from asymptomatic to symptomatic bacteriuria, which could lead to pyelonephritis and adverse obstetric outcomes such as prematurity, low birth weight and higher foetal mortality rates. Kirkham et al, (2005) also stated that the adverse effects of undiagnosed ASB on mother and child have made researchers to suggest routine culture screening for all pregnant women attending antenatal clinic in order to prevent mother and child from any form of complication that may arise due to infection.

Imade et al, (2010) in their study found that in many hospitals in Africa, routine urine culture test is not carried out for antenatal clients probably due to cost implication and time factor for culture results (usually 48 hours period) instead many clinicians opt for the strip urinalysis method for assessing urine in pregnant women. The writer further stated that, the true picture of such urine specimen cannot be fully assessed, as the strip cannot quantify the extent of infection in such a patient as well as provide antimicrobial therapy, which is usually seen in the case of culture test. Again, Imade et al, (2010) stated in many health centres in Africa, the attention of clinicians and health care providers is usually on

the presence of glucose and protein in urine specimens with less attention on possible asymptomatic infection.

In similar study, Abdullahi and Yunusa (2015) observed that during their first test, it became known that ASB in pregnancy is common with a prevalence of 2–10% and is similar to that observed among non-pregnant women. It is however more likely to progress to symptomatic urinary tract infection during pregnancy because of the physiological changes associated with pregnancy.

According to Smaill and Vazquez (2015), ASB if left untreated, about 30% of the affected mothers will develop complications. Pyelonephritis can lead to perinatal and maternal complications, including preterm delivery, low birth weight, foetal mortality, hypertension, anaemia and renal insufficiency.

According to Foxman (2010), screening for ASB has been shown to be cost effective when compared with treating urinary tract infection and pyelonephritis without screening. To Nicolle et al, (2005) the best time for screening for ASB is the first prenatal visit or in early pregnancy between 12-16 weeks of gestation.

From research, Abdullahi and Thairu (2015) and Patterson and Andriole (1997) suggested that urine should be cultured in each trimester to improve the detection of bacteriuria during the gestational period.

2.2 Physiological changes during pregnancy

According to Mobasheri et al (2012), during pregnancy, there are physiological changes that affect the normal functioning of the body in each trimesters. These changes are called a hormonal and mechanical change that increases the risk of urinary stasis and backward flow of urine from the bladder into the kidneys. To Çelen et al, (2011) due to the short urethra approximately 30-40 mm in females it becomes difficult to observe 100% hygiene due to the distended pregnant belly which increases the frequency of UTI in pregnant women. Indeed, UTIs are among the most common bacterial infections during pregnancy.

According to Mobsheri et al, (2002) pregnant women are considered immunocompromised UTI hosts because of the physiologic changes associated with pregnancy. These changes increase the risk of serious infectious complications from asymptomatic urinary infections even in healthy pregnant women.

In similar a study, Beerepoot et al, (2012) stated that oral antibiotics are the treatment of choice for asymptomatic bacteriuria and cystitis. The standard course of treatment for pyelonephritis is hospital admission and intravenous antibiotics. Antibiotic prophylaxis are indicated in some cases. Patients treated for symptomatic UTI during pregnancy should be continued on daily prophylactic antibiotics for the duration of their pregnancy.

From the global perspective, study conducted by Gilbert et al, (2013) pointed out that urinary tract is a common site of infection in humans especially women. Thus, during pregnancy, UTI is associated with increased risks of maternal and neonatal morbidity and mortality, even when the infection is asymptomatic. Gilbert et al. (2013) again further pointed out that ASB among pregnant women across different populations is noted to be a

problem of global significance. Globally, study conducted by several researchers found out that the prevalence of ASB in pregnant women in general has reach it height ranging from 2.5% to over 10%, although there are certain variations in different countries and geographical regions. For instance, ASB screening in pregnant women in Turkey has suggested incidence of 8.5%, Çelen et al, (2011) 10.7% in Nigeria, Kehinde et al., (2011) 12.3% in Brazil, (Darze et al., 2011). 13.2% and in India Rajaratnam et al (2014) found 10.4% in North-west Ethiopia, Alemu et al., (2012) in Bangladeshi, prevalence of 12% was obtained, Ullah, et al., (2007) found 7.3% in Ghana, Turpin et al (2007). Masinde et al, (2009) observed prevalence of 13% in Tanzania.” In West Bengal, Rajshkehar and Umashanker (2013) found that a prevalence of 11% among pregnant women was recorded. Rajshkehar and Umashanker (2013) also reported that countries with high rates of preterm birth and neonatal mortality also have rates of ASB in pregnancy that exceed rates seen in more developed countries.

Gilbert et al (2013) in their findings stated that screening and treatment of ASB have improved birth outcomes in several more developed countries and would likely improve maternal and neonatal health worldwide. Thus, the prevalence of ASB in pregnant women in Asian countries such as Pakistan, Bangladesh, and India was reported to be 6–10.2% by Khattak et al., (2006), Jubaida et al., (2015) and Urmila et al., (2012).

Other studies such as Nawal and Senani (2011); Versi et al., (1997) and Sheiner et al., (2009) found that “the highest age-specific prevalence was found in the 26-30 years, and the lowest in the 46-48 years in Saudi Arabia, *Streptococcus agalactiae* was the most predominant organism closely followed by *Escherichia coli*. Again, in Israel, a large population-based study of nearly 200,000 pregnant Israeli women demonstrated a 2.5%

rate of asymptomatic bacteriuria (and a 2.3% rate of symptomatic UTI. In this population, asymptomatic bacteriuria was found to have an association with multiple pregnancy complications, including hypertension, diabetes, intrauterine growth retardation, prolonged hospitalization, and preterm labour. The authors suggested that these findings might be a marker for intensity of prenatal care that would reduce urinary infections (Nawal and Senani, 2011). Additionally, their follow-up study examining women with asymptomatic urinary tract infection showed a clear association between asymptomatic bacteriuria and low birth weight and preterm delivery, a finding consistent with those of multiple previous investigations (Sheiner et al., 2009).

In Ghana, Obirikorang et al, (2012a) carried out prospective hospital-based study and found carried out 9.5% of prevalence of ASB among pregnant women in their second trimester. The study also found that the highest prevalence of significant bacteriuria with the age ranges between 30-34 years having the highest prevalence.” In Nigeria, Okonko et al (2010); Kolawole et al., (2009) also reported a prevalence rate as high as 47.5%. According to Okonko et al (2010); Kolawole et al., (2009), this high incidence of ASB may be attributed to factors such as poor housing, poor drainage systems, and lack of proper personal and environmental hygiene, genuine population susceptibility since it is factors such as low socio-economic status, sexual intercourse, and pregnancy among others that are found among Nigerian women.

Study done in the East African region, by Masinde et al, (2009) reported that the prevalence of UTIs among pregnant women was found to be 15.5 % in Tanzania, 13.3% in Uganda (Andabati and Byamugisha, 2010) and 14% in Sudan (Hamdan et al., 2011). This

was however lower than a study in Kenya (Ayoyi et al., 2017) that found prevalence at 21.5%.

2.3 Urinary Tract Infection (UTI)

A research conducted by Al-Dujaily (2000) revealed that UTI is one of the most common infections where one or more parts of urinary system becomes infected usually after bacteria overcome the natural defence mechanism of urinary tract. The researcher further stated that though UTI could affect both sexes, women are more affected than men due to the short nature of their urethra, loss of prostatic secretion and the ease of urinary tract contamination by faecal flora. In similar study, Awaness et al (2000) stated that pregnant women are more prone to UTI than non-pregnant women due to the pregnancy-associated physiological changes, extended belly and the difficulty with personal hygiene. According to MacLean (2001) and Warren (1996), clinically, UTI can be divided into asymptomatic and symptomatic bacteriuria. The authors further explained that symptomatic UTI could be accompanied with a variety of clinical signs and symptoms. These are dysuria, pyuria, and strong urge to urinate frequently, even immediately after the bladder is emptied, painful burning sensation on, discomfortable pressure and bloody urine, which may have a strong, smell. Study by Ferry et al., (1988) and Ryan (2004) found that in ASB, urine culture reveals significant growth of bacteria greater than 10^5 CFU of bacteria/ml) showing any clinical manifestation. To D. Gilbert, Moelleaving Jr, Eliopoulos, and Sande (2005) ASB could be found both pregnant and non-pregnant women but in pregnancy, there is a greater chance of progressing from asymptomatic to symptomatic form, which could lead to pyelonephritis.

According to Rajaratnam et al. (2014) and Amiri et al. (2015b), there are microbes that are able to invade the urinary tract and be involved in the pathogenesis of UTI. Masinde et al. (2009) also stated that UTI is one of the most common recurrent acquired infections and one of the major causes of increasing number of stillbirth deliveries. Totsika et al. (2012) in their study also found out that, about 150 million deaths per year globally were caused by UTI and its associated complications. They further emphasized that the infection can be developed in about 40%-50% of women and about 5% in men. UTIs are the second common complications in pregnancy after anaemia and if not controlled well, can adversely affect the health of infant or the pregnant mother. The result of Amiri et al. (2015b) concluded that about 5% prevalence of UTI in pregnant women is a contributing factor for low-birth-weight infants. In order to solve this, there should be a need for education on the risk of infection and its complications in pregnant women by educating the women on the causes and its prevention. Similar study conducted in Ghana by Boye et al. (2012) stated that proper diagnostic tests must be carried out during pregnancy to prevent the pregnant woman from a high risk of serious complications. The writers' findings also showed that the prevalence was 56.5%, although comparatively high in pregnant women, 50.4% of the infections were among pregnant women who were in their second trimester whiles *Escherichia coli* was the highest bacteria isolated with percentage of 48.7 and women between 15-32 years were most affected.

2.4 Epidemiology of UTI

Study carried out by Stamm and Norrby (2001) revealed that UTI is one of the most common bacterial infections in humans, significantly in women who are more susceptible when they become pregnant. Schaeffer and Nicolle (2016) in their study defined UTI as the presence of microbial pathogens within the urinary tract usually classified by the site

of infection. The kidneys-pyelonephritis, bladder-cystitis, the urethra-urethritis. UTI can be asymptomatic or symptomatic. Disease may reappear during pregnancy and if two or more episodes over a period of three months, six or more episode in one year then it is termed as recurrent UTI. It can be either because of relapse by the same organism that was treated first or a reinfection by new organism. Relapse is when the treated organism persists after two weeks of therapy (Johansen et al., 2011).

According to Hooton (2001) and (Nicolle et al., 2005), approximately 50% of women will experience UTI at some point in their lifetime and some women will suffer multiple recurrences.

Foxman (2010) confirmed by saying that, each year, there are approximately 7 million cases of acute cystitis occurring mainly in young women. There are approximately 250,000 cases of pyelonephritis, usually among adult women, resulting in 100,000 hospitalizations per year. There reason is that during pregnancy, the urinary tract will endure an intense physiological and anatomical change that makes healthy women vulnerable to serious infection and complications arising from conditions such as asymptomatic and symptomatic UTI.” In similar reports, Vasudevan (2014) mentioned that there is physiological increase in plasma volume during pregnancy that increases urine concentration by up to 70%, subsequently developing glycosuria in pregnant women, which causes bacterial growth in the urine.

From Macejko and Schaeffer (2007) point of view, ASB in pregnancy constitutes the major risk factors for developing symptomatic UTI which leads to the cause of major complications for the mother as well as the foetus. To Garingalo-Molina (2000), its

prevalence is reported to occur in 2-11% of all pregnancies, although rates in certain groups of patients may vary from less than 2% to more than 10%.

From other African countries, Gebre-Selassie (1998) pointed out that a study in Jimma South Western Ethiopia had 7% prevalence of ASB among pregnant women while in Turkey. Emiru, et al, (2013) indicated 10.6% prevalence, in Nigeria. Kutlay et al, (2003) found a much higher prevalence of 86.6% of ASB among pregnant women. These findings were confirmed by Schnarr and Smaill (2008) that approximately about 25% of women with ASB during pregnancy were reported to develop acute symptoms subsequently.

An earlier research pointed it out that the prevalence of ASB to be 2% to 13% in pregnant women.” Emiru et al. (2013) in their findings pointed out that, there are a number of conditions associated with an increased prevalence of ASB in pregnancy. Some of these are low socioeconomic status; grand multiparity and past history of ASB has an association with two-fold increase in the rate of bacteriuria. Valencia, Cromer, and gynaecology (2000) in their study also “reported that there would be increases with advancing age, sexual activity, and sickle cell trait.” Study done in Saudi Arabia by al-Sibai, Saha, and Rasheed (1989), “reported a 14.2% prevalence of ASB among pregnant women and showed that ASB has a significant association with low family income, large family size (10+), and living in overcrowding condition. Similar study by Debebe (2005) also revealed that there was 12.2% prevalence in diabetic women and 18.7% in women with previous history of UTI.

Other findings by Cedergren and Gynecology (2004) revealed that, women with “gestational diabetes mellitus may have complication up to 5% of pregnancies and may be

associated with an increased risk of both foetal and maternal morbidity.” Cedergren and Gynecology (2004) again added that the significance of ASB lies in its potential to cause acute pyelonephritis in 20-40% of pregnant women with untreated bacteriuria. In addition to that a symptomatic UTI, a variety of condition has been reported to be associated with ASB, these includes pre-term labour, low birth weight, and pre-eclampsia (Carroli et al, 2001) up to 27% of preterm birth has been associated with clinical form of UTI” (Foxman & Buxton, 2013). From studies conducted in Nigeria by Iwalokun et al, (2012) came out that *Escherichia coli* was the most common organism isolated, however, *Proteus mirabilis* formed 21.6% of isolates in one study of pregnant women and *P. mirabilis* 17.9% and Enterobacter 10.7% in patients with sickle cell anemia. According to Awonuga et al. (2011) and Manjula et al, (2016), studies from Omen in Nepal had 5% as its prevalence and 75% of the isolates were *E.coli* and this was consistent with studies from developed countries.

2.5 Pathogenesis of Urinary Tract Infections

Bacteria that cause UTIs usually enter the bladder through the urethra. (Harbinger & Contraceptives, 2014), however, infections may also occur through the blood or lymph. Most upper and lower UTIs result from bacterial ascent from the bowel or vaginal mucosa. According to Schaeffer and Schaeffer (2007), most common infecting pathogens are resident facultative anaerobes and gram-negative bacteria from the bowel and vaginal flora. *E coli* is the causative organism in nearly 85% of UTIs, *Staphylococcus saprophytic* represents 10% to 15% of cases, and Enterobacteriaceae species, *Proteus*, and *Klebsiella* comprise the remaining minority. After gaining entrance, organism such as *E. coli* attaches to the bladder wall and form a biofilm that resists the body's immune response (Salvatore et al., 2011).

Other bacterial characteristics such as motility are also important in the organism pathogenesis of UTIs because it enable the organism to ascend to the upper urinary tract and obstruct urine flow, which might result in pyelonephritis (John et al, 2016). In addition, John et al, (2016) found there are Virulence factors of bacteria that play an important role in urinary tract infections. Some organism mostly uropathogenic *E.coli* which is present within bowel flora can infect the urinary tract by expressing some specific virulence factors that permit adherence and colonization of the lower urinary tract causing urinary tract infections (John et al., 2016).

Pathogenesis can also be through ascending or haematogenous route. Ascending route is the most common route of infection in females and is aided by conditions such as pregnancy, urethral obstruction, and instrumentation. Blood borne route (haematogenous route) occurs because of bacteraemia although it is mostly not common. During pregnancy, progesterone-mediated smooth muscle relaxation is believed to contribute to renal pelvis and ureteral dilation as well as impaired ureteral peristalsis increased urinary retention, and increased bladder capacity, creating a permissive environment for bacterial ascent (Ovalle & Levancini, 2001).

Pregnancy is associated with significant anatomic and physiologic change in the kidneys and urinary collecting system that affect the development of bacteriuria (Soma-Pillay et al., 2016). In non-pregnant women, bacteriuria may be unimportant. However, in pregnant women, bacteriuria is more likely to be persistent and is associated with the subsequent development of symptomatic UTI. Differences in urine pH and osmolality and pregnancy-induced glycosuria and aminoaciduria may facilitate bacterial growth (Connolly & Thorp, 1999). Additionally, the physiological increase in plasma volume during pregnancy

decreases urine concentration and up to 70% pregnant women develop glycosuria, which encourages bacterial growth in the urine (Lucas et al, 1993).

2.6 Factors associated with UTI

Research has shown that there are some factors that increase a women's risk of developing UTI. The rate of UTIs in women gradually increases with age, thus incomplete bladder emptying allows the residual urine to be rapidly infected by bacteria present. According to Harbinger and Contraceptives (2014), bacteria that cause UTIs usually enter the bladder through the urethra. However, infections may also occur through the blood or lymph. Most upper and lower UTIs result from bacterial ascent from the bowel or vaginal mucosa. The most common infecting pathogens are resident facultative anaerobes and gram-negative bacteria from the bowel and vaginal flora. To Schaeffer and Schaeffer (2007) “*E. coli* is the causative organism of 85% of UTIs, *Staphylococcus saprophyticus* represents 10% to 15% of cases.

To Salvatore et al. (2011) the bacterial after gaining entrance, organism such as *E. coli* attaches to the bladder wall and form a biofilm that resists the body's immune response.”

There are some studies such as Goldenberg, Hauth, and Andrews (2000) explained that urinary tract infections could cause preterm labour and delivery. Thus, the bacterial invasion activates the foetal membranes to produce a large number of cytokines, endotoxins, and exotoxins. These substances stimulate prostaglandin synthesis, release, and initiate neutrophil chemotaxis, infiltration, activation culminating the synthesis and release of protease and other bioactive substances. The prostaglandin stimulates uterine contraction while the proteases attack the chorioamniotic membrane, leading to rupture.

To Hamdan et al (2011) there is contamination of the lower third of the urethra with pathogens from the vagina and the rectum, incomplete emptying of their bladders and exposure of the female urogenital system to bacteria during sexual intercourse are some of the factors of UTI.” Again, Hamdan et al (2011) added that there are several patient social demographic factors associated with an increased frequency of bacteriuria during pregnancy. Compared with high social-economic status patients, patients with low socio-economic status have a 5-fold increased incidence of asymptomatic bacteriuria.” Other risk factors for asymptomatic bacteriuria according to Alvarez et al (2010), includes diabetes mellitus, neurogenic bladder retention, history of backward flow of urine from the bladder into the kidneys (treated or untreated), previous renal transplantation, (Ghafari, et al., 2008) and a history of previous urinary tract infections. To Çelen et al. (2011) infections result from ascending colonization of the urinary tract, primarily by existing vaginal, perineal, and faecal flora. Various maternal physiologic and anatomic factors predispose to ascending infection.

Coulthard et al. (2010) in their study also found that, there is a loss of ureteral tone in pregnant women and are combined with increased urinary tract volume which results in urinary stasis, which can lead to dilatation of the ureters, renal pelvis, and calyces. Urinary stasis and the presence of backward flow of urine from the bladder into the kidneys predispose some pregnant women to upper urinary tract infections and acute nephritis. Çelen et al. (2011) pointed out that “although the influence of progesterone causes relative dilatation of the ureters, ureteral tone progressively increases above the edge of the pelvic inlet during pregnancy. Thus, the glycosuria also leads to an increase in levels of urinary amino acids during pregnancy are additional factors that lead to asymptomatic urinary tract infections.” It was again pointed out by Amiri et al. (2015b) that children born with

mothers with pyelonephritis are much more prone to impairment of mental and motor development. In similar study, McDermott et al. (2000) found that “there is a significant statistical correlation between UTI and congenital retardation. According to Obstetrics and gynecology (2015) there are several factors that can make a pregnancy high risk, including existing health conditions, the mother’s age, lifestyle, health issues that happen before or during pregnancy. To Smaill and Vazquez (2015) and Shriver (2017) older first-time mothers have normal pregnancies, but research shows that older women are at higher risk for certain problems than younger women includes pregnancy-related high blood pressure (called gestational hypertension) and diabetes (called gestational diabetes).

2.7 Consequences of Untreated UTI in Pregnancy

According to Masinde, Gumodoka, Kilonzo, and Mshana (2009), untreated ASB is a risk factor for acute cystitis (40%) and pyelonephritis (25-30%) in pregnancy. These account for 70% of all cases of symptomatic UTI among unscreened pregnant women (Parveen, Momen, Begum, Begum, & Hospital, 2011).

To Masinde et al. (2009), asymptomatic and symptomatic bacteriuria have been reported among pregnant women to be 13.0% and 17.9% respectively. Undiagnosed, untreated or unrecognized lower urinary tract infection can ascend to cause pyelonephritis. It is seen more frequently in the second and third trimester (80-90%). Out of one third of cases of untreated ASB can progress to pyelonephritis (Adam & Saadia, 2015).

Up to 40% of pregnant women with ASB will develop an acute kidney infection such as pyelonephritis. (Smaill & Vazquez, 2015) and approximately 50% of these will have

premature labour (Siakwa et al., 2014). Untreated ASB in pregnancy often will lead to adverse maternal and foetal outcomes (Kehinde et al., 2011).

Adverse maternal outcomes that may occur include symptomatic cystitis, pyelonephritis and preterm labour and delivery (Prasanna, Naimisha, Swathi, & Shaik, 2015). In pregnancy, pyelonephritis may lead to septicaemia, chronic pyelonephritis, loss of renal function and respiratory distress syndrome. (Wing, Fassett, Getahun, & gynecology, 2014)

Table 1: Maternal and foetal complications of ASB in pregnancy

Maternal complications	Foetal complication
Anemia	Intrauterine death
Hypertension	Intrauterine growth retardation
Chorioamnionitis	Low birth weight
Symptomatic acute cystitis pyelonephritis	Prematurity
Pre-eclampsia	Retardation

(McGladdery, Aparicio, Verrier-Jones, Roberts, & Sacks, 1992); (Uncu et al., 2002).

Table 1 above showing maternal and foetal complication of ASB in pregnancy

2.8 Diagnosis

There are several methods of diagnosing UTI but according to Wilson and Gaido (2004) the most common techniques are the urinalysis, Gram staining and urine culture. An earlier study from Schmiemann, Kniehl, Gebhardt, Matejczyk, and Hummers-Pradier (2010) came out that urine culture is the most important technique for diagnosis pyelonephritis in pregnant women who present with typical symptoms.

Research carried out by Lumbiganon, Laopaiboon, Thinkhamrop, and Gynecology (2010) suggested that all pregnant women should be screened for bacteriuria at first prenatal visit or at 12-16 weeks of gestation. From Farkash et al. (2012) and Flores-Mireles, Walker, Caparon, and Hultgren (2015) they all suggested that tests should not be repeated for pregnant women whose first samples were negative but should be repeated for those who are associated with the factors of developing UTI (diabetes, sickle cell disease).

From Gilbert et al. (2013), screening and treating ASB in pregnancy is recommended during antenatal care especially at initial registration. According to Manjula et al. (2016), culture is the gold standard and is recommended test for diagnosing ASB but the challenge with it is that the test is expensive and unavailable in most low resource settings and this could be a limiting factors as screening for ASB is concerned.

Early studies done on adult women by Kass in 1950 and reported again by Nicolle et al. (2005) came out to establish a threshold of 10^5 CFU per mL in a voided specimen as the standard to define a positive urine culture.

2.8.1 Dipstick urinalysis

A urine test strip or dipstick is a basic diagnostic tool used to determine pathological changes in a patient's urine in standard urinalysis. From Misdraji and Nguyen (1996), they stated that a standard urine test strip may comprise up to 10 different chemical pads or reagents which react when immersed in and then removed from a urine sample. Microscopy is the technique used to diagnose clients with UTI but has its own set of limitations (Graham & Galloway, 2001).

According to Dielubanza and Schaeffer (2011), urinalysis is an array of biochemical assays and microscopic evaluations designed to aid in the presumptive diagnosis of UTI by facilitating the rapid identification of bacteriuria and pyuria and it is the most commonly used diagnostic test use in the outpatient evaluation of suspected UTI (Wilson & Gaido, 2004)

It had also been stated by Whiting, Westwood, Watt, Cooper, and Kleijnen (2005) that leukocyte esterase and nitrite are the most commonly referenced, and perhaps the most useful indices from the urine dipstick screening assay. The presence of leukocyte esterase suggests pyuria, indicative of host inflammatory response. Nitrite is the product of bacterial reduction of urine nitrate, and suggests the presence of gram-negative bacteria (Dielubanza & Schaeffer, 2011). When compared with urine cultures growing 10^3 cfu/mL or greater, the sensitivity and specificity for the finding of a positive result for both tests were 71% and 83%, respectively (Pfaller et al., 1987)

False-negative results for leukocyte esterase can occur in the setting of early infection, when bacteriuria is present without host inflammatory response and false-negative results for nitrite can occur in the setting of infection with gram-positive or other no nitrate-reducing organisms (Cheesbrough, 2006b)

On microscopic evaluation, the presence or absence of bacteria is very important in determining the likelihood of infection, however, the high incidence of contamination with clean-catch urine specimens and possibility for false-negative findings if bacterial colony count is lower than 10^5 CFU/mL are significant confounding factors (Li, Ma, Wong, & health, 2002). As such, the presence of white blood cells and the absence of vaginal

epithelial cells in the urine sample can be vital to the presumptive diagnosis of UTI (Dielubanza & Schaeffer, 2011)

According to (Abraham, 2013) a positive nitrite test has a specificity of 90% but a sensitivity as low as 30% for a UTI. Combination of the two tests leads to a more accurate detection of a UTI with sensitivity of up to 88%. Urine culture was used as the reference standard in all of the studies and remains the gold standard test for detecting ASB (Teppa & Roberts, 2005)

2.8.2 Culture and antibiotics susceptibility

The urine culture is performed to grow and identify organisms mainly bacteria and fungi that may cause UTI. The antibiotic sensitivity or susceptibility test helps to select an appropriate antibiotic that is effective against specific types of bacteria or fungi causing an infection (Leekha, Terrell, & Edson, 2011). To (Leekha et al., 2011), urine culture is done to find out the cause of a UTI, make a decision about the best treatment for a UTI and this is called sensitivity testing and also to find out if treatment for a UTI is successful.

Whiles in the bladder, urine is normally sterile and free from any organisms. A sample of urine is added to a medium that promotes the growth of germs (bacteria), if no germs grow, the culture is negative and if it grows, it is positive. The type of germ may be identified using a microscope or a chemical test. Sometimes other tests are done to find the right medicine for treating the infection. This is called sensitivity testing (Cheesbrough, 2006b)

A normal result is when no bacteria or fungi grow in the culture. The result is negative, abnormal result is when bacteria or fungi grow in the culture, and the result is termed positive. A count of 100,000 or more bacteria per millilitre of urine may cause by infection. Either a count ranging from 100 to 100,000 could be caused by infection or contamination of the sample or the urine culture test must be repeated. If the count is 100 or less, infection is unlikely but you may have a count of 100 or less if the client is already taking antibiotics (Cheesbrough, 2006b)

2.9 Treatment of UTI

Bacteria mostly cause UTIs and treatment is done by the use of antibiotics. According to Al Sibiani (2010), screening for ASB in pregnant women has been shown to be cost effective when compared with treating UTI and pyelonephritis without screening. Generally, the commencement of the treatment process starts after the diagnosis of the infection but these initial attempts of treating the disease can lead to problematic consequences, as the treatment has to be made after the confirmation of the etiological agent (Vasudevan, 2014)

The initial treatment efforts involve the employment a variety of antimicrobial agents and this could in turn make the pathogen resistant to commonly employed drugs. Such kind of treatment is referred to as empirical treatment. Therefore, a sporadic assessment of the causative pathogens against the antimicrobial agents is necessary. The significance of the bacterial resistance towards to the commonly employed antibiotics during pregnancy has gained the interest of my scientific analysts and researchers (Bérard, Santos, Ferreira, & Perreault, 2011)

The administration of the anti-infective drugs during pregnancy should be carefully monitored to ensure the safety of the foetus as majority of the anti-infective drugs are capable of crossing the placental barrier (Macejko & Schaeffer, 2007)

Synthetic antimicrobial agents belonging to the family of quinolones are generally not recommended in animals due to associated risk factors related to pregnancy but the adverse effect has not been illustrated in humans (Gilstrap III et al., 2001). Research studies have confirmed the safety of beta lactam antibiotics like penicillin and cephalosporin during pregnancy (Schnarr & Smaill, 2008)

However, these antibiotics are deemed safe due to the absence of teratogenic affects that can bring about any physiological defects in the new-born foetus but is sometimes associated with allergic reactions. Studies done by Dashe, Gilstrap III, and America (1997) have also provided sufficient evidences to confirm the property of antibiotic resistance exhibited by certain pathogens against amoxicillin and ampicillin which in turn has limited their usage.

Though studies demonstrate the efficacy of nitrofurantoin, it is ineffective against *Proteus* species (Christensen, 2000; David et al., 1995; Sahm et al., 2001). Employment of trimethoprim during the first trimester of pregnancy has resulted in cardiovascular defects in new-borns (Milo et al., 2005). Demonstrative studies have revealed the harmful effects of sulphonamides during the last two trimesters of pregnancy. Therefore, women diagnosed with ASB are prone to experience repeated infection and continuous antibiotic treatment is recommended in such cases. However, employment of antimicrobial agents interferes with the normal gastrointestinal flora.

According to Goldenberg, Culhane, Iams, and Romero (2008), WHO defines preterm delivery or birth as one that occurs at more than 20 weeks' gestation, but less than 37 weeks. Preterm birth is the single largest contributor to poor outcome in the perinatal period. Laboratory and clinical data have shown a link between spontaneous preterm labour and delivery and both systemic and ascending genital tract infections (Choi, Park, Jang, Uh, & Lee, 2012); (Lamont et al., 2011).

By contrast, antibiotics have been shown to be beneficial in preventing maternal and short-term neonatal complications in the context of premature rupture of membranes (PROM) before term (SL Kenyon, Taylor, & Tarnow-Mordi, 2001); (Sara Kenyon, Boulvain, & Neilson, 2003)

The diagnosis and treatment of ASB, bacterial vaginosis (BV), and gonorrhoea appeared to reduce the risk of preterm birth (Lamont et al., 2011); (Brocklehurst, Gordon, Heatley, & Milan, 2013)

The recent resolution of the 2014 World Health Assembly has clearly sounded the alarm by recognizing that antibiotic resistance through the abuse and misuse of these drugs is a major public health issue and urges member states to strengthen drug management systems...and to encourage the development of new diagnostics and treatment options.

2.10 Antibiotic Resistant

A study from Rouse et al. (1995), came out that the frequencies of isolated pathogens and their antimicrobial resistance patterns can vary in different geographical regions. ASB

treatment is generally recommended only during pregnancy and at preoperative evaluation of men before urological procedures (Dalal et al., 2009)

Despite these recommendations, overuse of antibiotics is common in treating bacterial infection. This is particularly true in women with recurrent urinary tract infections (rUTIs). For many years, the inappropriate use of antibiotics has been recognized to be a major problem, leading to higher healthcare costs as well as increased antimicrobial resistance through the selection and spread of drug resistant microorganisms with severe consequences for patient health (Kislak, Eickhoff, & Finland, 1964); (Rüttimann, Keck, Hartmeier, Maetzel, & Bucher, 2004). Most pregnant women are exposed to some type of medication during pregnancy (Crider et al., 2009)

Drugs prescribed during pregnancy can exercise a teratogenic effect on foetuses, and those prescribed during breastfeeding can affect infant health. Antibiotics are among the more frequently prescribed types of medication during pregnancy and lactation (Nahum, Uhl, Kennedy, & Gynecology, 2006). The epidemiology of antimicrobial resistance varies among countries, particularly due to the impact of antibiotic prescriptions (Le & Miller, 2001); (Goossens, Ferech, Vander Stichele, Elseviers, & Lancet, 2005); (Costelloe, Metcalfe, Lovering, Mant, & Hay, 2010)

In 2013, CDC (Centre for Disease Control and Prevention) published a report outlining the top 18 drug-resistant threats to the United States. These threats were categorized based on level of concern: urgent, serious, and concerning. In general, threats assigned to the urgent and serious categories require more monitoring and prevention activities, whereas the threats in the concerning category require less. Urinary tract infection (UTI)

due to *Escherichia coli* and other types of bacteria can develop resistance, which allows them to release an enzyme called Extended Spectrum Beta-Lactamase (ESBL). It is a type of enzyme or chemical produced by some bacteria which causes some antibiotics not to work for treating bacterial infection (Cho & Chung, 2017)

Globally, antimicrobial resistance (AMR) has become an important public health threat. Resistant bacteria associated with life-threatening infections are becoming increasingly prevalent, it this limits therapeutic options (Andersson & Hughes, 2011). A surveillance was carried out in Ghana by Opintan et al. (2015) on antimicrobial resistance. The findings were that antimicrobial resistant levels were very high, greater than 50% The relatively high ciprofloxacin resistant demonstrated by the most predominant isolates, *Coliform spp.* and *E. coli*, in this study should be of great concern to medical practitioners, drug regulatory agencies and policy makers. This emphasizes the need for continuous evaluation of the quality of common antibiotics, prudent drug prescription and judicious use of ciprofloxacin in UTI management (Afriyie et al., 2015)

Across the northern, middle and southern sectors of Ghana, varied levels of resistant was observed in some of the antimicrobials (Opintan et al., 2015). The antimicrobials that showed very high resistance level were ampicillin, tetracycline, chloramphenicol and trimethoprim-sulphamethoxazole. This is consistent with studies carried out in some counties in Africa (Opintan et al., 2015). These older antimicrobials are cheap, and their continual use (whether appropriate/inappropriate) in both humans and animals contribute to the high resistant levels.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study design

The research employed a cross sectional study between May to June 2019 to collect both qualitative and quantitative data on pregnant women attending antenatal clinic at Akwapim North Municipality. Data collected were factors on demographics, environmental, clinical/pregnancy history, health facility and sterile urine specimens. The data was analyzed to determine the proportion of ASB among pregnant women and its bacteria isolated susceptibility patterns and the results were presented as frequencies and percentages. The associated factors were analysed to find out which factors contributed to the development of ASB among pregnant women who were recruited from the six (6) health care facilities after they have consented to be part of the study. Binary logistic regression analysis was used to estimate the odds of developing ASB and the associated factors that were involved.

3.2 Study site

The study was conducted at Akwapim North Municipality, which is located at the south-eastern part of the Eastern Region that is about 58 km from Accra the capital city of Ghana. The Akwapim North Municipal shares boundaries to the north east with Yilo Krobo, north with New Jauben Municipal, southeast with Dangbe West, southwest with Akwapem South District, and in the west with Suhum-Kraboia-Coaltar District. The District covers a land area of about 450 sq. km representing 2.3 percent of the total area of the Eastern Region and has about 230 settlements.

From the 2010 population and housing census (PHC) the population of Akwapem North Municipality is 136,483 representing 5.2 percent of the Eastern region's total population of 263,3154.

The Total Fertility Rate (TFR) for the Municipality 3.6 that slightly higher than the Regional average of 3.55. The General Fertility Rate (GFR) is 103.4 births per 1000 women aged 15-49 years that is slightly lower than the regional average of 103.9. The Crude Birth Rate (CBR) is 26 per 1000 population. About 17 percent (16.3%) of the population aged 12 years and older had once been married but are either divorced, widowed or separated. Only four percent population aged 12 years and older are in consensual unions.

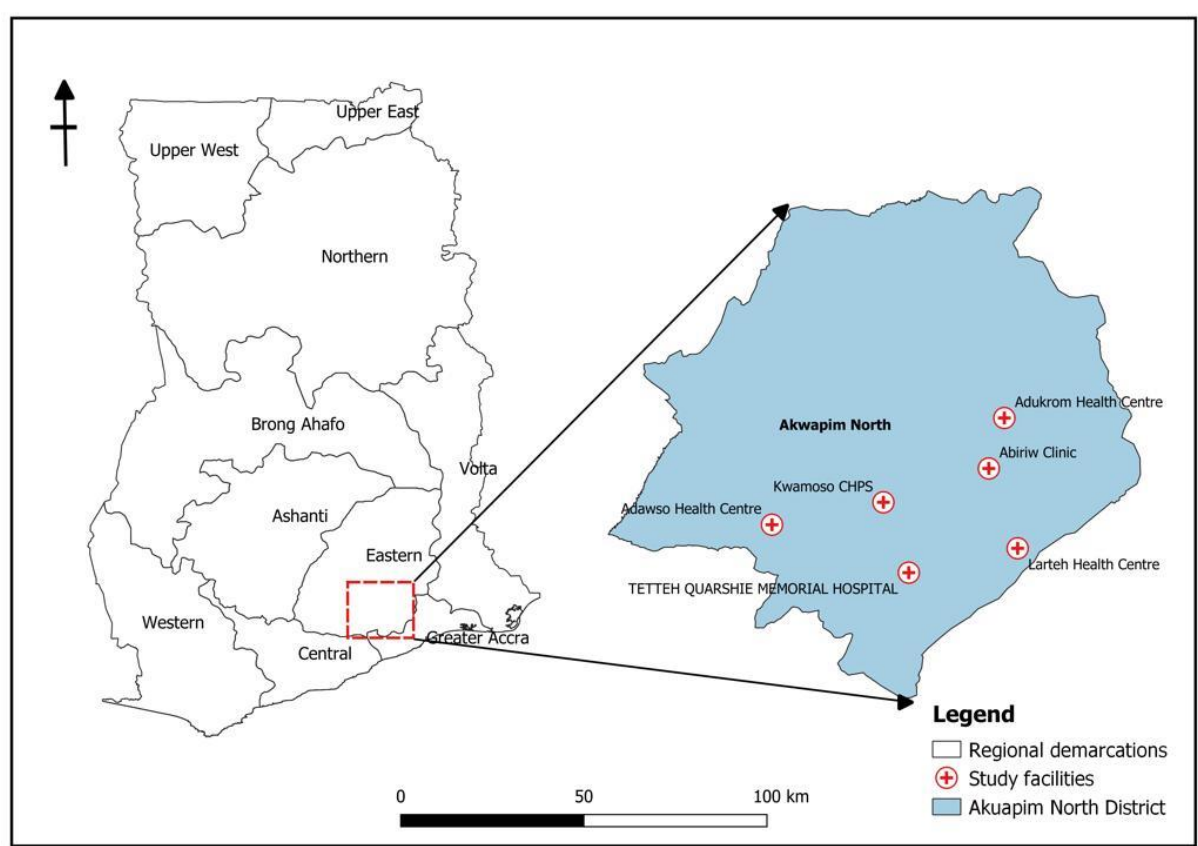


Figure 2: Map of Akwapem North

3.3. Study population

The study population was all pregnant women who were attending antenatal clinic at any of the six (6) selected health facilities at Akwapem North Municipality during May to June 2019

3.4 Inclusion criteria

1. All pregnant women coming for antenatal clinic and are staying in Akwapem North Municipality for at least six months
2. All pregnant women without any signs and symptoms of UTI after screening with routine urine examination test

3.5 Exclusion criteria

1. Pregnant women who are on any antibiotic treatment two weeks prior to collection of specimens will be excepted
2. Pregnant women who reported vagina bleeding a week ago prior to the study will be excluded.

3.6 Variables

The variables measured were:

3.6.1. Dependent variables

The dependent variables was presence of bacterial growth ($> 10^5$ bacteria cfu/ml) or absence of bacterial growth.

3.6.2. Independent variables

Independent variables were Socio demographic factors, environmental factors, clinical/ pregnancy history and health facility

Table 2: Factors associated with ASB among pregnant women at Akwapem North Municipality

Independent variables grouped under each associated factors			
Socio demographic factors	Environmental factors	Clinical/pregnancy history	Health facility
Age	Residence	Frequency of sexual intercourse	Number of ANC visits
Religion	Population	Parity	Availability of diagnostics
Educational status	Source of water	Gravidity	Previous of health facility
Occupation	Toilet facility	Gestational age	Sensitivity of diagnostics
Financial status	Distance to health facility	Miscarriage	Duration of diagnostics
Marital status		Birth defects	Place of delivery
Duration of staying together		Any medical condition	Type of health facility
Number of children		Multiple pregnancy	
		Mode of delivery	
		Outcome of previous delivery	
		Any previous medical complications	
		Last UTI experience	

Table 2a. Operational definition of the socio demographic factors

Study variable	Operational definition	Measurement scale	Data collection technique
Age	Age of pregnant woman at last birthday	Continuousyears	Semi-structured questionnaire
Religion	Belief in worship	Nominal Christian Moslem Traditionalist	Semi-structured questionnaire
Educational status of Pregnant woman & Husband	Highest level of education mention during the time of interview	Ordinal No formal education Basic Advanced	Semi-structured questionnaire
Occupation of Pregnant woman Husband	The work the pregnant woman/husband does	Nominal Student Unemployed Employed	Semi-structured questionnaire
Monthly income level	How much couple earn at the end of each month	Continuous < GH¢ 1000 > GH¢ 1000	Semi-structured questionnaire
Marital status	Description of the pregnant women's relationship with the other	Nominal Single Cohabiting Married Divorced Widowed	Semi-structured questionnaire
Total family size	Number of people staying together	Two Three > three	Semi-structured questionnaire
Duration of marriage/staying together	For how long the pregnant woman has been married/staying together	Continuous <1year 1-3years >3years	Semi-structured questionnaire

Table 2b: Operational definition of the environmental factors

Study variable	Operational definition	Measurement scale	Data collection technique
Residence	Home of the pregnant woman	Ordinal Self-contained Compound house	Simi structured questionnaire
Source of water	Source of household water used by pregnant woman	Ordinal Tab Borehole River/stream Rain	Simi structured questionnaire
Toilet facility	A place of convenience	Ordinal Private Public	Simi structured questionnaire
Distance from a health facility when you board a vehicle	How far from your house to health facility.	Interval Not far (less than 20 minutes Far (1 hour Very far (more than an hour)	Simi structured questionnaire
Mode of transport	How the pregnant woman gets to the health facility	Ordinal By foot Trotro/Taxi Private car	Simi structured questionnaire

Table 2c: Operational definition of the clinical/pregnancy history

Study variable	Operational definition	Measurement scale	Data collection technique
Frequency of sexual intimacy	How often couple engage in sexual intimacy	Continuous <3 times /week >3times /week	Semi structured questionnaire
Gravidity	Number of times the woman has been pregnant	Ordinal Primigravidae (one) Multigravidae (two) Multigravidae (three)	Semi structured questionnaire
Parity	How many times the woman has given birth	Nominal Nulliparous (yet to) Primiparous (one) Multiparous (more than two)	Semi structured questionnaire
Gestational age at the time of sample collection	How old is the pregnancy (months)	Ordinal 1 st trimester (1-3) 2 nd trimester (4-6) 3 rd trimester (7-9)	Review from maternal & child health record book
Multiple pregnancy	A woman delivers two or more offspring during one pregnancy	Binary Yes No	Semi structured questionnaire
Mode of previous delivery	Method by which the baby was delivered	Ordinal SVD C/S	Semi structured questionnaire
Miscarriage/abortion	Loss of pregnancy within 20 weeks of gestation	Binary Yes No	Semi structured questionnaire
Type of miscarriage/abortion	Means by which mother lost her foetus (baby)	Ordinal No miscarriage/abortion Spontaneous(natural) Induced (medicine)	Semi structured questionnaire
Previous delivery with any birth defects	Baby born with a part of the body mission or malformed	Binary yes No	Review from maternal & child health record book
Any medical condition	Has the pregnancy woman been diagnosed of any	Binary Yes	Review from maternal & child health record book

Any medical condition in family	medical condition Have they diagnosed any medical condition in your family	No Binary	Review from maternal & child health record book
Outcome of previous delivery	Child's present condition	Yes No Ordinal	Review from maternal & child health record book
Use of catheter	Did they ever used catheter on you	Yet to give birth Good poor Binary	Semi structured questionnaire
Last UTI experience	When was the last time you had UTI	No Yes Ordinal	Semi structured questionnaire
Did you seek for medical treatment	Treatment for UTI	Before marriage Married but not pregnant During pregnancy Binary	Semi structured questionnaire
Where did you seek for the treatment	Place where pregnant woman was treated	Yes No Ordinal	Semi structured questionnaire
Do you sometimes buy antibiotics without prescription	Ordered medicine from clinician	Health facility Pharmacy/drug store Traditional medicine Binary Yes No	Semi structured questionnaire

Table 2d: Operational definition of the health facility

Study variable	Operational definition	Measurement scale	Data collection technique
Availability of diagnostics	Type of test carried out for diagnosis of UTI	Ordinal RUE C/S	Review from maternal & child health record book
Where do you attend ANC	ANC clinic	Ordinal Hospital Health centre CHPS	Review from maternal & child health record book

3.7. Sampling

3.7.1. Sample size determination

The sample size was calculated from Cochran's formula $n = Z^2 p (1-p) / e^2$

Where n is the minimum sample size, Z is the standard z score that corresponds with 95% confidence interval which is 1.96, p is the proportion of pregnant women with ASB and e is the allowable error margin set at 5%.

$n = Z^2 p (1-p) / e^2$ this implies that

Z= 95% CI is 1.96

p= proportion of pregnant women with ASB in Akwapem North Municipality. In Akwapem North Municipality the proportion of ASB is unknown but a similar study was carried out at Komfo Anokye with prevalence of 7.3% (Turpin, Minkah, Danso, & Frimpong, 2007) was used for the calculation of the minimum sample size for the study

$p = 7.3\% = 0.073$

$e = 5\% = 0.05$

$$\begin{aligned} n &= Z^2 p (1-p) / e^2 = 1.96^2 * 0.073 (1-0.073) / 0.05^2 = 3.8416 * 0.073 (0.927) / 0.0025 \\ &= 3.8416 * 0.073 (0.927) / 0.0025 = 3.8416 * 0.067671 / 0.0025 \\ &= 3.8416 * 0.067671 / 0.0025 = 0.2599649136 / 0.0025 \\ &= 103.985 \sim 104 \text{ participants} \end{aligned}$$

3.7.2 Sampling method

A five-year antenatal attendance book was used to calculate the mean attendance for each of the 23 health facilities in the Municipality. Six health facilities were selected for the study based on the highest number of antenatal attendance. Samples were proportionately allocated to the six health facilities based on their five-year attendance. Those who consented to be part of the study had their urine specimens screened with the routine urine

examination test to exclude those with protein, leucocyte, nitrate, glucose and pus cells in their urine. Based on the number that was negative for protein, leucocyte and nitrate and pus cells in their urine, the pregnant women were randomly selected by picking YES or NO which was written on pieces of paper, folded, and put into a bowl. All those who picked YES were selected for the study. Instances where only a pregnant woman's result was negative on a particular day, that person was selected automatically for the study. The procedure was repeated on another antenatal day for those who were not already screened until the require number from each stratum was gotten.

3.7.3 Selection of participants

Routine urine examination was used as a baseline after they had satisfied the inclusion criteria and consented to be part of the study. Urine specimens from the pregnant women were collected and screened for the presence of protein, nitrate, glucose, leucocytes and pus cell. All those who were negative after the RUE test were randomly selected by picking YES or NO to give equal chance of been included into the study.

3.8. Data collection techniques and tools

3.8.1 Review of Patients' Records

Maternal and child health record book (antenatal book) was used to retrieve information on clinical and pregnancy history such as gestational age, previous delivery with any birth defects, any medical condition and outcome of previous delivery. These questions were part of the questionnaire but for the sake of recall bias and not all, they were medically inclined, their antenatal book was used to get accurate information on those independent variables.

3.8.2 Questionnaires

Structured questionnaire was used to collect data on the independent variables. Those who were able to read and write were given the questionnaires to fill. Research assistants were present to help those who could not read or write by interpreting the questions into the local dialect

3.9. Pre-Testing and Review of Instrument

The principal investigator and the research assistants pretested the questionnaire at Tetteh Quarshie Memorial Hospital for reliability and efficiency. Issues raised on some of the questions were amended before the start of the study.

3.10. Data collection

Well-trained health workers translated the questions into the local dialect for those who were not able to read or write and this was done confidentially.

The questionnaires were used to seek relevant information in relation to socio demographic and other important clinical data related to UTI. After filling the questionnaires, the participants were educated on how to take the urine specimen to avoid contamination.

Each procedure was explained to each participant to follow on how to obtain a urine specimen devoid of contamination. An UV sterilized plastic wide mouth leak proof screw-capped transparent urine container, well label with ULAN, age and time of collection was given to the participant to produce about 10–20 mL of mid-stream urine specimen.

3.11. Sample Transportation

Specimens were placed in a cold box and transported to the laboratory. Within an hour for analysis following the standard laboratory, protocol (Organization, 1997).

3.12 Laboratory analysis

3.12.1. Culture and Antimicrobial susceptibility

Each urine specimen was well mixed by swirling the container. A sample was plated (cultured) in a labelled petri dishes containing a media of Cystine Lactose Electrolyte Deficient (CLED) and 5% sheep blood agar media for the primary isolation of uropathogen using a sterile calibrated wire loop (0.002 mL) to inoculate a loopful of urine onto a half plate of each of the agars.

The culture plates were incubated between 35 °C-37 °C aerobically for 18-24 hours. When there is bacterial growth after 18-24 hours of incubation morphological identification, biochemical test, colony count and sensitivity was performed.

3.12.1.1 Biochemical test

Biochemical tests were performed with pure 24-hour old cultures. Positive and negative controls were included along with test specimens. The biochemical tests were based on standard procedures for the identification of bacterial pathogens (Perilla et al., 2003).

3.12.1.1.1. Catalase test

About 2-3 mL of hydrogen peroxide solution was poured into a test tube. A sterile glass rod was used to pick the test organism into the hydrogen peroxide solution. Active

bubbling indicated a positive catalase test and no bubbles indicate a negative catalase test. *Staphylococcus species* are catalase positive (Cheesbrough, 2006a).

3.12.1.1.2 Coagulate test / Slide coagulase test

Placed a drop of distilled water on each end of a clean microscope slide. A dense suspension of *Staphylococci* from culture at both ends. One was labelled as test and the other as control. The control suspension served to rule out false positive due to auto agglutination. The test suspension reacted with a drop of citrated plasma and mix well. Agglutination or clumping of cocci within 5-10 seconds was taken as positive. Some *Staphylococcus aureus* may not produce bound coagulase and the tube must identify such strains coagulates test (Cheesbrough, 2006a).

3.12.1.1.3. Tube coagulase test

Three small test tubes were labelled as test, negative and positive controls. A 0.2 mL of plasma was pipetted into each of the labelled test tubes.

A 0.8 mL of the test broth culture was pipetted into the tube labelled test and 0.8 mL of a known *Staphylococcus aureus* culture to the tube labelled positive and the third tube, which served as the negative control. A 0.8mL of sterile broth was added after mixing gently; it was incubated in three tubes at 35 °C-37 °C and examined for clot after an hour. If no clotting has occurred, it was examined again after 3 hours and until no clumping at room temperature overnight. Clumping indicates positive result of *Staphylococcus. aureus* and no clumping indicate a negative for *Staphylococcus aureus*. These findings correlate with Cheesbrough (2006) who used this method to perform the tube coagulase test.

3.12.1.1.4. Indole test

A test organism was picked with a sterile bacteriological loop, emulsified in a bijou bottle containing 3 mL of sterile tryptone water, and incubated at 35 °C-37 °C for 18-24 hours.

A 0.5 mL of Kovac's reagent was added and shook gently. A red colour on the surface layer within 10 minutes indicates indole positive and no red surface layer indicate indole negative. Indole test is a positive test for *Escherichia coli*. The findings agreed with similar study by Cheesbrough (2006a).

3.12.1.1.5. Litmus milk decolonization test

A heavy test organism was picked with a sterile bacteriological loop and inoculated it into 0.5 mL of sterile litmus milk medium to incubate at 35 °C-37 °C for about 3-4 hours. A colour change was examined from mauve to white or pale yellow. A positive and negative control were set alongside the test. The incubation time was not be more than 4 hours because some strains of *Streptococci viridans* also reduce litmus milk with prolong incubation.

White or pale yellow-pink colour is a suggestive of Enterococcus and no change or a pink colour shows absent of Enterococcus species (Cheesbrough, 2006a)

3.12.1.1.6. Urease test

A bijou bottle containing 3 mL of sterile Christensen's modified urea broth was heavily inoculated with the test organism and incubated at 35°C-37°C for about 4-15 hours. A known positive strain of *Klebsiella* is set as a positive control and *Staphylococcus aureus*

as a negative control. A pink colour of urease test indicates a positive test and no pink colour indicate a negative test. (Cheesbrough, 2006a)

3.12.1.1.7. Oxidase test

A 2 or 3 drops of freshly prepared oxidase reagent was placed on a piece of filter paper in a clean petri dish. A cover slip or a piece of stick was used to pick a colony of the test organism and smear it on the filter paper. A blue-purple colour developed within few seconds indicated a positive oxidase test. No blue-purple colour indicated a negative oxidase test. (Cheesbrough, 2006a)

3.12.1.1.8. Citrate test

A sterile bacteriological loop was used to pick the test organism and then inoculated onto Simon's citrate agar in a bijou bottle and incubate for 18-48 hours for 35⁰C-37⁰C. A bright blue colour in the medium indicated a positive test and no change from the green colour indicated a negative test. Controls was also set along site the test (Cheesbrough, 2006a)

3.12.2 Culture results

Culture results were interpreted as no growth, growth (significant) and insignificant. According to the standard criteria of colony count, colonies were counted and multiply by the bacteriological loop volume to give bacteria numbers. Bacteriuria considered significant is when a count of a single type pathogen is greater than or equal to 10⁵ CFU/ mL, insignificant is when it is less than 10⁵ CFU/ mL and no growth is when there is no single growth of bacterium in the urine plated (cultured) on the media in the petri dish. (Coulthard et al., 2010b)

3.12.3. Antimicrobial susceptibility testing (AST)

Distinct colonies were picked from CLED to perform antimicrobial susceptibility testing. Mueller Hinton agar was used. For 18-24 hours at 35⁰C-37⁰C aerobically (Bryan & Immunology On-line, 2011)

A loopful of bacteria was taken from the pure colony, put in 0.85% NaCl solution, and mixed gently until a homogenous solution was attained. The turbidity of the solution was adjusted to optical density of 0.5 McFarland standard to standardize the inoculum size.

A sterile cotton swab was dipped into the solution and excess was removed by gently pressed against the inner wall of the tube containing the solution. The cotton bag was streaked on the entire surface of Muller Hinton agar. The inoculum plate left at room temperature to dry for about 3 minutes. Antibiotics disk was placed on the Muller Hinton agar with a sterile forceps and place in an incubator for 18-24 hours at 35⁰C-37⁰C. (Christensen 2000, Stammi and Hootoon 1993, Santos 2002.)

The diameter for each antibiotics was measured in millilitres to get the zone of inhibition. The measured diameter for each antibiotics was compared to a standard zone interpretative chart. That diameter measurement that fall within the range of the standard was classified as sensitive and the diameter measurement that falls below the standard chart will be classified as resistant.

The measured zone diameter was compared to standard chart that helped to classify an antibiotic as sensitive or resistant.

3.12.4 Colony Count

Colonies were counted on CLED and multiplied by the volume of the loop size. A bacterial count of 10^4 per mL was considered insignificant for UTI. A count between of $10^4 - 10^5$ per mL was considered as doubtful significance and that was repeated. Colony counts more than 10^5 per mL was considered significant bacterial growth.

Negative was defined as a growth less than 10^5 colony-forming units per millilitre (cfu/mL). Positive was defined as the presence of one or two different uropathogens with a growth of at least 10^5 cfu/mL. Uropathogens isolated in the study were *Escherichia coli* (*E. coli*), *Proteus spp*, *Klebsiella spp* and *Staphylococcus aureus*.

3.13. Laboratory quality control

Standard operational procedures (SOP) was strictly followed during each procedure and controls were set along the tests.

The media that was prepared and antibiotics used to perform were according to the Clinical and Laboratory Standards Institute (CLSI) guidelines. An autoclave tape was used during the preparation of the media to check for a complete sterilization. Prepared media from each batch was controlled at different conditions- one at room temperature for 24-48 hours, another set of media was refrigerated for at a day and the third plate was incubated at 35°C - 37°C for 18-24 hours to check for possible contamination.

Known bacteria were cultured to control the media used for the study. Susceptibility testing was done by using *E.coli* strain ATTC 25922,

3.14 Data Analysis

The raw data which was secured and password was entered into Microsoft excel spreadsheet version 16 windows 10. The data was cleaned, edited, coded and then exported into STATA software version 15, which is one of the statistical software packages for statistical analysis.

Data was first analysed descriptively by running for frequencies and proportions. Continuous variable such as age was summarized into means, standard deviation and range. Age was then re-categorized into age groups of 10 years interval. according to recommendation from Kim, Dietz, England, Morrow, and Callaghan (2007)

Categorical variables were presented as proportions and frequencies in tables. The laboratory isolated pathogens and its antibiotics susceptibility were presented in frequencies and proportions.

Binary logistic regression was done to determine factors associated with ASB.

The variables which were statistically significant at $p \leq 0.05$ as those proven plausible in in literature to factors associated with ASB were controlled for in a multiple logistic regression model to detect that were statistically significant at $p \leq 0.05$ to cause ASB among pregnant women at Akwapem North Municipality. The results were presented in two by two tables which displayed the frequencies, percentages, crude and adjusted odds ratios (OR) and 95% confidence interval (CI) and p-value.

CHAPTER FOUR

RESULTS

One hundred and thirty four (134) urine specimens were analysed from pregnant women in six selected health facilities in the Akwapim North Municipality who came for their antenatal clinic during the period of the study. Routine urine examination was performed and those pregnant women whose results were negative for protein, leucocytes, nitrite, glucose and pus cells less than 4 HPF and consented were enrolled into the study. Microbiological culture method was performed to determine the proportion of ASB among pregnant women at Akwapem North Municipality. Ages of participants ranged from a minimum of 17 years to 43 years with an average age of 29.9 years (SD $\pm$ 6.3).

Majority of the pregnant women, 72 representing 53.7% were in the age range of 25-34 years and 24.6% pregnant women were above 35 years.

All participants and the fathers' of the inborn babies (foetus) had some level of education. Seventy three (73) pregnant women representing 54.5% had basic education while 79 representing 58.9% of the baby's (foetus) father had advanced education. More than 78% of the participants were working at the time of the study but only 17 representing 12.7% earned a monthly income above one thousand Ghana cedis. More than 50% of the pregnant woman were married, 57(42.5%) were co habiting and remaining 5 representing 3.8% were single. Fifty-five (55) of the respondents representing 41.0% were yet to have their first child/twins and 18 representing 13.5% had total family size more than five.

The prevalence of ASB among the study sample was 8.2% (4.2%-14.2%).

Table 3 showed the demographic characteristics of the pregnant women.

Table 3: Demographic characteristics of pregnant women

Age (Mean	±	SD	Minimum	Maximum
29.9	±	6.3	17	43

Variables	Frequency (n)	Percentage (%)
Age category (years)		
15-24	29	21.7
25-34	72	53.7
35+	33	24.6
Religion		
Christian	120	89.5
Moslem	13	9.7
Traditionalist	1	0.8
Educational level (wife)		
Basic	73	54.5
Advanced	61	45.5
Educational level (husband)		
Basic	55	41.1
Advanced	79	58.9
Occupation		
Unemployed/student	29	21.6
Employed	105	78.4
Monthly income (wife)		
Less than 1000 GHA¢	117	87.3
More than 1000 GHA¢	17	12.7
Marital status		
Single	5	3.8
Cohabiting	57	42.5
Married	72	53.7
Years of married/staying together		
Less than a year	37	27.6
1-3 years	41	30.6
More than 3 years	56	41.8
Total family size		
Two (couple)	55	41.0
Three	24	17.9
Four	17	12.7
Five	20	14.9
More than five	18	13.5

Source: Fieldwork, 2019

Table 4: Proportion of bacteria isolated from urine culture results among pregnant women at Akwapem North

Culture result	Frequency	Percentage	Lower limit	Upper limit
Significant Growth ($>10^5$ cfu/mL)	11	8.20	4.2	14.2
No bacteria isolated	123	91.80	85.4	95.6
Total	134	100.00		

Source: Fieldwork, 2019

As indicated in the earlier part of this study, ASB is the presence of bacteria in urine without symptoms of acute UTI. There are more than two methods that can be used for diagnosis of UTI but the most common techniques are the RUE and C/S. However, C/S is the gold standard. A pregnant woman with a condition of ASB, will show a normal result with RUE test since the technique lacks appropriate sensitivity and specificity (Schnarr & Smaill, 2008). In the current study, urine culture and sensitivity was randomly ran for 134 pregnant women who visited any of the six (6) selected health facilities in the Akwapem North Municipality. One hundred and thirty four (134) pregnant women were screened with the current technique (RUE) that is normally employed at these health facilities. RUE method was performed and the results for those who were negative were assumed free from bacterial infection. However, a sterile urine container was given to all those participants to produce another urine specimen for culturing. Culture and sensitivity (C/S) testing was performed. Eleven (11) turned up with bacteria growth representing 8.2% CI (4.2-14.2) that were negative from the earlier test performed. This therefore meant that they were actually having ASB. Figure 3 below gives the pictorial view of the isolated bacteria. In order to check how significant this proportion of the number of pregnant women who actually had ASB, a binomial test was run as shown in Table 5.

Figure 3 The proportion of ASB among pregnant women at Akwapem North Municipality

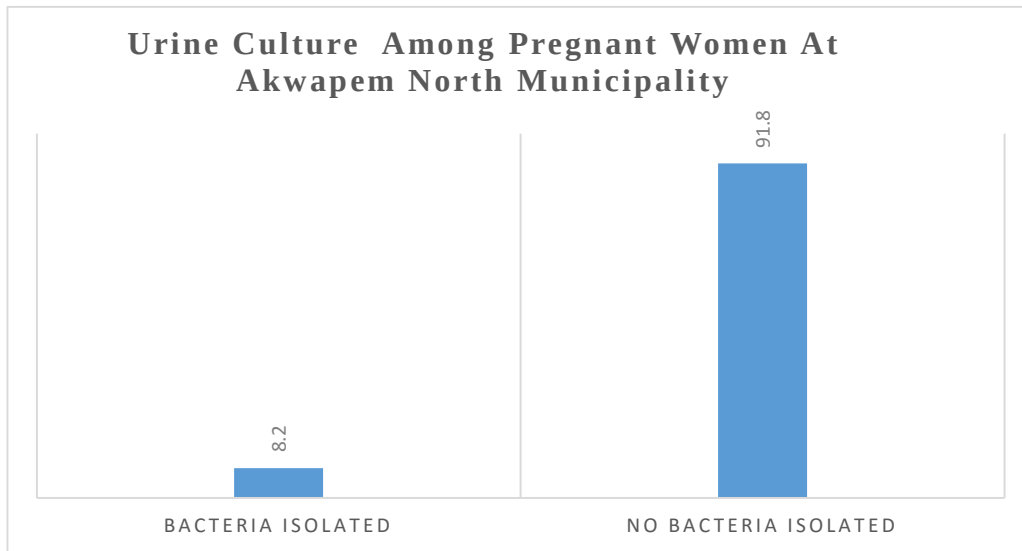


Figure 3: Urine Culture among Pregnant Women at Akwapem North Municipality

Table 5: Binomial Test for Sample Proportion

	Category	N	Observed Prop.	Test Prop.	P-value
Bacteria growth	Group 1 No bacteria growth	123	0.918	.999	0.000 ^a
	Group 2 Bacteria Growth	11	0.082		
	Total	134	1.000		

a. Alternative hypothesis states that the proportion of cases in the first group < .999.

The Binomial Test in Table 5 revealed that the proportion (0.082) of pregnant women who were really having ASB was very significant since the p-value (0.000) which is less than 0.05. This therefore means that, out of every 1000 pregnant women who were initially declared to be free from UTI (ASB), 82 of them were actually having ASB at Akwapem North Municipality at 95% confidence level.

Table 6: Isolated bacteria from ASB pregnant women at Akwapem Mampong and its antimicrobial susceptibility pattern.

Bacteria isolated	<i>E .coli</i> n(%)	<i>Klebsiella spp</i> n(%)	<i>Proteus spp</i> n (%)	<i>Staph. aureus</i> n (%)	Total n (%)
Total bacteria isolated	7(63.6)	2(18.2)	1(9.1)	1(9.1)	11(100)
<u>Antibiotics</u>					
Ampicillin					
Sensitive	5 (71.4)	2 (100)	0 (0)	0 (0)	7 (63.6)
Resistant	2 (28.6)	0 (0)	1 (100)	1 (100)	4 (36.4)
Cotrimoxazole					
Sensitive	2 (28.6)	0 (0)	0 (0)	1 (100)	3 (27.3)
Resistant	5 (71.4)	2 (100)	1 (100)	0 (0)	8 (72.7)
Cefuroxime					
Sensitive	4 (57.1)	1 (50)	0 (0)	0 (0)	5 (45.5)
Resistant	3 (42.9)	1 (50)	1 (100)	1 (100)	6 (54.6)
Gentamicin					
Sensitive	6 (85.7)	1 (50)	1 (100)	0 (0)	8 (72.7)
Resistant	1 (14.3)	1 (50)	0 (0)	1 (100)	3 (27.3)
Nalidixic Acid					
Sensitive	5 (71.4)	1 (50)	1 (100)	0 (0)	7 (63.6)
Resistant	2 (28.6)	1 (50)	0 (0)	1 (100)	4 (36.4)
Nitrofurantoin					
Sensitive	5 (71.4)	2 (100)	1 (100)	1 (100)	9 (81.8)
Resistant	2 (28.6)	0 (0)	0 (0)	0 (0)	2 (18.2)
Pipemidic Acid					
Sensitive	4 (57.1)	1 (50)	1 (100)	1 (100)	7 (63.6)
Resistant	3 (42.9)	1 (50)	0 (0)	0 (0)	4 (36.4)
Tetracycline					
Sensitive	4 (57.1)	2 (100)	0 (0)	0 (0)	6 (54.6)
Resistant	3 (42.9)	0 (0)	1 (100)	1 (100)	5 (45.5)

Source: Fieldwork, 2019

Table 6 showed the antimicrobial susceptibility patterns of four (4) bacteria isolated from eleven (11) pregnant women at Akwapem North Municipality. The bacteria were three Gram negatives namely *Escherichia coli*, *Klebsiella spp* and *Proteus spp* and *Staphylococcus aureus* as the only Gram-positive bacteria isolated from the study.

From table 6 above, the study showed that *E. coli* was the highest bacteria isolated from 7 pregnant women representing 63.6% followed by *Klebsiella spp* which was isolated from 2 pregnant women representing 18.2%. The other two bacteria were *Proteus spp* and *Staphylococcus aureus* were isolated from two pregnant women representing a 9.1% each.

From the study, Nitrofurantoin was the most effective antibiotics, which was sensitive to 81.8 % of the bacteria isolated, followed by Gentamicin 72.7% sensitive.

Cotrimoxazole was the highest resistant antibiotics to the isolated four (4) bacteria among the pregnant women in Akwapem North Municipality representing 72.7%. Tetracycline was the second antibiotics with a resistant of 45.5%.

Table 7: Socio demographic factors and its association with ASB

Variable	Bacteria		Crude odds ratio	
	No Growth	Growth	cOR (95% CI)	P-value
Age category (years)				0.41
15-24	25 (86.21)	4 (13.79)	1.00(reference)	
25-34	68 (94.44)	4 (5.56)	0.37(0.08-1.59)	
35+	30 (90.91)	3 (9.09)	0.63(0.13-3.08)	
Religion				0.94
Christian	110 (91.67)	10 (8.33)	1.00(reference)	
Moslem	12 (92.31)	1 (7.69)	0.92(0.11-7.86)	
Traditionalist	1 (100)	0 (0)	(empty)	
Education(woman)				0.53
Basic	66 (90.41)	7 (9.59)	1.00(reference)	
Advanced	57 (93.44)	4 (6.56)	0.66(0.18-2.39)	
Education(husband)				0.76
Basic	50 (90.91)	5 (9.09)	1.00(reference)	
Advanced	73 (92.41)	6 (7.59)	0.82(0.24-2.85)	
Occupation				0.32
Unemployed/student	28 (96.55)	1 (3.45)	1.00(reference)	
Employed	95 (90.48)	10 (9.52)	2.95(0.36-24.22)	
Monthly income				0.57
<1000	108 (92.31)	9 (7.69)	1.00(reference)	
>=1000	15 (88.24)	2 (11.76)	1.6(0.31-8.17)	
Marital status				0.39
Single	4 (80)	1 (20)	1.00(reference)	
Cohabiting	51 (89.47)	6 (10.53)	0.47(0.04-4.97)	
Married	68 (94.44)	4 (5.56)	0.24(0.02-2.65)	
Family size				0.12
Two	52(94.6)	3 (5.4)	1.00(reference)	
Three	20(83.3)	4(5.4)	3.46(0.711-16.88)	
Four	16(94.1)	1(5.9)	1.08(0.105-11.15)	
Five	18(90)	2(10)	1.92(0.29-12.46)	
More than five	17(94.4)	1(5.6)	1.01(0.99-10.46)	

Source: Fieldwork, 2019

Table 7 shows the prevalence of ASB with respect to socio demographic factors. Among the age category, 15-24 had the highest prevalence with percentage of 13.8 as compared to the other age category although it showed no association with ASB.

Table 8: Environmental factors and its association with asymptomatic bacteriuria

Variable	Bacteria		Crude odd ratio	
	No Growth	Growth	cOR(95% CI)	P-value
Residence				0.74
Self-Contained	51 (92.73)	4 (7.27)	1.00(reference)	
Compound House	72 (91.14)	7 (8.86)	1.24(0.34-4.48)	
Years of marriage /staying together				0.29
<1 year	36 (97.3)	1 (2.7)	1.00(reference)	
1-3 years	38 (92.68)	3 (7.32)	2.84(0.28-28.84)	
>3 years	49 (87.5)	7 (12.5)	5.14(0.6-44.02)	
Source of water				0.46
Tab	96 (92.31)	8 (7.69)	1.00(reference)	
Borehole	21 (87.5)	3 (12.5)	1.71(0.42-7.05)	
River/Stream	6 (100)	0 (0)	(empty)	
Water consumption				0.56
< 1 litre/day	54 (93.1)	4 (6.9)	1.00(reference)	
2-3 litre/day	51 (92.73)	4 (7.27)	1.06(0.25-4.48)	
>3 litre/day	18 (85.71)	3 (14.29)	2.25(0.46-11.09)	
Toilet facility				0.04*
Private	94 (94.95)	5 (5.05)	1.00(reference)	
Public	29 (82.86)	6 (17.14)	3.9(1.1-13.75)*	

Source: Fieldwork, 2019

Table 9: Clinical/pregnancy history and its association with asymptomatic bacteriuria

Variable	Bacteria		Crude odds ratio	P-value
	No Growth	Growth	COR (95% CI)	
Frequency of intercourse/week				0.35
<= 3 times/week	119 (92.25)	10 (7.75)	1.00(reference)	
>3 times/week	4 (80)	1 (20)	2.98(0.3-29.46)	
Gravidity				0.09
Primigravidae(One)	32 (94.12)	2 (5.88)	1.00(reference)	
Multigravidae (Two)	28 (82.35)	6 (17.65)	3.43(0.64-18.49)	
Multigravidae(> Two)	63 (95.45)	3 (4.55)	0.76(0.12-4.83)	
Parity				0.14
Nulliparous(Yet to give birth)	41 (85.42)	7 (14.58)	1.00(reference)	
Primiparous (One)	21 (91.3)	2 (8.7)	0.56(0.11-2.94)	
Multiparous (>One)	61 (96.83)	2 (3.17)	0.19(0.04-0.98)*	
Stage of pregnancy				0.08
1st trimester	21 (80.77)	5 (19.23)	1.00(reference)	
2nd trimester	33 (91.67)	3 (8.33)	0.38(0.08-1.78)	
3rd trimester	69 (95.83)	3 (4.17)	0.18(0.04-0.83)*	
Multiple pregnancy				0.01*
NO	118 (93.65)	8 (6.35)	1.00(reference)	
YES	5 (62.5)	3 (37.5)	8.85(1.78-44.12)**	
Any miscarriage				0.11
NO	68 (88.31)	9 (11.69)	1.00(reference)	
YES	55 (96.49)	2 (3.51)	0.27(0.06-1.33)	
Any medical condition				0.02*
No	115 (93.5)	8 (6.5)	1.00(reference)	
Yes	8 (72.73)	3 (27.27)	5.39(1.19-24.49)*	
Outcome of previous pregnancy				0.16
Yet to give birth	41 (85.42)	7 (14.58)	1.00(reference)	
Good	69 (95.83)	3 (4.17)	0.25(0.06-1.05)	
Poor	13 (92.86)	1 (7.14)	0.45(0.05-4.04)	
Ever use catheter				0.92
No	99 (91.67)	9 (8.33)	1.00(reference)	
Yes	24 (92.31)	2 (7.69)	0.92(0.18-4.55)	
Experienced of last UTI				0.55
Before Marriage	38 (100)	0 (0)	(empty)	
Married But Not Pregnant	10 (83.33)	2 (16.67)	1.67(0.31-8.92)	
When Pregnant	75 (89.29)	9 (10.71)	1.00(reference)	
Seek medical conditions				0.71
No	16 (94.12)	1 (5.88)	1.00(reference)	
Yes	107 (91.45)	10 (8.55)	1.5(0.18-12.58)	
Buy antibiotic without prescription				0.48
No	76 (90.48)	8 (9.52)	1.00(reference)	
Yes	47 (94)	3 (6)	0.61(0.15-2.41)	

Source: Fieldwork, 2019

Table 10: Health facility and its association with asymptomatic bacteriuria

Variable	Bacteria		Crude odds ratio	
	No Growth	Growth	COR(95% CI)	P-value
Type of test				0.26
RUE	92(90.2)	10(9.8)	1.00(reference)	
C/S	31(96.9)	1(3.1)	0.29(0.04-2.41)	
Place of ANC clinic				0.36
Hospital	49(94.2)	3(5.8)	1.00(reference)	
Health Centre	69(89.6)	8(10.4)	1.89(0.4-7.5)	
CHPS	5(100)	0(0.0)	(empty)	

Source: Fieldwork, 2019

Table 11: Multiple Logistic Regression Results for factors Associated with asymptomatic bacteriuria

Variables	Bacteria		Unadjusted Model		Adjusted Model	
	No Growth	Growth	cOR(95%CI)	P-value	aOR(95%CI)	P-value
Toilet facility				0.04		0.06
Private	94 (94.95)	5 (5.05)	1.00(reference)		1.00(reference)	
Public	29 (82.86)	6 (17.14)	3.9(1.1-13.8)		4.03(0.93-17.5)	
Multiple pregnancy				0.01		0.01
No	118(93.6)	8(6.4)	1.00(reference)		1.00(reference)	
Yes	5(62.5)	3(37.5)	8.85(1.7-44.2)		9.52(1.7-51.9)	
Any medical condition				0.03		0.09
No	115(93.5)	8(6.5)	1.00(reference)		1.00(reference)	
Yes	8(72.7)	3(27.3)	5.4(1.19-24.5)		2.0(0.26-16.9)	

cOR-crude odds ratio aOR-adjusted odd ratio CI-confidence interval.

Multiple logistic regression analysis was conducted on all the associated factors that were statistically significant at 95% CI and $P \text{ value} \leq 0.05$ at the bivariate level. These factors were toilet facility, multiple pregnancy and any medical condition. Out of the three associated factors that were significantly associated with ASB at the bivariate analysis, only one was statistically significant and strongly associated with the development of ASB at the multiple logistic regression analysis level ($P \text{ value} \leq 0.05$). This is shown on table 11 above.

CHAPTER FIVE

DISCUSSION

The study investigated the proportion of ASB among a study population of one hundred and thirty four (134) pregnant women from six (6) selected health facilities in Akwapem North Municipality during a period of May to July 2019. Urine specimens were cultured from pregnant women whose initial results with RUE were negative for protein, nitrite, leucocytes and pus cells less than 5/ HPF. The results of the study showed that eleven (11) out of one hundred and thirty four (134) pregnant women had had ASB giving proportion of 8.2% (4.3-14.6). The prevalence is almost close to similar work done by Debebe (2005) This study is in agreement with what several researches said about the prevalence of ASB among pregnant women that is from 2.5% to over 10% (Abdullahi & Thairu, 2015).

In contrast to this study, the study done in Nigeria by Kutlay et, al, (2003) had a much higher prevalence of 86.6%, which may be due to the difference geographical area of the study population or the screening method used in selecting the participants.

ASB rarely causes serious problems however in pregnancy, if this condition is left untreated, more than 30% of the pregnant women will develop serious complications (Schnarr & Smaill, 2008).

From the Binomial Test in Table 4 shown that the proportion 11/134 (0.082) of pregnant women who were really having ASB was very significant since the p-value (<0.001) is less than 0.05. This therefore means that, out of every 1000 pregnant women who were initially declared free from urinary tract infection with the RUE technique used in Akwapem North Municipality among the participants, eighty two (82) will have ASB and

out of that, more than twenty five (25) of them will develop serious complications. Some of these consequences of untreated ASB in pregnant women may lead to pyelonephritis, low birth weight, premature labor, eclampsia, premature rupture of the membrane, mental retardation, fatal death, pregnancy-induced hypertension, anaemia (Mohamed et al., 2017). This can be a great worry to families since more resources will be spent to treat these conditions or even spend the whole lifetime looking after a human being from infancy through adulthood to old age if he/ she has developed a mental condition. Life can also be lost since this condition can result into fatal death on the part of either the child, mother or both.

According to Çelen et al. (2011), in Turkey the prevalence of ASB was 8.5 which has a difference of 0.3% from this study. Similar studies were conducted in the same country Ghana but in different geographical regions. These studies were conducted in Ashanti Region at Komfo Anokye Teaching Hospital, Kumasi by Turpin et al. (2007) and had a prevalence of 7.2%. At Korle-bu Teaching Hospital in the Greater Accra Region, the capital city of Ghana, the prevalence of ASB was 5.5% (Labi et al., 2015). This research was also carried out at Akwapem North Municipality from May-July, 2019 in the Eastern Region of Ghana and had a result of 8.2% prevalence of ASB among pregnant women. These variations in prevalence can be attributed to several factors. Some of these factors can be grouped as sociodemographic factors, environmental factors, clinical/pregnancy history and health facilities. These factors will be explained into details when discussing the third objective and the findings of this study.

Four (4) different types of bacteria were isolated from the study. These were *E.coli* 7(63.6%), *Klebsiella* spp 2(18.1%), *Proteus* spp 1(9.1%) and *Staphylococcus aureus* 1(9.1%).

Comparing the study to similar studies done in Ghana, the commonest bacteria isolated was in line with the one conducted by Turpin et al. (2007) at Komfo Anokye Teaching Hospital, Kumasi which had *E. coli*- 6(37.5%). In Greater Accra Region, Labi et al. (2015) had *Enterococcus* spp of 4(26.7%) as the common bacteria isolated at the Korle-Bu Teaching Hospital. Studies done in different countries all confirmed *E coli* to be the most causative bacteria causing ASB among pregnant women. This can be affirmed by Amiri et al. (2015a) in Babol city, Emamghorashi, Mahmoodi, Tagarod, and Heydari (2012) Jahrom, Masinde et al. (2009) in Tanzania Al Haddad (2005) in Yemen Mobsheri et al. (2002) in Gorgan, all had *E.coli* as the most causative bacteria in their studies. This is consistent with the work done at Akwapem North Municipality.

Antibiotics are among the most frequently prescribed types of medication during pregnancy and lactation (Nahum et al., 2006). The second objective of this study is to determine the antibacterial susceptibility pattern of the antibiotics on the isolated bacteria among the pregnant women in Akwapem North Municipality.

The study showed the antimicrobial susceptibility patterns of four (4) different types of bacteria isolated from eleven (11) pregnant women. The bacteria were three Gram negatives, namely *Escherichia coli*, *Klebsiella* spp and *Proteus* spp and *Staphylococcus aureus* as the only Gram positive bacteria isolated from the study.

From the results on table 6, which showed the total bacteria isolated, *E. coli* was the most predominant bacteria isolated from 7 pregnant women representing 63.6% followed by *Klebsiella* spp. that was isolated from 2 pregnant women representing 18.2%. The other two bacteria were *Proteus* spp and *Staphylococcus aureus*. *Proteus* spp was isolated from one pregnant woman and *Staphylococcus aureus* was from another pregnant woman representing a 9.1% each.

From the study, Nitrofurantoin was the most effective antibiotics, which was 81.8% sensitive to the bacteria isolated. This was in agreement to the study done by Labi et al. (2015) and went further to explain that the antibiotics is not commonly used for treatment of UTI in Ghana therefore its abuse is limited. From this study Gentamicin was 72.7% sensitive to the isolated bacteria and from researcher's point of view, this antibiotics is an injectable therefore the use of it might be limited unless prescribe by a clinician or a pharmacist and also the pain in injecting one's self with a needle.

Cotrimoxazole was the highest resistant antibiotics to the isolated four (4) bacteria among the pregnant women in Akwapem North Municipality representing 72.7%. It is very common in Ghana and both the injection and the tablet so the abuse of it is high. Cefuroxime is also gradually becoming resistant since this is what is given to pregnant women for treatment of UTI. (Sorlozano et al., 2014) When RUE result is suggestive of urinary tract infection it must be confirmed by C/S to know its susceptibility pattern and its epidemiology.

Epidemiological studies carried out among pregnant women in different populations worldwide have identified a diverse range of factors for asymptomatic bacteriuria. (Tellapragada et al., 2016).

The result of this study showed that there were no statistically significant associations with the development of ASB between most of the factors.

Labi et al. (2015) reported, the prevalence of ASB was associated with sexual activity during pregnancy, but not with sexual frequency, their finding affirmed in the current study. The frequency of sexual intercourse per week was not statistically significant (p-value 0.353)

At the bivariate level, only four of these factors were statistically significant at at 95% CI and P value ≤ 0.05 . The results from the analysis indicate that toilet kind (p-value = 0.03), multiple pregnancy (p-value = 0.01), family history of medical condition (p-value = 0.04) and UTI previous experience (p-value= 0.03) were associated with ASB. This means that, there is a possibility of pregnant women having ASB based on these factors.

According to Andabati and Byamugisha (2010), women who have many children before the present pregnancy and it has been reported that multiparity is associated with ASB. In this study, the number of births was not statistically significant but it was multiple pregnancy that was strongly associated with a 9.5 folds greater odds of getting ASB compared to those with no multiple pregnancy in both bivariate and multivariate analysis OR 8.9 and 9.2 respectively.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The prevalence of ASB among pregnant women is 8.2 (4.3%-14-6%) at Akwapem North Municipality.

E.coli was the most predominate bacteria isolated with 63.6%. Quantitative urine culture is the ideal test for the detection of ASB. The culture method helps to identify the bacteria and per it susceptibility pattern in order to reduce the antibiotics resistance which has now become a public health problem globally.

Early detection and treatment are essential to safeguard the health of mother and fetus. In this study, Nitrofurantoin was the most sensitive with a percentage of 81.8 and Cotrimoxazole was the most resistant of 72.7%.

6.2. Recommendation

6.2.1 Implications for clinical practice

The Director at the Municipality must help upgrade laboratories in the municipality so that screening for ASB can be done for all pregnant women with a more sensitive technique instead of the the routine urine examination which is not sensitive in detecting ASB among pregnant women.

Screening for ASB with the gold standard will help in knowing the bacteria causing the infection and deciding the best choice of antibiotics if there are any bacteria isolated so that we may help in reducing the bacteria resistance.

6.2.2 Implication for policy

The Ministry of Health must liaise with the Pharmacy Council to come with a policy on how antibiotics are sold in the country. This will help reduce the abuse of antibiotics in the country.

6.2.3. Implications for research

The district must help the laboratories by providing them with computers so that the data generated in form test carried out on daily basis can be analyzed to come out with policies in the municipality.

REFERENCES

- Abdullahi, H. I., & Thairu. (2015). Asymptomatic bacteriuria among pregnant women attending antenatal: evaluation of screening test. *IOSR Journal of Pharmacy*, 5(8), 41-47.
- Abdullahi, H. I., & Thairu, Y. J. I. J. o. P. (2015). Asymptomatic bacteriuria among pregnant women attending antenatal: evaluation of screening test. 5(8), 41-47.
- Adam, I., & Saadia, Z. (2015). Urinary tract infections in pregnancy. In: SMGroup.
- Afriyie, D. K., Gyansa-Lutterodt, M., Amponsah, S. K., Asare, G., Wiredu, V., Wormenor, E., & Bugyei, K. A. J. P. A. M. J. (2015). Susceptibility pattern of uropathogens to ciprofloxacin at the Ghana police hospital. 22(1).
- Akerele, P. A., F. Okonofua, J %J Journal of Obstetrics, & Gynaecology. (2001). Prevalence of asymptomatic bacteriuria among pregnant women in Benin City, Nigeria. 21(2), 141-144.
- Al Haddad, A. (2005). Urinary tract infection among pregnant women in Al-Mukalla district, Yemen. *East Mediterr Health J*.
- Al Sibiani, S. A. J. J. o. K. A. U. (2010). Asymptomatic bacteriuria in pregnant women in Jeddah, Western Region of Saudi Arabia: call for assessment. 17(1), 29.
- Amiri, M., Lavasani, Z., Norouzirad, R., Najibpour, R., Mohamadpour, M., Nikpoor, A. R., . . . Marzouni, H. Z. (2015a). Prevalence of urinary tract infection among pregnant women and its complications in their newborns during the birth in the hospitals of Dezful city, Iran, 2012-2013. *Iranian Red Crescent Medical Journal*, 17(8).
- Amiri, M., Lavasani, Z., Norouzirad, R., Najibpour, R., Mohamadpour, M., Nikpoor, A. R., . . . Marzouni, H. Z. J. I. R. C. M. J. (2015b). Prevalence of urinary tract infection among pregnant women and its complications in their newborns during the birth in the hospitals of Dezful city, Iran, 2012-2013. 17(8).
- Andabati, G., & Byamugisha, J. J. A. h. s. (2010). Microbial aetiology and sensitivity of asymptomatic bacteriuria among ante-natal mothers in Mulago hospital, Uganda. 10(4).
- Andersson, D. I., & Hughes, D. J. F. m. r. (2011). Persistence of antibiotic resistance in bacterial populations. 35(5), 901-911.
- Bérard, A., Santos, F., Ferreira, E., & Perreault, S. (2011). Urinary tract infections during pregnancy. In *Urinary tract infections*: InTech.
- Blomberg, B., Olsen, B. E., Hinderaker, S. G., Langeland, N., Gasheka, P., Jureen, R., . . . Midtvedt, T. J. S. j. o. i. d. (2005). Antimicrobial resistance in urinary bacterial isolates from pregnant women in rural Tanzania: implications for public health. 37(4), 262-268.

- Brocklehurst, P., Gordon, A., Heatley, E., & Milan, S. J. J. C. D. o. s. r. (2013). Antibiotics for treating bacterial vaginosis in pregnancy. (1).
- Çelen, Ş., Oruç, A. S., Karayalçın, R., Saygan, S., Ünlü, S., Polat, B., . . . gynecology. (2011). Asymptomatic bacteriuria and antibacterial susceptibility patterns in an obstetric population. 2011.
- Cheesbrough, M. (2006a). *District laboratory practice in tropical countries* (Vol. 2): Cambridge university press.
- Cheesbrough, M. (2006b). *District laboratory practice in tropical countries*: Cambridge university press.
- Choi, S. J., Park, S. D., Jang, I. H., Uh, Y., & Lee, A. J. A. o. l. m. (2012). The prevalence of vaginal microorganisms in pregnant women with preterm labor and preterm birth. 32(3), 194-200.
- Christensen, B. J. J. o. a. c. (2000). Which antibiotics are appropriate for treating bacteriuria in pregnancy? , 46(suppl_1), 29-34.
- Costelloe, C., Metcalfe, C., Lovering, A., Mant, D., & Hay, A. D. J. B. (2010). Effect of antibiotic prescribing in primary care on antimicrobial resistance in individual patients: systematic review and meta-analysis. 340, c2096.
- Coulthard, M. G., Kalra, M., Lambert, H. J., Nelson, A., Smith, T., & Perry, J. D. J. P. (2010). Redefining urinary tract infections by bacterial colony counts. 125(2), 335-341.
- Crider, K. S., Cleves, M. A., Reefhuis, J., Berry, R. J., Hobbs, C. A., Hu, D. J. J. A. o. p., & medicine, a. (2009). Antibacterial medication use during pregnancy and risk of birth defects: National Birth Defects Prevention Study. 163(11), 978-985.
- Dafnis, E., & Sabatini, S. J. T. A. j. o. t. m. s. (1992). The effect of pregnancy on renal function: physiology and pathophysiology. 303(3), 184-205.
- Dalal, S., Nicolle, L., Marrs, C. F., Zhang, L., Harding, G., & Foxman, B. J. C. I. D. (2009). Long-term Escherichia coli asymptomatic bacteriuria among women with diabetes mellitus. 49(4), 491-497.
- Dashe, J. S., Gilstrap III, L. C. J. O., & America, g. c. o. N. (1997). Antibiotic use in pregnancy. 24(3), 617-629.
- David, S. B., Einarson, T., David, Y. B., Nulman, I., Pastuszak, A., Koren, G. J. F., & pharmacology, c. (1995). The safety of nitrofurantoin during the first trimester of pregnancy: meta-analysis. 9(5), 503-507.
- Debebe, S. (2005). *Asymptomatic Bacteriuria in Pregnant Women in Harar, South Eastern Ethiopia*. Addis Ababa University,
- Dielubanza, E. J., & Schaeffer, A. J. J. M. c. (2011). Urinary tract infections in women. 95(1), 27-41.

- Emamghorashi, F., Mahmoodi, N., Tagarod, Z., & Heydari, S. T. (2012). Maternal urinary tract infection as a risk factor for neonatal urinary tract infection. *Iranian journal of kidney diseases*, 6(3), 178.
- Etminan-Bakhsh, M., Tadi, S., & Darabi, R. J. E. p. (2017). Asymptomatic bacteriuria in pregnant women attending Boo-Ali Hospital Tehran Iran: Urine analysis vs. urine culture. 9(11), 5760.
- Farkash, E., Weintraub, A. Y., Sergienko, R., Wiznitzer, A., Zlotnik, A., Sheiner, E. J. E. J. o. O., . . . Biology, R. (2012). Acute antepartum pyelonephritis in pregnancy: a critical analysis of risk factors and outcomes. 162(1), 24-27.
- Fihn, S. D. J. N. E. J. o. M. (2003). Acute uncomplicated urinary tract infection in women. 349(3), 259-266.
- Flores-Mireles, A. L., Walker, J. N., Caparon, M., & Hultgren, S. J. J. N. r. m. (2015). Urinary tract infections: epidemiology, mechanisms of infection and treatment options. 13(5), 269.
- Gilbert, N. M., O'Brien, V. P., Hultgren, S., Macones, G., Lewis, W. G., Lewis, A. L. J. G. a. i. h., & medicine. (2013). Urinary tract infection as a preventable cause of pregnancy complications: opportunities, challenges, and a global call to action. 2(5), 59-69.
- Gilstrap III, L. C., Ramin, S. M. J. O., & America, g. c. o. N. (2001). Urinary tract infections during pregnancy. 28(3), 581-591.
- Goldenberg, R. L., Culhane, J. F., Iams, J. D., & Romero, R. J. T. I. (2008). Epidemiology and causes of preterm birth. 371(9606), 75-84.
- Goldenberg, R. L., Hauth, J. C., & Andrews, W. W. J. N. E. j. o. m. (2000). Intrauterine infection and preterm delivery. 342(20), 1500-1507.
- Goossens, H., Ferech, M., Vander Stichele, R., Elseviers, M., & Lancet, E. P. G. J. T. (2005). Outpatient antibiotic use in Europe and association with resistance: a cross-national database study. 365(9459), 579-587.
- Graham, J., & Galloway, A. J. J. o. C. P. (2001). ACP Best Practice No 167: the laboratory diagnosis of urinary tract infection. 54(12), 911-919.
- Harbinger, H. A., & Contraceptives, O. J. U. P. (2014). Urinary tract infection. 39(8), 17-18.
- Kehinde, A. O., Adedapo, K. S., Aimaikhu, C. O., Olayemi, O., Salako, B. J. T. m., & health. (2011). Significant bacteriuria among asymptomatic antenatal clinic attendees in Ibadan, Nigeria. 39(3), 73-76.
- Kenyon, S., Boulvain, M., & Neilson, J. P. J. C. D. o. S. R. (2003). Antibiotics for preterm rupture of membranes. (2).
- Kenyon, S., Taylor, D., & Tarnow-Mordi, W. f. J. T. L. (2001). Broad-spectrum antibiotics for preterm, prelabour rupture of fetal membranes: the ORACLE I randomised trial. 357(9261), 979-988.

- Kim, S. Y., Dietz, P. M., England, L., Morrow, B., & Callaghan, W. M. J. O. (2007). Trends in pre-pregnancy obesity in nine states, 1993–2003. *15*(4), 986-993.
- Kirkham, C., Harris, S., & Grzybowski, S. J. p. (2005). Evidence-based prenatal care: part II. Third-trimester care and prevention of infectious diseases. *10*, 11.
- Kislak, J. W., Eickhoff, T. C., & Finland, M. J. N. E. J. o. M. (1964). Hospital-acquired infections and antibiotic usage in the Boston City Hospital—January, 1964. *271*(16), 834-835.
- Kunin, C. M. (1997). *Urinary tract infections. Detection, prevention, and management*: Williams & Wilkins.
- Kunin, C. M., & McCormack, R. C. J. N. E. J. o. M. (1968). An epidemiologic study of bacteriuria and blood pressure among nuns and working women. *278*(12), 635-642.
- Labi, A., Yawson, A., Ganyaglo, G., & Newman, M. J. G. m. j. (2015). Prevalence and associated risk factors of asymptomatic bacteriuria in ante-natal clients in a large teaching hospital in Ghana. *49*(3), 154-158.
- Lamont, R. F., Nhan-Chang, C.-L., Sobel, J. D., Workowski, K., Conde-Agudelo, A., Romero, R. J. A. j. o. o., & gynecology. (2011). Treatment of abnormal vaginal flora in early pregnancy with clindamycin for the prevention of spontaneous preterm birth: a systematic review and metaanalysis. *205*(3), 177-190.
- Le, T. P., & Miller, L. G. J. C. i. d. (2001). Empirical therapy for uncomplicated urinary tract infections in an era of increasing antimicrobial resistance: a decision and cost analysis. *33*(5), 615-621.
- Leekha, S., Terrell, C. L., & Edson, R. S. (2011). *General principles of antimicrobial therapy*. Paper presented at the Mayo Clinic Proceedings.
- Li, P., Ma, L., Wong, S. J. J. o. p., & health, c. (2002). Is bag urine culture useful in monitoring urinary tract infection in infants? , *38*(4), 377-381.
- Lumbiganon, P., Laopaiboon, M., Thinkhamrop, J. J. C. o. i. O., & Gynecology. (2010). Screening and treating asymptomatic bacteriuria in pregnancy. *22*(2), 95-99.
- Macejko, A. M., & Schaeffer, A. J. J. U. C. (2007). Asymptomatic bacteriuria and symptomatic urinary tract infections during pregnancy. *34*(1), 35-42.
- Manjula, R., Kavya, H., Kashinakunti, S., Shivakumar, S., Dorle, A., Lalitha, D. J. B. J. o. M., & Research, M. (2016). Diagnostic accuracy of Griess test for asymptomatic bacteriuria in pregnancy. *11*(8).
- Masinde, A., Gumodoka, B., Kilonzo, A., & Mshana, S. (2009). Prevalence of urinary tract infection among pregnant women at Bugando Medical Centre, Mwanza, Tanzania. *Tanzania journal of health research*, *11*(3).
- McDermott, S., Callaghan, W., Szwejbka, L., Mann, H., Dagui, V. J. O., & Gynecology. (2000). Urinary tract infections during pregnancy and mental retardation and developmental delay. *96*(1), 113-119.

- McGladdery, S., Aparicio, S., Verrier-Jones, K., Roberts, R., & Sacks, S. J. Q. A. I. J. o. M. (1992). Outcome of pregnancy in an Oxford-Cardiff cohort of women with previous bacteriuria. 83(4), 533-539.
- Milo, G., Katchman, E., Paul, M., Christiaens, T., Baerheim, A., & Leibovici, L. J. C. D. o. S. R. (2005). Duration of antibacterial treatment for uncomplicated urinary tract infection in women. (2).
- Misdraji, J., & Nguyen, P. L. J. P. m. (1996). Urinalysis: when—and when not—to order. 100(1), 173-192.
- Mobsheri, E., Tabbraei, A., Ghaemei, E., MOUJERLOU, M., Vakili, M., Dastforooshan, M., & GHOLAMEI, S. (2002). DISTRIBUTION OF ASYMPTOMATIC BACTERIURIA IN PREGNANT WOMEN REFERRING TO DEZYANI HOSPITAL IN GORGAN.
- Mohamed, N. R., Omar, H. H. H., & Abd-Allah, I. M. J. I.-J. (2017). Prevalence and Risk Factors of Urinary Tract Infection among Pregnant Women in Ismailia City, Egypt. 6(3), 62-72.
- Nahum, G. G., Uhl, K., Kennedy, D. L. J. O., & Gynecology. (2006). Antibiotic use in pregnancy and lactation: what is and is not known about teratogenic and toxic risks. 107(5), 1120-1138.
- Nasiri, R. M., & Muhi, F. A. (2019). THE PROPORTION OF PREGNANCY-ASSOCIATED ASYMPTOMATIC BACTERIURIA IN AL-KARKH HOSPITAL.
- Nicolle, L. E., Bradley, S., Colgan, R., Rice, J. C., Schaeffer, A., & Hooton, T. M. J. C. i. d. (2005). Infectious Diseases Society of America guidelines for the diagnosis and treatment of asymptomatic bacteriuria in adults. 643-654.
- Obirikorang, C., Quaye, L., Bio, F., Amidu, N., Acheampong, I., Addo, K. J. J. o. M., & Sciences, B. (2012). Asymptomatic Bacteriuria among Pregnant Women Attending Antenatal Clinic at the University Hospital, Kumasi, Ghana. *Journal of Medical and Biomedical Sciences* (2012) 1(1): 38-44
- 1(1), 38-44.
- Obstetrics, C. o. O. P. J., & gynecology. (2015). The American College of Obstetricians and Gynecologists Committee Opinion no. 630. Screening for perinatal depression. 125(5), 1268.
- Opintan, J. A., Newman, M. J., Arhin, R. E., Donkor, E. S., Gyansa-Lutterodt, M., Mills-Pappoe, W. J. I., & resistance, d. (2015). Laboratory-based nationwide surveillance of antimicrobial resistance in Ghana. 8, 379.
- Ortega-González, Y., & Castro-Díaz, D. J. C. B. D. R. (2014). Antibiotic considerations for urinary tract infections in pregnancy. 9(3), 167-174.
- Parveen, K., Momen, A., Begum, A. A., Begum, M. J. J. o. D. N. M. C., & Hospital. (2011). Prevalence of urinary tract infection during pregnancy. 17(2), 8-12.

- Pfaller, M., Ringenberg, B., Rames, L., Hegeman, J., Koontz, F. J. D. m., & disease, i. (1987). The usefulness of screening tests for pyuria in combination with culture in the diagnosis of urinary tract infection. 6(3), 207-215.
- Prasanna, B., Naimisha, M., Swathi, K., & Shaik, M. V. J. I. J. C. M. A. S. (2015). Prevalence of asymptomatic bacteriuria in pregnant women, isolates and their culture sensitivity pattern. 4(8), 28-35.
- Rao, V. M., Venkatesh, B. S., & Rao, S. R. J. I. J. C. M. A. S. (2018). Asymptomatic Bacteriuria in Pregnant Women-Study at a Tertiary Maternity care Hospital in Hyderabad, India. 7(5), 1133-1142.
- Rouse, D. J., Andrews, W. W., Goldenberg, R. L., Owen, J. J. O., & Gynecology. (1995). Screening and treatment of asymptomatic bacteriuria of pregnancy to prevent pyelonephritis: a cost-effectiveness and cost-benefit analysis. 86(1), 119-123.
- Rüttimann, S., Keck, B., Hartmeier, C., Maetzel, A., & Bucher, H. C. J. C. I. D. (2004). Long-term antibiotic cost savings from a comprehensive intervention program in a medical department of a university-affiliated teaching hospital. 38(3), 348-356.
- Sahm, D. F., Thornsberry, C., Mayfield, D. C., Jones, M. E., Karlowsky, J. A. J. A. a., & chemotherapy. (2001). Multidrug-Resistant Urinary Tract Isolates of *Escherichia coli*: Prevalence and Patient Demographics in the United States in 2000. 45(5), 1402-1406.
- Salvatore, S., Salvatore, S., Cattoni, E., Siesto, G., Serati, M., Sorice, P., . . . biology, r. (2011). Urinary tract infections in women. 156(2), 131-136.
- Samuel, O., Victoria, O., & Ifeanyi, O. J. U. J. o. C. M. (2016). Prevalence of asymptomatic bacteriuria among the pregnant women receiving antenatal care at federal medical centre Owerri, Nigeria. 4(1), 1-5.
- Schaeffer, A., & Schaeffer, E. J. C.-W. U. t. e., Philadelphia. (2007). Infections of the urinary tract In: Wein AJ, Kavoussi LR, Novick AC, Partin AW, Peters CA, Editors.
- Schmiemann, G., Kniehl, E., Gebhardt, K., Matejczyk, M. M., & Hummers-Pradier, E. J. D. Ä. I. (2010). The diagnosis of urinary tract infection: a systematic review. 107(21), 361.
- Schnarr, J., & Smaill, F. J. E. j. o. c. i. (2008). Asymptomatic bacteriuria and symptomatic urinary tract infections in pregnancy. 38, 50-57.
- Shriver, E. (2017). National Institute of Child Health and Human Development (NICHD). Pediatric Terminology: Current efforts, 2015. In.
- Siakwa, M., John, M., Kpikpitse, D., Ankobil, A., Hansen-Owoo, E. J. A. J. o. P., & Childbirth. (2014). A comparison of women with symptomatic and asymptomatic bacteriuria in Cape Coast, Ghana. 2(2), 27-30.
- Smaill, F. M., & Vazquez, J. C. J. C. d. o. s. r. (2015). Antibiotics for asymptomatic bacteriuria in pregnancy. (8).

- Sorlozano, A., Jimenez-Pacheco, A., del Castillo, J. d. D. L., Sampedro, A., Martinez-Brocal, A., Miranda-Casas, C., . . . Gutiérrez-Fernández, J. J. A. j. o. i. c. (2014). Evolution of the resistance to antibiotics of bacteria involved in urinary tract infections: a 7-year surveillance study. *42*(10), 1033-1038.
- Szweda, H., & Józwik, M. J. D. P. M. (2016). Urinary tract infections during pregnancy-an updated overview. *20*(4), 263-272.
- Tellapragada, C., Eshwara, V. K., Bhat, P., Acharya, S., Kamath, A., Bhat, S., . . . Health, P. (2016). Risk factors for preterm birth and low birth weight among pregnant Indian women: a hospital-based prospective study. *Journal of Preventive Medicine*, *49*(3), 165.
- Teppa, R. J., & Roberts, J. M. J. J. o. t. S. f. G. I. (2005). The Uriscreeen Test to Detect Significant A symptomatic Bacteriuria During Pregnancy. *12*(1), 50-53.
- Tunçalp, Ö., Were, W., MacLennan, C., Oladapo, O., Gülmezoglu, A., Bahl, R., . . . gynaecology. (2015). Quality of care for pregnant women and newborns—the WHO vision. *122*(8), 1045-1049.
- Turpin, C., Minkah, B., Danso, K., & Frimpong, E. J. G. m. j. (2007). Asymptomatic bacteriuria in pregnant women attending antenatal clinic at komfo anokye teaching hospital, kumasi, ghana. *41*(1), 26.
- Ugbogu, O. J. J. M. S. (2007). Asymptomatic bacteriuria among pregnant women in Abakaliki, Ebonyi State Nigeria. *7*(4), 698-700.
- Uncu, Y., Uncu, G., Esmer, A., Bilgel, N. J. C., obstetrics, e., & gynecology. (2002). Should asymptomatic bacteriuria be screened in pregnancy? , *29*(4), 281-285.
- Vasudevan, R. J. J. M. E. (2014). Urinary tract infection: an overview of the infection and the associated risk factors. *1*(2), 00008.
- Villar, J., Ba'aqueel, H., Piaggio, G., Lumbiganon, P., Belizán, J. M., Farnot, U., . . . Donner, A. J. T. L. (2001). WHO antenatal care randomised trial for the evaluation of a new model of routine antenatal care. *357*(9268), 1551-1564.
- Whiting, P., Westwood, M., Watt, I., Cooper, J., & Kleijnen, J. J. B. p. (2005). Rapid tests and urine sampling techniques for the diagnosis of urinary tract infection (UTI) in children under five years: a systematic review. *5*(1), 4.
- Wilson, M. L., & Gaido, L. J. C. i. d. (2004). Laboratory diagnosis of urinary tract infections in adult patients. *38*(8), 1150-1158.
- Wing, D. A., Fassett, M. J., Getahun, D. J. A. j. o. o., & gynecology. (2014). Acute pyelonephritis in pregnancy: an 18-year retrospective analysis. *210*(3), 219. e211-219. e216.
- Yadav, L. K., & Yadav, R. L. J. I. J. o. R. i. M. S. (2018). Asymptomatic UTI in pregnancy attending at tertiary care of Nepal. *6*(4), 1119-1128.
- Afriyie, D. K., Gyansa-Lutterodt, M., Amponsah, S. K., Asare, G., Wiredu, V., Wormenor, E., & Bugyei, K. A. (2015). Susceptibility pattern of uropathogens to

- ciprofloxacin at the ghana police hospital. *Pan African Medical Journal*, 22, 1–7.
<https://doi.org/10.11604/pamj.2015.22.87.6037>.
- Akerele, P. A., F. Okonofua, J., & Gynaecology. (2001). Prevalence of asymptomatic bacteriuria among pregnant women in Benin City, Nigeria. *Journal of Obstetrics Gynaecology*, 21(2), 141-144.
- Al Haddad, A. (2005). Urinary tract infection among pregnant women in Al-Mukalla district, Yemen. *Eastern Mediterranean Health Journal*, 11, No. 3,.
- Al Sibiani, S. A. J. J. o. K. A. U. (2010). Asymptomatic bacteriuria in pregnant women in Jeddah, Western Region of Saudi Arabia: call for assessment. 17(1), 29.
- Amiri, M., Lavasani, Z., Norouzirad, R., Najibpour, R., Mohamadpour, M., Nikpoor, A. R., . . . Marzouni, H. Z. (2015). Prevalence of urinary tract infection among pregnant women and its complications in their newborns during the birth in the hospitals of Dezful city, Iran, 2012-2013. *Iranian Red Crescent Medical Journal*, 17(8).
- Andabati, G., & Byamugisha, J. (2010). Microbial aetiology and sensitivity of asymptomatic bacteriuria among ante-natal mothers in Mulago hospital, Uganda. *African health sciences*, 10(4).
- Andersson, D. I., & Hughes, D. J. F. m. r. (2011). Persistence of antibiotic resistance in bacterial populations. 35(5), 901-911.
- Bérard, A., Santos, F., Ferreira, E., & Perreault, S. (2011). Urinary tract infections during pregnancy. In *Urinary tract infections: InTech*.
- Blomberg, B., Olsen, B. E., Hinderaker, S. G., Langeland, N., Gasheka, P., Jureen, R., . . . Midtvedt, T. (2005). Antimicrobial resistance in urinary bacterial isolates from pregnant women in rural Tanzania: implications for public health. *Scandinavian journal of infectious diseases*, 37(4), 262-268.
- Brocklehurst, P., Gordon, A., Heatley, E., & Milan, S. J. J. C. D. o. s. r. (2013). Antibiotics for treating bacterial vaginosis in pregnancy. (1).
- Çelen, Ş., Oruç, A. S., Karayağın, R., Saygan, S., Ünlü, S., Polat, B., & Danişman, N. (2011). Asymptomatic bacteriuria and antibacterial susceptibility patterns in an obstetric population. *ISRN obstetrics gynecology*, 2011.
- Cheesbrough, M. (2006). *District laboratory practice in tropical countries*: Cambridge university press.
- Choi, S. J., Park, S. D., Jang, I. H., Uh, Y., & Lee, A. J. A. o. l. m. (2012). The prevalence of vaginal microorganisms in pregnant women with preterm labor and preterm birth. 32(3), 194-200.
- Christensen, B. (2000). Which antibiotics are appropriate for treating bacteriuria in pregnancy? *Journal of antimicrobial chemotherapy*, 46(suppl_1), 29-34.

- Costelloe, C., Metcalfe, C., Lovering, A., Mant, D., & Hay, A. D. J. B. (2010). Effect of antibiotic prescribing in primary care on antimicrobial resistance in individual patients: systematic review and meta-analysis. *340*, c2096.
- Coulthard, M. G., Kalra, M., Lambert, H. J., Nelson, A., Smith, T., & Perry, J. D. (2010). Redefining urinary tract infections by bacterial colony counts. *J Pediatrics*, *125*(2), 335-341.
- Crider, K. S., Cleves, M. A., Reefhuis, J., Berry, R. J., Hobbs, C. A., & Hu, D. J. (2009). Antibacterial medication use during pregnancy and risk of birth defects: National Birth Defects Prevention Study. *J Archives of pediatrics adolescent medicine*, *163*(11), 978-985.
- Dafnis, E., & Sabatini, S. (1992). The effect of pregnancy on renal function: physiology and pathophysiology. *The American journal of the medical sciences*, *303*(3), 184-205.
- Dalal, S., Nicolle, L., Marrs, C. F., Zhang, L., Harding, G., & Foxman, B. J. C. I. D. (2009). Long-term Escherichia coli asymptomatic bacteriuria among women with diabetes mellitus. *49*(4), 491-497.
- Dashe, J. S., Gilstrap III, L. C. J. O., & America, g. c. o. N. (1997). Antibiotic use in pregnancy. *24*(3), 617-629.
- David, S. B., Einarson, T., David, Y. B., Nulman, I., Pastuszak, A., Koren, G. J. F., & pharmacology, c. (1995). The safety of nitrofurantoin during the first trimester of pregnancy: meta-analysis. *9*(5), 503-507.
- Debebe, S. (2005). *Asymptomatic Bacteriuria in Pregnant Women in Harar, South Eastern Ethiopia*. Addis Ababa University,
- Dielubanza, E. J., & Schaeffer, A. J. (2011). Urinary tract infections in women. *Medical clinics*, *95*(1), 27-41.
- Emamghorashi, F., Mahmoodi, N., Tagarod, Z., & Heydari, S. T. (2012). Maternal urinary tract infection as a risk factor for neonatal urinary tract infection. *Iranian journal of kidney diseases*, *6*(3), 178.
- Etminan-Bakhsh, M., Tadi, S., & Darabi, R. (2017). Asymptomatic bacteriuria in pregnant women attending Boo-Ali Hospital Tehran Iran: Urine analysis vs. urine culture. *Electronic physician*, *9*(11), 5760.
- Farkash, E., Weintraub, A. Y., Sergienko, R., Wiznitzer, A., Zlotnik, A., Sheiner, E., & Biology, R. (2012). Acute antepartum pyelonephritis in pregnancy: a critical analysis of risk factors and outcomes. *European Journal of Obstetrics Gynecology*, *162*(1), 24-27.
- Fihn, S. D. (2003). Acute uncomplicated urinary tract infection in women. *New England Journal of Medicine*, *349*(3), 259-266.

- Flores-Mireles, A. L., Walker, J. N., Caparon, M., & Hultgren, S. J. (2015). Urinary tract infections: epidemiology, mechanisms of infection and treatment options. *Nature reviews microbiology*, 13(5), 269.
- Gilbert, N. M., O'brien, V. P., Hultgren, S., Macones, G., Lewis, W. G., & Lewis, A. L. (2013). Urinary tract infection as a preventable cause of pregnancy complications: opportunities, challenges, and a global call to action. *Global advances in health medicine*, 2(5), 59-69.
- Gilstrap III, L. C., & Ramin, S. M. (2001). Urinary tract infections during pregnancy. *Obstetrics gynecology clinics of North America*, 28(3), 581-591.
- Goldenberg, R. L., Culhane, J. F., Iams, J. D., & Romero, R. J. T. I. (2008). Epidemiology and causes of preterm birth. 371(9606), 75-84.
- Goldenberg, R. L., Hauth, J. C., & Andrews, W. W. (2000). Intrauterine infection and preterm delivery. *New England Journal of Medicine*, 342(20), 1500-1507.
- Goossens, H., Ferech, M., Vander Stichele, R., Elseviers, M., & Lancet, E. P. G. J. T. (2005). Outpatient antibiotic use in Europe and association with resistance: a cross-national database study. 365(9459), 579-587.
- Graham, J., & Galloway, A. (2001). ACP Best Practice No 167: the laboratory diagnosis of urinary tract infection. *Journal of Clinical Pathology*, 54(12), 911-919.
- Harbinger, H. A., & Contraceptives, O. (2014). Urinary tract infection. *US Pharm*, 39(8), 17-18.
- Kehinde, A. O., Adedapo, K. S., Aimaikhu, C. O., Olayemi, O., Salako, B., & health. (2011). Significant bacteriuria among asymptomatic antenatal clinic attendees in Ibadan, Nigeria. *Tropical medicine health*, 1107290180-1107290180.
- Kenyon, S., Boulvain, M., & Neilson, J. P. J. C. D. o. S. R. (2003). Antibiotics for preterm rupture of membranes. (2).
- Kenyon, S., Taylor, D., & Tarnow-Mordi, W. f. J. T. L. (2001). Broad-spectrum antibiotics for preterm, prelabour rupture of fetal membranes: the ORACLE I randomised trial. 357(9261), 979-988.
- Kirkham, C., Harris, S., & Grzybowski, S. (2005). Evidence-based prenatal care: part II. Third-trimester care and prevention of infectious diseases. *policy*, 10, 11.
- Kislak, J. W., Eickhoff, T. C., & Finland, M. J. N. E. J. o. M. (1964). Hospital-acquired infections and antibiotic usage in the Boston City Hospital—January, 1964. 271(16), 834-835.
- Kunin, C. M. (1997). *Urinary tract infections. Detection, prevention, and management*: Williams & Wilkins.
- Kunin, C. M., & McCormack, R. C. (1968). An epidemiologic study of bacteriuria and blood pressure among nuns and working women. *New England Journal of Medicine*, 278(12), 635-642.

- Labi, A., Yawson, A., Ganyaglo, G., & Newman, M. (2015). Prevalence and associated risk factors of asymptomatic bacteriuria in ante-natal clients in a large teaching hospital in Ghana. *Ghana medical journal*, 49(3), 154-158.
- Lamont, H. F., Blogg, H. J., & Lamont, R. F. (2014). Safety of antimicrobial treatment during pregnancy: a current review of resistance, immunomodulation and teratogenicity. *Expert opinion on drug safety*, 13(12), 1569-1581.
- Le, T. P., & Miller, L. G. J. C. i. d. (2001). Empirical therapy for uncomplicated urinary tract infections in an era of increasing antimicrobial resistance: a decision and cost analysis. 33(5), 615-621.
- Leekha, S., Terrell, C. L., & Edson, R. S. (2011). *General principles of antimicrobial therapy*. Paper presented at the Mayo Clinic Proceedings.
- Li, P., Ma, L., & Wong, S. (2002). Is bag urine culture useful in monitoring urinary tract infection in infants? *Journal of paediatrics child health*, 38(4), 377-381.
- Lumbiganon, P., Laopaiboon, M., & Thinkhamrop, J. (2010). Screening and treating asymptomatic bacteriuria in pregnancy. *Current opinion in Obstetrics Gynecology*, 22(2), 95-99.
- Macejko, A. M., & Schaeffer, A. J. (2007). Asymptomatic bacteriuria and symptomatic urinary tract infections during pregnancy. *Urologic Clinics*, 34(1), 35-42.
- Manjula, R., Kavya, H., Kashinakunti, S., Shivakumar, S., Dorle, A., & Lalitha, D. (2016). Diagnostic accuracy of Griess test for asymptomatic bacteriuria in pregnancy. *British Journal of Medicine Medical Research*, 11(8).
- Masinde, A., Gumodoka, B., Kilonzo, A., & Mshana, S. (2009). Prevalence of urinary tract infection among pregnant women at Bugando Medical Centre, Mwanza, Tanzania. *Tanzania journal of health research*, 11(3).
- McDermott, S., Callaghan, W., Szwejbka, L., Mann, H., & Daguise, V. (2000). Urinary tract infections during pregnancy and mental retardation and developmental delay. *Obstetrics gynecology*, 96(1), 113-119.
- McGladdery, S., Aparicio, S., Verrier-Jones, K., Roberts, R., & Sacks, S. J. Q. A. I. J. o. M. (1992). Outcome of pregnancy in an Oxford-Cardiff cohort of women with previous bacteriuria. 83(4), 533-539.
- Milo, G., Katchman, E., Paul, M., Christiaens, T., Baerheim, A., & Leibovici, L. J. C. D. o. S. R. (2005). Duration of antibacterial treatment for uncomplicated urinary tract infection in women. (2).
- Misdraji, J., & Nguyen, P. L. (1996). Urinalysis: when—and when not—to order. *Postgraduate medicine*, 100(1), 173-192.
- Mobsheri, E., Tabbraei, A., Ghaemei, E., Moujerlou, M., Vakili, M., Dastforooshan, M., & Gholamei, S. (2002). Distribution of Asymptomatic Bacteriuria in Pregnant Women Referring to Dezyani Hospital in Gorgan.

- Mohamed, N. R., Omar, H. H. H., & Abd-Allah, I. M. J. I.-J. (2017). Prevalence and Risk Factors of Urinary Tract Infection among Pregnant Women in Ismailia City, Egypt. 6(3), 62-72.
- Nahum, G. G., Uhl, K., Kennedy, D. L. J. O., & Gynecology. (2006). Antibiotic use in pregnancy and lactation: what is and is not known about teratogenic and toxic risks. 107(5), 1120-1138.
- Nasiri, R. M., & Muhi, F. A. (2019). The Proportion Of Pregnancy-Associated Asymptomatic Bacteriuria In Al-Karkh Hospital.
- Newman, M. J., Frimpong, E., Donkor, E. S., Opintan, J. A., & Asamoah-Adu, A. (2011). Resistance to antimicrobial drugs in Ghana. *journal of Infection and Drug Resistance*, 4, 215.
- Nicolle, L. E., Bradley, S., Colgan, R., Rice, J. C., Schaeffer, A., & Hooton, T. M. J. C. i. d. (2005). Infectious Diseases Society of America guidelines for the diagnosis and treatment of asymptomatic bacteriuria in adults. 643-654.
- Nicolle, L. E., Bradley, S., Colgan, R., Rice, J. C., Schaeffer, A., & Hooton, T. M. (2005). Infectious Diseases Society of America guidelines for the diagnosis and treatment of asymptomatic bacteriuria in adults. *Clinical infectious diseases*, 643-654.
- Obirikorang, C., Quaye, L., Bio, F., Amidu, N., Acheampong, I., Addo, K. J. J. o. M., & Sciences, B. (2012). Asymptomatic Bacteriuria among Pregnant Women Attending Antenatal Clinic at the Uni-versity Hospital, Kumasi, Ghana. *Journal of Medical and Biomedical Sciences* (2012) 1(1), 38-44.
- Obstetrics, C. o. O. P. J., & gynecology. (2015). The American College of Obstetricians and Gynecologists Committee Opinion no. 630. Screening for perinatal depression. 125(5), 1268.
- Opintan, J. A., Newman, M. J., Arhin, R. E., Donkor, E. S., Gyansa-Lutterodt, M., Mills-Pappoe, W. J. I., & resistance, d. (2015). Laboratory-based nationwide surveillance of antimicrobial resistance in Ghana. 8, 379.
- Ortega-González, Y., & Castro-Díaz, D. J. C. B. D. R. (2014). Antibiotic considerations for urinary tract infections in pregnancy. 9(3), 167-174.
- Parveen, K., Momen, A., Begum, A. A., & Begum, M. (2011). Prevalence of urinary tract infection during pregnancy. *Journal of Dhaka National Medical Colleg*, 17(2), 8-12.
- Pfaller, M., Ringenberg, B., Rames, L., Hegeman, J., Koontz, F. J. D. m., & disease, i. (1987). The usefulness of screening tests for pyuria in combination with culture in the diagnosis of urinary tract infection. 6(3), 207-215.
- Prasanna, B., Naimisha, M., Swathi, K., & Shaik, M. V. (2015). Prevalence of asymptomatic bacteriuria in pregnant women, isolates and their culture sensitivity pattern. *Int J Cur Micro Apli Sc*, 4, 28-35.

- Rao, V. M., Venkatesh, B. S., & Rao, S. R. J. I. J. C. M. A. S. (2018). Asymptomatic Bacteriuria in Pregnant Women-Study at a Tertiary Maternity care Hospital in Hyderabad, India. 7(5), 1133-1142.
- Rouse, D. J., Andrews, W. W., Goldenberg, R. L., & Owen, J. (1995). Screening and treatment of asymptomatic bacteriuria of pregnancy to prevent pyelonephritis: a cost-effectiveness and cost-benefit analysis. *Obstetrics Gynecology*, 86(1), 119-123.
- Rüttimann, S., Keck, B., Hartmeier, C., Maetzel, A., & Bucher, H. C. J. C. I. D. (2004). Long-term antibiotic cost savings from a comprehensive intervention program in a medical department of a university-affiliated teaching hospital. 38(3), 348-356.
- Sahm, D. F., Thornsberry, C., Mayfield, D. C., Jones, M. E., Karlowsky, J. A. J. A. a., & chemotherapy. (2001). Multidrug-Resistant Urinary Tract Isolates of *Escherichia coli*: Prevalence and Patient Demographics in the United States in 2000. 45(5), 1402-1406.
- Salvatore, S., Salvatore, S., Cattoni, E., Siesto, G., Serati, M., Sorice, P., . . . biology, r. (2011). Urinary tract infections in women. *European journal of obstetrics gynecology*, 156(2), 131-136.
- Samuel, O., Victoria, O., & Ifeanyi, O. (2016). Prevalence of asymptomatic bacteriuria among the pregnant women receiving antenatal care at federal medical centre Owerri, Nigeria. *Universal Journal of Clinical Medicine*, 4(1), 1-5.
- Schaeffer, A., & Schaeffer, E. J. C.-W. U. t. e., Philadelphia. (2007). Infections of the urinary tract In: Wein AJ, Kavoussi LR, Novick AC, Partin AW, Peters CA, Editors.
- Schmiemann, G., Kniehl, E., Gebhardt, K., Matejczyk, M. M., & Hummers-Pradier, E. (2010). The diagnosis of urinary tract infection: a systematic review. *Deutsches Ärzteblatt International*, 107(21), 361.
- Schnarr, J., & Smaill, F. J. E. j. o. c. i. (2008). Asymptomatic bacteriuria and symptomatic urinary tract infections in pregnancy. 38, 50-57.
- Shriver, E. (2017). National Institute of Child Health and Human Development (NICHD). Pediatric Terminology: Current efforts, 2015. In.
- Siakwa, M., Kpikpitse, D., Laryea, T., Ankobil, A., Dare, S., & Ebu, N. (2014). Five-year neonatal mortality trend in a Ghanaian teaching hospital after the implementation of strategies to achieve the millennium development goal. *Int J Pediatrics Child Health*, 2(1), 043-049.
- Smaill, F. M., & Vazquez, J. C. (2015). Antibiotics for asymptomatic bacteriuria in pregnancy. *Cochrane database of systematic reviews*(8).
- Sorlozano, A., Jimenez-Pacheco, A., del Castillo, J. d. D. L., Sampedro, A., Martinez-Brocal, A., Miranda-Casas, C., . . . Gutiérrez-Fernández, J. (2014). Evolution of

- the resistance to antibiotics of bacteria involved in urinary tract infections: a 7-year surveillance study. *American journal of infection control*, 42(10), 1033-1038.
- Szweda, H., & Jóźwik, M. (2016). Urinary tract infections during pregnancy-an updated overview. *Dev Period Med*, 20(4), 263-272.
- Tellapragada, C., Eshwara, V. K., Bhat, P., Acharya, S., Kamath, A., Bhat, S., . . . Health, P. (2016). Risk factors for preterm birth and low birth weight among pregnant Indian women: a hospital-based prospective study. *Journal of Preventive Medicine*, 49(3), 165.
- Teppa, R. J., & Roberts, J. M. (2005). The Uriscreen Test to Detect Significant A symptomatic Bacteriuria During Pregnancy. *Journal of the Society for Gynecologic Investigation*, 12(1), 50-53.
- Tunçalp, Ö., Were, W., MacLennan, C., Oladapo, O., Gülmezoglu, A., Bahl, R., . . . gynaecology. (2015). Quality of care for pregnant women and newborns—the WHO vision. *BJOG: an international journal of obstetrics gynaecology*, 122(8), 1045-1049.
- Turpin, C., Minkah, B., Danso, K., & Frimpong, E. (2007). Asymptomatic bacteriuria in pregnant women attending antenatal clinic at komfo anokye teaching hospital, kumasi, ghana. *Ghana medical journal*, 41(1), 26.
- Ugbogu, O. (2007). Asymptomatic bacteriuria among pregnant women in Abakaliki, Ebonyi State Nigeria. *Med. Sci.*, 7(4), 698-700.
- Uncu, Y., Uncu, G., Esmer, A., Bilgel, N. J. C., obstetrics, e., & gynecology. (2002). Should asymptomatic bacteriuria be screened in pregnancy? , 29(4), 281-285.
- Vasudevan, R. (2014). Urinary tract infection: an overview of the infection and the associated risk factors. *J Microbiol Exp*, 1(2), 00008.
- Villar, J., Ba'aqueel, H., Piaggio, G., Lumbiganon, P., Belizán, J. M., Farnot, U., . . . Donner, A. (2001). WHO antenatal care randomised trial for the evaluation of a new model of routine antenatal care. *The Lancet*, 357(9268), 1551-1564.
- Whiting, P., Westwood, M., Watt, I., Cooper, J., & Kleijnen, J. (2005). Rapid tests and urine sampling techniques for the diagnosis of urinary tract infection (UTI) in children under five years: a systematic review. *BMC pediatrics*, 5(1), 4.
- Wilson, M. L., & Gaido, L. (2004). Laboratory diagnosis of urinary tract infections in adult patients. *Clinical infectious diseases*, 38(8), 1150-1158.
- Wing, D. A., Fassett, M. J., & Getahun, D. (2014). Acute pyelonephritis in pregnancy: An 18-year retrospective analysis. In *American Journal of Obstetrics and Gynecology* (Vol. 210, pp. 653–658). <https://doi.org/10.1016/j.ajog.2013.10.006>.
- Yadav, L. K., & Yadav, R. L. J. I. J. o. R. i. M. S. (2018). Asymptomatic UTI in pregnancy attending at tertiary care of Nepal. 6(4), 1119-1128.

APPENDICES

Appendix A: Consent Form

For pregnant women at Akwapem North Municipality

**Title Asymptomatic Bacteriuria among Pregnant Women Attending Antenatal Clinic
at Akwapem North Municipality**

Participant's statement

I acknowledge that I have read or have had the purpose and content of participant's information sheet read and that all questions have satisfactorily explained to me in a language I understand. (English/Akwapem Twi) I fully understand the content and any potential implication as well as my right to change my mind (withdraw from the research) even after I have signed this form. I voluntarily agree to be part of this research.

I agree for my voice to be recorded (please mark the response YES... NO...

Name or initials of participant ID Code.....

Participant's signature Thumb Print.....

Date

INTERPRETERS' STATEMENT

I interpret the purpose and contents of the Participants' Information Sheet to the afore named participant to the best of my ability in (English / Akwapim Twi) language to her proper understanding

All questions, appropriate clarifications sort by the participant and answers were duly interpreted to her satisfaction.

Name of Interpreter.....

Signature of Interpreter.....

Date:

STATEMENT OF WITNESS

I was present when the purpose and contents of the Participant Information Sheet was read and explained satisfactorily to the participant in the language she understood (Akwapim Twi)

I confirm that she has given the opportunity to ask questions/seek clarifications and it were duly answered to her satisfaction before voluntarily agreeing to be part of the research.

Name:

Signature..... OR Thumb Print

Date:

INVESTIGATOR STATEMENT AND SIGNATURE

I certify that the participant has been given ample time to read and lean about the study.

All questions and clarifications raised by the participant have been addressed Researcher's

name: Eli Dzandu

Signature

Date

Appendix B: Participants information sheet for pregnant women at Akwapem North Municipality

Project title: **Asymptomatic Bacteriuria among Pregnant Women attending antenatal clinic at Akwapem North Municipality**

Introduction

I am Eli Dzandu, (principal investigator) a student from the School of Public Health, University of Ghana. I am conducting a study as partial fulfilment for the ward of MPhil in Epidemiology and Disease Control. My contact details are, Tel 0207821719 and email eldzandu@gmail.com

Background and purpose of the research

Pregnant women become susceptible to infections when they become pregnant. Routine urine examination is test done for them when they visit the antenatal clinic. This test is not sensitive enough to detect those pregnant women who have urinary tract infection and are asymptomatic. They are left because of the test not been sensitive to detect the infection in their urine this research is therefore done to carry out urine culture for the pregnant women to determine if there is the need for all pregnant women to do urine culture and sensitivity as one of their routine antenatal tests

Nature of Research

This is cross sectional study that will be carried out to determine the proportion of asymptomatic bacteriuria among pregnant women. This study will be carried out at Akwapem North Municipality and the minimum sample size will be 114 in which urine samples will be taken from the participants.

The findings from the study will address and help stakeholders to come out with policies that will help minimise urinary tract infection among pregnant women.

Participant involvement

Your participation in the study will require you answer questions on urinary tract infection. The principal investigator or the research assistants will administer questionnaires. It will take about 20 minutes to answer the questions, which will be translated into **Akwapem Twi**. After the questionnaires, a sterile urine container well labelled will be given to each participant to give 20 ml of urine samples. These urine samples will then be taken to the laboratory to be cultured. Samples that are positive

meaning they have bacterial growth will be identified and drug sensitivity testing will be done to find out which of the antibiotics will cure each participants that has the bacterial in her urine.

Potential Risks

The study does not foresee any direct harm to the research participants except when answering certain questions. They have the right to refuse to answer any question if they feel uncomfortable about it

Benefits

The participants will be made aware of the fact that there will be no direct benefits. Participant will be given health education on “asymptomatic bacteriuria among pregnant women” and the effects of not treating it when infected with bacteria during pregnancy. The findings will benefit the District Health Management Team in planning for health care delivery in the district among pregnant women.

Cost

There will be no cost for participating in the study

Compensation

Participating in this study is solely voluntary and no monetary compensation to participants for accepting to be part of this study will be given

Confidentiality

Confidentiality of participants will be ensured and maintained throughout the study. Names of participants will not be captured on questionnaires. Data collected will be securely stored and will be accessed by the research team. Dissemination of results from the study will not be linked to the identity of the participants

Voluntary Consent/ Withdrawal

The participants will be made aware that participating in the study is voluntary and they can opt not to be part or can withdraw from the study at any point in time without explanation.

Awareness would be made to participants of the fact that there will be no direct benefits or risks involved in the study except that some of the questions may be a bit discomforting. Importance of the study will be explained to the participants and confidentiality assured

throughout the study. Only willing participants will be part of the study. Data obtained will be used only for the set objectives of this study. Coded numbers will be used identify the participants and data stored both electronically and in hard copies with access given only to the research team. Participants found to have bacterial infection in their urine samples brought for the study will be referred to the midwife for further medical care.

Outcome and feedback

Data collected will only be used for this study. No feedback on the data will be given to the participants

Appropriate alternatives procedure and treatment

You do not have to participate in the research in order to receive care

Feedback to participants

No direct feedback of finding will be communicated to participants. However, recommendations from the study findings will be shared with the hospital for possible advice to improve health care in the municipality.

Funding information

This research is self-financed by the principal investigator

Sharing of participants information/data

Data generated from the study will only be used for the purpose of this research. The principal investigator will own the data and only the team members of the research will have access to the data. No unauthorized person will have access to participant's information. Should the research be published at any point in time, clearance will be obtained from the Ethics Review Committee of Ghana Health Service.

Storage of samples

After the urine is plated on the appropriate medium for incubation, the rest of the urine samples will be discarded appropriately and samples will not be stored for any future research

Provision of information and consent for participants

A copy of the information sheet will be given to you after it has been signed of thumb printed to keep.

Whom to contact for further clarification/questions

If you have further questions or issues regarding this study which require clarification, you may contact

ELI DZANDU PRINCIPAL INVESTIGATOR 0207821719

DR ERNEST KENU, UNIVERSITY OF GHANA (SUPERVISOR) 0244592122

This research has been reviewed and approved by Ghana Health Service Ethics Review Committee. If you want further clarification on ethical issues and your right as a research participant, you can contact the Ghana Health Service **Ethics Review Committee Administrator, Madam Hannah Frimpong on 0507041223 or email address Hannah.Frimpong@hru-ghs.org**

Appendix C: Questionnaire

School Of Public Health
Applied Epidemiology and Disease Control
College Of Health Sciences
University Of Ghana

I am a postgraduate student offering Applied Epidemiology and Disease Control at the School of Public Health, University of Ghana. As part of one of the requirements to complete the program, I am writing a research paper on the topic: **Asymptomatic Bacteriuria among Pregnant Women at Akwapim North Municipality 2019**. All the information you will provide will be used only for the purpose of this study that it will be treated confidentially. To this end we kindly request that you complete the following questionnaire. Your response is of the utmost importance to us

Please do not write your name on the questionnaire

QUESTIONNAIRE

Participant ID.....	Health Facility.....	Date.....
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Please tick the appropriate answer

Part one-Socio demographic factors				
1	Age			
	years			
2	Religion	Christian	1	[]
		Moslem	2	[]
		Traditionalist	3	[]
	Educational level			
3	Wife	Basic	1	[]
		Advanced	2	[]
4	Husband	Basic	1	[]
		Advanced	2	[]
5	Occupation	Student/employed	1	[]
		Employed	2	[]
6	Family monthly income	< 1000 GH¢	1	[]
		> 1000 GH¢	2	[]
7	Marital status	Single	1	[]
		Cohabiting	2	[]
		Married	3	[]
8	Total family size	Two (couple)	1	[]

		Three	2	[]
		Four	3	[]
		Five	4	[]
		More than five	5	[]
	Part two- Environmental factors			
9	Residence	Self-contained	1	[]
		Compound house	2	[]
10	How long have you married/staying together	Less than 1 year	1	[]
		1-3 years	2	[]
		More than 3 years	3	[]
11	Source of household water use	Tab	1	[]
		Borehole	2	[]
		River/Stream	3	[]
12	Quantity of water consumed per day	Less than 1 L per day	1	[]
		2-3 L per day	2	[]
		More than 4 L per day	3	[]
13	Type of toilet facility you use	Private	1	[]
		Public	2	[]
	Part –three Clinical and pregnancy history			
14	Frequency of intercourse/week	< = 3 times per week	1	[]
		>times per week	2	[]
15	Gravidity	Primigravidae (one)	1	[]
		Multigravidae (two)	2	[]
		Multigravidae (>two)	2	[]
16	Parity	Nulliparous(yet to give birth	1	[]
		Primiparous (one)	2	[]
		Primiparous (two)	3	[]
17	Stage of pregnancy	1 st trimester (1-3)	1	[]
		2 nd trimester (4-6)	2	[]
		3 rd trimester (7-9)	3	[]
18	Multiple pregnancy	No	1	[]
		Yes	2	[]
19	Any miscarriage	No	1	[]
		Yes	2	[]

20	Any medical condition	No	1	[]
		Yes	2	[]
21	Outcome of previous pregnancy	Yet to give birth	1	[]
		Good	2	[]
		Poor	3	[]
22	Ever used catheter	No	1	[]
		Yes	2	[]
23	Experienced last UTI	Before marriage	1	[]
		Married but not pregnant	2	[]
		When pregnant	3	[]
24	Seek medical condition	No	1	[]
		Yes	2	[]
25	But antibiotics without prescription	No	1	[]
		Yes	2	[]

Part four-Health facility

26	Type of test	RUE	1	[]
		C/S	2	[]
27	Place of ANC clinic	Hospital	1	[]
		Health center	2	[]
		CHPS	3	[]
