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# **EFFECT OF POOR MENSTRUAL HEALTH ON UTI DIAGNOSIS**

Biochemistry Thesis

Presented by

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To the Keck Science Department  
of Claremont McKenna, Scripps, and Pitzer Colleges  
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The Degree of Bachelor of Arts

Senior Thesis in Biochemistry

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## **Abstract**

Urinary Tract infections (UTIs) are microbial invasions of the urinary tract because of abnormal pathogen growth. They have short term symptoms like abdominal pain, fever and urinary frequency. Khayelitsha is a township that has a population of 2.4 million, 52% of which are women. This area is shaped by poor governance in South Africa that exacerbated medical issues due to a lack of resources. With lack of sanitary pad accessibility and knowledge of proper hygiene practices during the menstrual cycle, women are getting infected with UTIs 2-3 times a year. With an increase in antimicrobial resistance patterns, areas like Khayelitsha cannot properly treat UTIs in turn making the life of citizens difficult without accessibility to medicines and medical care. The purpose of this research is to highlight the factors that lead to increased UTIs in areas like Khayelitsha, where limited resources result in poor menstrual practices. I propose a short-term study that focuses on collecting baseline data for UTI diagnosis and treatment in Khayelitsha. It will involve 100,000 women and girls within the Khayelitsha Township area ranging from ages 13-45. I expect to see correlations between data such as, 1) financial stability and affording menstrual pads, 2) environmental hygiene and reported UTI/menstrual health issues. This study aims to not only inform the public on the importance of improving sanitary towel accessibility, but also act as a plea to the South African government to fund ESBL PCR testing kits aimed at aiding medical personnel in rapid testing of early UTI symptoms.

## Introduction

Urinary Tract infections (UTIs) are microbial invasions of the urinary tract as a result of abnormal pathogen growth (Odoki, 2019). They are the most common infection among outpatients and affect more women than men, with 50-60% of adult women being affected within their lifetime, and 10% of women getting an infection yearly (Simmering et al., 2017). Recurrences of the infection are extremely common, with women often getting a second urinary tract infection within the same year. With the increasing resistance to uropathogens, infections such as those of the urinary tract are becoming more prevalent, especially in low income countries such as South Africa (Adejumo & Archibong, 2013, 14-27). 80% of these urinary tract infections are generally caused by the bacteria *E.Coli*.

UTIs lead to short-term symptoms such as dysuria, abdominal pain, urinary frequency, and even fever (Flores-Mireles et al., 2015, 269-284). UTIs can be divided into two main groups: community-acquired UTIs and nosocomial UTIs (Hospital). Community-acquired UTIs (CA-UTIs) are an infection of the urinary system that takes place in a community setting or early hospitalization of up to 48 hours. *Escherichia Coli* is a common cause of community-acquired UTIs, alongside *Staphylococcus saprophyticus*, *Citrobacter freundii*, and *Klebsiella pneumoniae* (Niveditha et al., 2012, 1478-1482). Nosocomial UTIs are caught in hospital settings after 72 hours of hospitalization. Some countries like Algeria have a low prevalence of UTIs among patients admitted in acute care unit areas for more than 48 hours, while in Uganda the prevalence of nosocomial UTIs has caused a 20-26% drug resistance among antenatal mothers in a Mulago hospital. Odoki et al. conducted a study in the Bushenyi district (a rural area in Uganda) and focused on the prevalence of bacterial UTIs and the associated factors among patients attending the district hospital. They found factors such as gender, age, pregnancy, hospitalization status, and genitourinary tract abnormalities important to the risk of first-time and recurring UTIs. In their cross-sectional study, they used 267 clean catch midstream urine (MSU) samples from patients in the hospital and analyzed them through standard microbiology methods. The results showed that 32.2% of the patients in the study had a UTI, most prevalently individuals under the age of 19 and female. They tried to use the research from this study to adopt UTI screenings in hospitals, but it was not successful (Odoki, 2019).

Both Nosocomial and community acquired UTIs have severe complications, including but not limited to blood infections, pyelonephritis, and kidney infections (Acobsen & Shirliff, 2011, 460-465). UTI diagnosis can either be asymptomatic, acute, chronic, complicated, or uncomplicated based on the clinical manifestations that have been shown. This is all dependent on how much of the urinary tract is involved, the severity of the infection, and the patient's ability to respond to treatment. Both community and nosocomial UTIs pose serious threats to public health care because they can reduce a person's quality of life. Research shows that women get UTIs up to 30 times more often than men, and when further research is conducted, we see that associated issues such as high blood pressure and diabetes increase the chances of UTI infections. During a woman's menstrual cycle, estrogen levels are considerably lower, and this in turn increases the chances of getting a UTI. Estrogen production is known to stimulate antibiotic production within a woman's body, and this strengthens the cells within the urinary tract. It has been noted that estrogen production within the body has assisted menopausal women in tackling recurring UTIs (Rosen et al., 2008, 3337-3345).

Uncomplicated UTIs start with uropathogens that remain in the gut, and they infect the periurethral area and are then able to colonize the urethra. They then migrate to the bladder where manifestation of pili and adhesins cause the colonization and invasion of the superficial umbrella cells (Nicolle, 2008, 1-12). The host of inflammatory responses including the neutrophil infiltration begins to clear the extracellular bacteria. Some bacteria avoid the immune system, either through host cell invasion or through morphological changes that result in resistance to neutrophils, and these bacteria undergo multiplication, resulting in biofilm formation (Hoberman et al., 2003, 195-202). These bacteria produce toxins and proteases that induce host cell damage, releasing essential nutrients that promote bacterial survival and ascension to the kidneys. Kidney colonization results in bacterial toxin production and host tissue damage. If left untreated, UTIs can ultimately progress to bacteremia if the pathogen crosses the tubular epithelial barrier in the kidneys. Uropathogens that cause complicated UTIs follow the same initial steps as uncomplicated infections, including periurethral colonization. However, in order for the pathogen to cause infection, the bladder must be compromised (Sabrina, 2010, 348).

### *Nosocomial UTIs*

Nosocomial UTIs are defined as an infection of the urinary tract that occurs after 72 hours of hospital admission. Nosocomial urinary tract infections (UTIs) are mainly found in hospitals, making up 40% of all hospital-obtained infections (Bono et al., 2022). The most common hospital UTI strains include *K. pneumoniae*, *Proteus*, *Enterococcus* and *Staphylococcus*. When looking at global statistics, over 150 million individuals suffer from nosocomial UTIs per annum, and this has a direct correlation to the number of funds lost in the healthcare system (\$6 billion). Due to outpatient treatment decreasing due to antimicrobial resistance, more people have to be admitted into hospitals for UTI treatment. Studies by Simmering et al reported that in 2011 there were 400,000 hospitalizations as a result of UTIs and this cost up to \$2.8 billion. Individuals were staying 4-5 days within the hospital, medication and treatment came up to \$8409 per person (Simmering et al., 2017).

Patients who have indwelling urinary catheters, are undergoing urological treatments, are elderly female patients, as well as people with enervating disease are usually at the highest risk of developing nosocomial UTIs. The organisms that cause these infections usually come from a patient's endogenous intestinal flora (bacteria inside the intestines), but they also come from moist environments within the hospital setting (Lui et al., 2018). These types of UTIs have a higher antibiotic resistance and make them harder to treat than most regular UTIs. There is a need to decrease the number of nosocomial UTIs, and there are important policies in place to try and reach that goal. Methods conducted in hospitals, like catheterisation through aseptic techniques and sterilization of equipment, as well as the use of closed drainage systems, must be taken into consideration when deciding how to keep environments clean and safely dispose of used materials. These forms of infections should only be treated after a patient's primary care giver has taken urine samples and a lab has confirmed the type of UTI the patient may have (Maharjan et al., 2012). Researchers are thinking about using catheters that contain antibiotics to try to reduce hospital incidences of nosocomial UTIs (Ferrante et al., 2021, 266-267).

### *Community-Acquired UTIs*

Community-acquired Urinary tract infections (CA-UTIs) are the most common type of UTI. Uropathogens are known to originate largely from colonic flora, and this fact is used in the way

CA-UTIs are empirically treated. As stated before, some countries like Uganda are showing increased drug resistance among adults, and factors associated with CA-UTIs are not very well understood (Behzadi et al., 2010, 111-115). The divide between uncomplicated and complicated UTIs makes it difficult to narrow down the issues and treatments of CA-UTIs in general. Uncomplicated UTIs occur in patients who have normal and unobstructed genitourinary tracts and are known to have no history of catheter implantation; they are most common in young and sexually active women. Complicated UTIs are associated with higher risk factors that can increase the likelihood of virulence and fundamental failure of antibiotic therapies (Fazly et al., 2021, 27). In 2011, the Infectious Disease Society of America (IDSA) advocated that cotrimoxazole, fosfomycin, or nitrofurantoin (antibiotics used in bacteria treatments) be used if the rates of resistance concerning uropathogens causing uncomplicated UTIs remained below 20%. Stronger antibiotics like beta-lactams or fluoroquinolones were provided as alternatives due to the increase in resistance (above 20%). Therefore, an awareness of regional susceptibility data regarding *E. coli* is very important for selecting appropriate antibiotics (Head, 2009, 227-244). However, the rate at which *E. coli* strains are becoming resistant to the vast majority of antibiotics is increasing worldwide.

Sandven et al. wanted to understand the cause of CA-UTIs in low-prevalence countries such as Norway. It is understood that community-acquired UTIs could be caused by extended-spectrum  $\beta$ -lactamase (ESBL)-producing Enterobacteriaceae, but the initial clinical epidemiology that causes these infections are unknown. Extended spectrum  $\beta$ -Lactamase is an enzyme that is produced by specific bacteria that makes them resistant to antibiotics. This ESBL production is usually associated with other bacteria that are located in the bowel (Søraas et al., 2013). Research performed a population-based case study to assess the risk factors associated with CA-UTIs as a result of ESBL-producing *E. Coli* or *K. pneumoniae*. The case study focused on 100 cases and 190 controls with CA-UTIs caused by ESBL-producing and non-ESBL-producing *E. coli* or *K. pneumoniae*, respectively. Independent risk factors like travel to higher prevalence continents like Asia or Africa in the past month, recreational swimming in freshwater, and diabetes were corrected for in the data analysis. Based on the results, researchers found that these independent risk factors are the main cause of ESBL-producing Enterobacteriaceae in countries



that have lower prevalence of CA-UTIs (Søraas et al., 2013).

### *Enterobacteriaceae-Producing Extended-Spectrum $\beta$ -lactamases (ESBLs)*

Enterobacteriaceae-producing extended-spectrum  $\beta$ -lactamases (ESBLs) play important roles in UTIs. These are evolving groups of plasmid enzymes that cause resistance to antibiotics like the penicillins, cephalosporins, and aztreonam. They are inhibited by beta-lactamase inhibitors such as clavulanic acid. Because antibacterial therapy for illnesses like UTIs have become more complex, the ESBL isolates are now associated with drug resistance, especially to fluoroquinolones, aminoglycosides, and sulfonamides, which are all involved in the treatment of UTIs (Pitout & Laupland, 2008, 156-166). Insertion sequences, integrons, and transposons haphazardly transmitted between bacteria played a crucial role in global dissemination of the most common ESBL genes, specifically blaCTX-M. The prevalence of ESBL-producing organisms increased dramatically in the last decade, in particular as an etiological agent in community-acquired infections and health care settings (Søraas et al., 2013).

When we look at this issue from a more global perspective, specifically in African countries, antibiotic resistance to uropathogens has more significance because there are poor treatment options available for the citizens. In countries like Ghana, antimicrobial treatment of UTIs is principally experimental due to the lack of laboratory and research facilities needed to study health issues (such as ESBL resistance) and for susceptibility and culture testing of bacteria (Rossouw & Ross, 2021). Due to poor resources and facilities in specific countries, there is little research on healthcare topics such as antimicrobial resistance patterns of uropathogens, and without data surveillance, there is little treatment for UTIs, in turn making the life of citizens difficult without accessibility to medicines and medical care. After spending 5-6 weeks in Cape Town working with primary schools and secondary schools in the Khayelitsha township community, I have seen first-hand the need to address the problem of UTIs, and contributions need to be made to effectively control and prevent these infections (Sorsdahl et al., 2010, 1218-1222). The extensive use of antimicrobial agents to treat community-acquired UTIs has caused the emergence of antimicrobial resistance among some of these bacterial species, especially in developing countries. In South Africa specifically, there is an amplified occurrence of community-acquired extended spectrum  $\beta$ -lactamase-producing organisms. A study conducted

in Gauteng, South Africa found that 425 out of 460 women had UTI pathogens, of which the majority were identified as *Escherichia coli* (79.6%) (Maphumulo & Bhengu, 2019).

### *Khayelitsha Township*

Discrimination against people of color during the Apartheid in south Africa caused citizens to settle in the outskirts of cities like Cape Town in segregated areas known as townships. Khayelitsha is a township that has a population of 2.4 million based on 2020 demographics. Mostly black Africans populate the area, and females make up 52% of the population. It has a very young population, with 40% of its residents being under the age of 19 (Baker, 2010). Areas like Khayelitsha are shaped by economic, social, and political issues in the country, and these impacts cause medical issues over time due to a lack of resources, funding, availability of clinical care, and the will of the government to help its citizens (van Rensburg, 2014).

Little research has examined how forces in township-based environments impact the health of residents within that area, especially for women. Khayelitsha is a majorly monofunctional residential area and secluded from the main city of Cape Town (Adejumo & Archibong, 2013, 14-27). In the West cape province of South Africa, primary care is not developed to be able to cater to those that live there. Gasson et al. estimated adherence to the guidelines for treating infections and found that 7.5% of infections in these areas were urogenital, and compliance with primary care guidelines was little to none. The treatment of antibiotic therapy was inappropriate in 51.2% of the cases (Ventola, 2015, 277-2823). Since there was a continuous increase of UTIs in the western cape, there was abuse of antibiotics, which in turn led to an increase in antibiotic-resistance (Twala, 2014).

UTIs affect the quality of life for women, and the consequences of these infections include sepsis, renal damage, and preterm birth, which the residents of Khayelitsha cannot identify nor treat. Asymptomatic bacteriuria in pregnant women continues to go undetected and untreated and leads to pyelonephritis. Although there have been people who have begun practicing antibiotic stewardship in the area, the need for money makes hustlers steal and sell these medicines to individuals in the illegal market, and the problem tends to return at a higher rate (Adejumo & Archibong, 2013, 14-27).

### *Socio-Economic Status*

Developing countries such as South Africa are consistently increasing their access to medical care. With big cities such as Johannesburg and Cape Town having well-known medical centers, townships surrounding the area tend to suffer because they are underfunded, understaffed, and lack the proper equipment to treat their surrounding citizens (Micklesfield et al., 2018). Socioeconomic health disparities are the main factor in the development of UTIs among girls and women in these townships. People of lower income, education, or job status tend to experience worse healthcare and can die earlier than those who are wealthier (Twala, 2014). These areas lack proper diagnosis and treatment of UTIs in townships all over South Africa and in the wider sub-Saharan region. Countries like South Africa lack tax-financed health care services to provide equal health care for the wider population, so countries such as these tend to treat people based on the availability of resources (Harris et al., 2011).

### *Female Demographic in Khayelitsha*

38% of the population in Khayelitsha are aged under 15, and 77% are under 35 years of age. Unemployment among women in the township is 45%, and 86% of the jobs held are unskilled. With studies showing that African countries are known for using sex as a form of leisure, the majority of the women in this area had 2-3 children by the age of 17 (Cooper et al., 1991, 423-427). Few studies have been done to understand the age of the first sexual encounter for young girls or the compensation offered to them after these events. Using Kenya as an example, girls are sexually active from the age of 14, and the rate of pregnancy is 2 for every 5 girls (Okigbo & Speizer, 2015).

We must also take into account the demographic of the elderly in Khayelitsha. South Africa has the highest population of elderly people in Africa. Since health insurance is low among the older population, especially in black households, there is an over-dependence on the public healthcare system and out-of-pocket payments (Maphumulo & Bhengu, 2019). In most African cultures, women are obligated to put their husbands first. If both are ill, the man will be treated first. Older women with communally transmitted diseases tend to go undetected for long periods of time until they become terminally ill. A study conducted in 2006 showed that elderly women were

twice as likely to die than men due to healthcare issues, while a 2016 study concluded that health amenities that are meant for the public face shortcomings, specifically poorly maintained equipment and infrastructure. The result is poor disease control and prevention practices (Okigbo & Speizer, 2015).

### *Hypothesis*

The purpose of this research is to highlight the biological, chemical, and environmental factors that lead to UTIs and how low income areas like Khayelitsha Township are impacted by poor medical systems that do not allow them to track the causes and treatments of urinary tract diseases as a result of menstrual health. Information about vaginal health, hormones, bodily fluids etc. is not well understood by the medical personnel in townships. In countries like South Africa, quality health care is a constitutional obligation for all citizens, and the government has programs that are intended to improve the health care quality for its residents. On qualitative yearly reports, we can see improvements in the healthcare setting but based on personal reports, services in hospitals and public clinics continue to fail their patients. There is little trust in medical institutions, and patients have begun to self-diagnose or leave illnesses left untreated. Since we are focusing on regions of South Africa, we can look at the history of the health care system and its concurrent impacts on the increased levels in communally transmitted diseases like UTIs.

Many issues within the South African healthcare realm are interconnected to the Apartheid era that lasted from 1948 to 1993, and traces of its effects can still be felt today within the economy and welfare of the nation's citizens (Maphumulo & Bhengu, 2019). The healthcare system was extremely disjointed because of discriminatory efforts by four varying ethnic groups broken up and segregated unwillingly by the Apartheid government. Each of these areas had its own healthcare operations, and some areas had better funding than others. The underfunded areas had spikes in diseases and untreated comorbidities. The prolonged waiting time in clinics or lack of organized systems has increased the number of issues in areas like Khayelitsha, decreased the level of hygiene, and caused infection control to be overwhelming. The South Africa Medical Association (SAMA) in 2015 concluded that facilities within the Western Cape region had poor waste management, maintenance, and inconsistency in cleanliness of the facilities (Micklesfield

et al., 2018). Unreliable inspection had left rooms in hospitals derelict, and they had a deplorable physical atmosphere.

## **Methodology**

I propose a short-term study that focuses on collecting baseline data that will aid in tracking the leading causes of UTIs and subsequent medical treatments in Khayelitsha. This short-term study will also act as a plea to the South African government to fund ESBL PCR testing kits aimed at aiding medical personnel in rapid testing of early UTI symptoms. Research has shown that one in ten patients will develop a UTI caused by an ESBL-PE, and these patients face an almost three times greater risk of recurrence. Although this may not be the most accurate form of testing, I aim to get the government and population involved in understanding the issues surrounding UTIs and not fixing the problem all at once. This methodology and predicted results are aimed at getting quantitative data and research to show the local government that there is a need to increase UTI testing, get professional programs within schools on proper menstrual care, and increase the affordability of menstrual pads.

This study will involve 100,000 willing women and girls within the Khayelitsha Township area ranging from ages 13-45 (menstruating ages). It will focus on surveys aging from 13 years to 45 years, and the study group will be roughly 80% women and 20% men. It will center mainly on observing monthly menstruation cycles. These observations aim to show how financial situations make women unable to afford sanitary pads, leading to reuse. We will focus on circumstances that lead to the purchase of antibiotic drugs on the street, causing resistance due to overuse. We will also analyze sanitation in hospitals and clinics, which can lead to poor treatment of UTIs.

I hope this proposed study serves as an important community resource and will change the way medical institutions located in and around underserved townships carry out UTI screenings with their available resources and their ability to track and treat urinary tract-infected patients.

### *Participants*

The roster of participants for this short term study will be based on a random selection from primary and secondary schools in Khayelitsha and willing working residents. We must also note that school children who are participating in the survey must have the consent of a parent or a guardian to participate. I have also chosen not to include teachers when it comes to the distribution of surveys because their personal relationships with the students which I do not

want affecting survey data. There is no monetary incentive, but three events in different parts of Khayelitsha focusing on menstrual health information sessions as well as UTI prevention will be held. The survey collection will take place for three months.

Because this is a large population to cover in a short time period, research assistants who are studying science either in biology or biochemistry will be recruited from local universities in Cape Town, such as the University of Cape Town, Rhodes University, and Stellenbosch University. These research assistants will be trained in data collection, the methodology, ethics, and our goals and motives for the project. Again, there will be no monetary compensation for this work, but we will provide transport and small stipends in the form of gift cards. This research work can also count toward summer and winter internships.

### *Procedure*

The data collection survey will be administered by the research assistants, and divided up depending on the location each assistant takes in Khayelitsha. Currently, the township is made up of 22 different areas, the main ones include site B, site C, Green Point, Litha Park, Mandela Park, Makaza, and Harare. We understand that that location is important and must be accessible by road. The safety of the research assistant is of the utmost importance. Each area will have 20-25 research assistants who will have the surveys and sanitary towels for distribution. There will be a tent in each site area where the information sessions will be held.

A survey will be administered to each participant when they attend the information session within their area. Information sessions will last 30-45 minutes because of attention spans and out of respect for other activities the participants may need to carry out. They will be administered either in English or Xhosa because these are the predominant languages spoken in the area.

After the information session, mini-surveys will be handed to each willing attendee. The survey will consist of ten basic yes or no questions surrounding menstrual health and general hygiene practices. This data will be then collected and placed in what looks like ballot boxes due to the number of surveys that will be conducted. They will be then added to a computer system, which will divide and count the yes and no answers. We will formulate conclusions from our research

and present this to local and national authorities to aid with the petitions for ESBL PCR testing kits.

We will take into account that our research will be using more paper than necessary, but due to the location of the research, we cannot use computers to administer the surveys. Khayelitsha has historically been known to have a very high crime rate and it would not be suitable to use any type of electrical devices in the area. There is also little to no internet access for the inhabitants. Areas in Khayelitsha have communal cybercafes that are utilized.

### *Data Collection*

This study will highlight specific independent variables that are important to my study. These variables include age, financial status, and level of education. The dependent variables include information on menstrual health and UTIs and the number of women complaining about menstrual irritation. I plan to use both descriptive and inferential statistics to conclude the best course of action when petitioning for EBSL kits.

This study will focus on understanding the impact of poor menstrual health in correlation to an increase in UTIs within the township of Khayelitsha. There are four key areas we will consider within the study: socio-economic issues, environmental cleanliness, financial status and age.

The surveys given to community members will ask the following questions (Appendix) ;

- a) “How clean is your home environment to support your menstrual cycle?” or
- b) “Is it difficult to pay for pads due to other financial burdens?”.

There being four distinct sections to the survey, asking 3-4 questions in each will allow us to distinguish the different factors that can affect both UTI numbers and Menstrual cleanliness. We think this is important because we don't want to misconstrue the data and confuse ‘what factor’ leads to ‘what outcomes’. During our survey, we will be aware that the responses given could suffer from recall bias and social desirability bias. Understanding the perspectives of citizens living within the township is important without assumption.



This method has its own strength, primarily the use of quantitative data on the number of people that suffer from the four main factors listed above. We hope that the use of empirical data will convince the government to provide testing kits to the township clinics.

Ethical considerations within data collection must be understood and analyzed. We must ask for research approval from the institutional review board within Pitzer college as well as research permits from SAHPRA (South African Health Products Regulatory Authority) who are responsible for clinical trial oversight, approval and inspection. The participants from the townships must verbally and physically consent and assent to participating in the survey. On the first of the survey forms, we will attach a name, date and signature section before they begin. These will be provided both in Khosa and English depending on the preferred language. The form will explain the purpose, risks and significance of the surveys. If the participant looks underage we will ask for guardian or parental consent before they can answer the questions needed.

### *Statistical Analysis*

I hope to use both descriptive and inferential statistics to understand menstrual health issues within the Khayelista community. This data will conclude the best course of action when petitioning for EBSL kits.

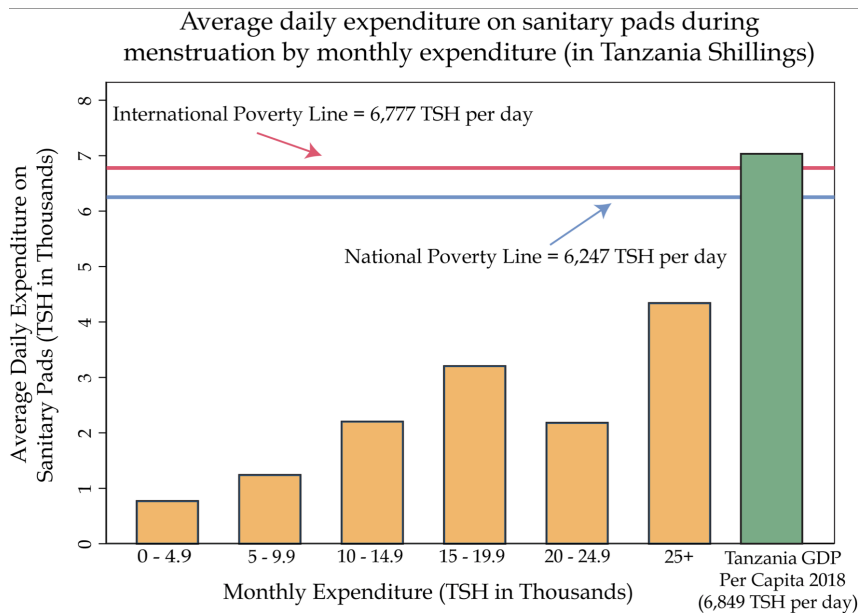
We can apply techniques such as the concentration index which focuses on quantifying the extent of inequality in one outcome over the distribution of another outcome (Olowe et al., 2015, 126-130). For this study, we hope that we can be used to measure the extent of inequality when comparing our increase in menstrual health issues to affordability of sanitary pads, creation of a clean environment and social-economic issues. The index takes a value between plus and minus one. A negative value shows that what we are measuring is inaccessible to the rich. A value equal or close to zero shows that there is equality. A higher value on the index shows a higher level of inequality. Because the concentration index has varying ways of being written, this study will employ the formula that Kakwani et al expressed as :

$$C_s = \frac{2}{n\mu} \sum_{i=1}^n M H M_{mi} r_i - 1$$

The categories of study, menstrual health issues in comparison to ability to afford pads, environmental cleanliness and socio-economic issues, will be represented as  $\mathbf{m}$ ,  $\mu$  will be the mean,  $r_i$  will be the fractional rank of individual  $\mathbf{i}$  in the wealth distribution from the poorest (relative) to the richest (relative) of population  $\mathbf{n}$ . The concentration index has been used in the analysis of menstrual hygiene management in different countries (Rottier et al., 2012). This provides a wider scope as compared to regression analysis. This approach will provide an opportunity to understand the main causes of poor menstrual hygiene within khayelitsha and understand how wealth can play one of the biggest roles when it comes to inaccessibility of sanitary pads and proper menstrual health that can lead to an increase in UTI symptoms.

## Expected Results

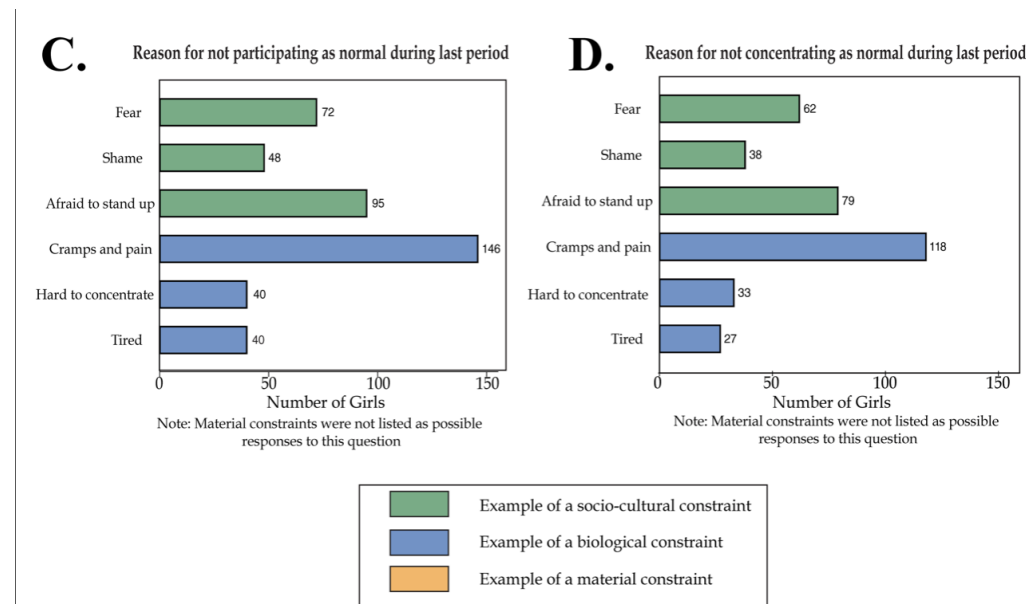
The results we expect to see once the data are analyzed are summarized below. Figure 1 describes the correlation between the daily amount spent on menstrual supplies and the income of the respondent.



### *Relationship between financial stability and ability to afford menstrual pads*

Figure 1 describes the biological, material, and socio-cultural constraints on effective menstrual hygiene management among secondary school students in Tanzania (Stoilova et al., 2022). The researchers aimed to understand the disparity between school girls and saw that girls spend between 12-70% of the daily national poverty line on pads during their menstrual cycle. The sample of students used in this study included those enrolled in four secondary schools within the Mwanza Region and the Geita Region of rural Tanzania. Three of these schools were day schools and one was boarding. The sample did its best to be representative of all the regions in Tanzania that have similar conditions. There were 432 males and 524 females in the study but the sample size was limited to the 524 female students within the schools because including more students was increasing the cost of the study. The data collected within their experiment

created the figure above. This figure shows the monthly expenditure and spending on sanitary pads during menstruation. The girl's self-reported amounts that they use to purchase sanitary towels in Tanzanian shillings alongside their monthly expenditure. The red line represents the international poverty line, the blue line shows the Tanzanian poverty line. The green bar indicates the daily value of the 2018 GDP per capita in Tanzania, while the yellow lines show monthly expenditure on sanitary towels during menstruation.



***Relationship between community social issues and reported UTI indications/menstrual health issues***

Figure 2 shows the socio-cultural constraints that are placed on girls in low-income areas (shown in green). This figure shows the reason for school absenteeism and reduced participation as a result of menstrual health. This data was still collected from the same study as figure 2 (Stoilova et al., 2022). It aims to understand the impacts of shame and fear as the most evident reasons for girls not speaking up about menstrual health, interacting with friends, or not informing parents or teachers about UTI infections as a result of reusing pads, or poor menstrual health guidance. The results from this study showed that 134 girls stated fear, while 84 girls stated shame as the reason for lack of participation in the study. Researchers identified negative social consequences when girls revealed issues around their period, these include sexualization and stigmas within peer and

parental interactions. Increasing evidence indicates that there is a significant impact of menstrual-related social constraints on girls' school and education.

We must identify the origin of fear and shame for women in communities such as those of rural Tanzania. The first is cultural and religious restrictions surrounding women who are on their period. The study highlighted that women were unable to cook, touch water, or participate in community gatherings because they believed they would “contaminate” others. The second reason speaks of menstruation being seen as a sign of sexual maturity. This meant that they were able to marry and be of childbearing age and they can be married off to older men in their village. Case studies found that early sexual debut, pregnancy, and early marriage increased the risk of not only STIs but also UTIs because these girls did not know how to take care of their bodies and the importance and need for proper hygiene.

#### ***Positive correlation between environmental hygiene and reported UTI/menstrual health issues***

Table 1 shows Poor environmental hygiene such as unclean spaces, and lack of water or soap can affect the management of menstrual hygiene which correlates to increased UTI numbers.

This table was taken from research conducted by Paul Tchounwou who aimed to understand period poverty and menstrual hygiene management in low-income and middle-income countries (Rossouw & Ross, 2021). He understood that menstrual hygiene management and health are gaining importance in promoting dignity for women in society, gender equality, and reproductive health. For this to happen both women and girls have to have spaces that are clean and safe for comfortably managing their menstrual cycle. Research by Mishra et al shows that unhygienic environmental conditions when cleaning, drying, or changing sanctuary towels can lead to UTIs. The research used data from the Performance monitoring and accountability survey that used multi-stage cluster sampling designs from each country, specifically Ivory Coast, DRC, Ethiopia, Ghana, Kenya, and Uganda. They focused the data collection on women aged 15-49 who have had a period in the last 3 months and who report their menstrual health. They firstly gadget the difference in menstrual products between women including but not limited to pads, tampons, cotton wool, mattress foam, buckets or nothing at all. They then reported on the availability of

safe, clean, private spaces for changing the menstrual materials, and accessibility to water and soap.

		DRC (Kinshasa)	Ethiopia	Ghana	Kenya	India (Rajasthan)	Indonesia	Nigeria	Uganda
		Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
Condition of main place for managing menstrual hygiene	Not clean	0.158	0.511	0.137	0.125	0.187	0.054	0.134	0.091
	No private	0.565	0.306	0.152	0.128	0.112	0.073	0.171	0.142
	Not safe	0.348	0.512	0.183	0.149	0.202	0.089	0.187	0.218
	Cannot lock	0.745	0.727	0.352	0.314	0.493	0.183	0.348	0.465
	No water	0.826	0.549	0.583	0.608	0.353	0.083	0.59	0.418
	No soap	0.838	0.631	0.561	0.674	0.39	0.135	0.618	0.425
	Does not have all six conditions	0.961	0.883	0.733	0.752	0.629	0.294	0.738	0.701
Materials used	No pads used	0.168	0.41	0.103	0.136	0.535	0.087	0.367	0.357
N		2102	4814	2861	4478	5018	8122	8121	2736

***Negative correlation between age and number of reported UTI symptoms Table 2 shows***

Table 2: This table is sourced from research conducted by Odoki et al that focused on the ‘prevalence of Bacterial Urinary Tract Infections and Associated Factors among Patients Attending Hospitals in Bushenyi District, Uganda’ (Odoki, 2019). The researcher understood that in rural areas such as Bushenyi District the prevalence of Urinary Tract diseases made up 22.3% of all hospital illnesses. Bushenyi is located in the western region of Uganda, with a population of 235,000 people. 3 hospitals serve these people including, Kampala international teaching hospital, Ishaka hospital, and Comboni Hospital. These hospitals were all involved in the study because of the fact that they are major healthcare for inpatients and outpatient care within the district.

The Sample of this study consisted of 267 individuals who filled out surveys that used the prevalence of UTIs among patients attending these hospitals. From the data, we can see that the sample consisted of women who were in the age of infancy to elderly dependents. Their study showed that individuals under the age of 19-49 were found to have higher positive UTI results as compared to those under 19 and over 50.

Age range	Positive UTI (%)	Negative UTI (%)	Total (%)
<1	7 (8.1)	13 (7.2)	20 (7.5)
1–9	5 (5.8)	28 (15.5)	33 (12.4)
10–19	1 (1.2)	19 (10.5)	20 (7.5)
20–29	28 (32.6)	36 (19.9)	64 (24.0)
30–39	10 (11.6)	22 (12.2)	32 (12.0)
40–49	10 (11.6)	20 (11.0)	30 (11.2)
50–59	8 (9.3)	19 (10.5)	27 (10.1)
≥60	17 (19.8)	24 (13.3)	41 (15.4)
Total	86 (100)	181 (100)	267 (100)

### *Study Design Concerns*

I do believe that there are flaws to my proposed short-term study, some of which I will highlight in hope of getting better solutions on how to address these issues and reach my goal of inviting the government to help address these issues. The first problem may be the population size and the research assistants. Although my goal is to get 30-50 research assistants from local universities around Cape Town, it may be unrealistic to assume that students will be interested in conducting research in degraded areas without receiving a salary for their work. We can tackle this problem by petitioning for work study pay from individual universities as well as using funds from the study budget to provide stipends for the students.

Also, Khayelitsha is known as a slum dwelling area and since the research design requires the assistants to be spread out, they will have to be divided into 3-5 individuals per location. This makes it difficult to guarantee their safety during their time in the townships, although we are only working during the day to make the process as safe as possible. This can be improved by working with local police authorities surrounding Khayelitsha who can be divided to patrol with

the students when they are conducting the surveys. The South African Medical Association (SAMA) has worked with local authorities when conducting projects before and they could provide assistance for the designated days that the police can be utilized.

The targeted population is made up of a majority of women, who tend to work or go to school during the day. I am unsure of how to have tents providing information sessions on menstrual health and UTIs without missing important individuals, such as the high school girls, who may need the knowledge or the sanitary pads being given as a result of survey participation. We can avoid these complications by having divided groups of the university students giving surveys. There can be alternating groups for weekdays and weekends which can allow us to target a larger sample size.



## **Conclusion**

Fundamentally, I hope that this short-term study can serve as an introduction to understanding illnesses such as UTIs as a result of poor menstrual health in low-income countries like South Africa. I expect to see relationships between financial status, environmental cleanliness, social issues, lack of proper menstrual education, poor access to medical resources, and improper treatment as the main factors affecting the increase in UTI numbers and menstrual health illnesses.

Although I understand that there is more to be done to improve this short-term study, I believe this is a strong initial effort to make an immediate impact in the lives of the vulnerable.

My visit to the townships in South Africa proved that there is little light that has been shed on the political, social, and economic issues that impact women's health, from a young age onwards, and this study aims to rectify that by shedding light on the issues that occur within communities such as Khayelitsha.

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## **Appendix: Supplementary Material**

### **Proposed survey Questions**

#### **Survey Information**

These survey sessions will provide information on:

- 1) The importance of changing pads,
- 2) How to use sanitary towels,
- 3) Options outside of pads and tampons,
- 4) The importance of good and clean menstrual health,
- 5) The connection between menstrual health and UTIs.

#### **Proposed Survey Questions**

- 1) are you able to track your menstrual cycle?
- 2) Do you have enough sanitary pads for each cycle?
- 3) Does your cycle make you miss school/work?
- 4) Do you feel like your cycle affects you negatively?
- 5) Do you know how to deal with your emotions, cravings, and pains during your cycle?
- 6) Do you have emotional and physical support during your cycle?
- 7) Are your parents, teachers and friends understanding during your cycle?
- 8) Do you feel ashamed when your cycle comes?
- 9) What emotions do you feel when you think about your cycle?
- 10) What other problems do you have with your cycle?
- 11) How much does it cost every month for your menstrual cycle?
- 12) Would you use reusable pads?
- 13) What can you tell me about your cycle?
- 14) Have you had negative experiences with your cycle?
- 15) Is your environment clean (e.g toilet) during your cycle?