Nationwide research on Increased Rate of UTI in an early age resulting in Endometriosis and Infertility and female reproductive health

By

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Bachelor of Biotechnology

Declaration

It is hereby declared that

1. The thesis submitted is my/our own original work while completing a degree at Brac University.

2. The thesis does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.

3. The thesis does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.

4. I have acknowledged all main sources of help.

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Approval

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Abstract

Urinary Tract Infections (UTIs) are common bacterial infections affecting women worldwide, often leading to significant reproductive health issues. Although frequently considered minor, recurring UTIs, especially at a young age, have been linked to serious conditions like endometriosis and infertility. Endometriosis, where tissue similar to the uterine lining grows outside the uterus, can cause chronic pelvic pain and infertility. This study explores the correlation between early-onset UTIs and the subsequent development of endometriosis and infertility in Bangladeshi women. The research surveyed 300 patients from Kurmitola General Hospital, Dhaka, 286 of whom had a history of UTIs. A detailed questionnaire captured medical history and lifestyle factors such as age, BMI, miscarriage or stillbirth history, diabetes, nutritional status, and socioeconomic background. The study aimed to understand how demographic variables affect susceptibility to UTIs, how UTIs may contribute to endometriosis development, and how both conditions affect fertility outcomes. Several significant findings emerged. Age and BMI were critical factors, with many UTI patients falling within the 35-45 age range and higher BMIs being linked to increased risk of both UTIs and endometriosis. A history of miscarriage or stillbirth was reported by nearly half of the participants, and secondary infertility was prevalent, affecting 80% of UTI patients. Additionally, 89.5% of women with UTIs were diagnosed with endometriosis, indicating a strong association between the two conditions. Diabetes also emerged as a complicating factor, affecting infection susceptibility and reproductive health. Treatment for UTIs was inconsistent, with only 80% of the patients having received treatment, and many delayed seeking care. Timely treatment appeared to mitigate some risks, while delayed care was linked to more severe reproductive issues. The study also revealed that women from lower socioeconomic backgrounds, particularly those with poor nutrition and inadequate healthcare access, faced higher rates of both UTIs and endometriosis.Socioeconomic factors such as education, occupation, and sanitation habits also played a role. Women with higher educational levels sought earlier treatment, resulting in better reproductive health outcomes. Those in physically demanding jobs or with limited sanitation facilities at work reported more frequent UTIs, underscoring the need for workplace interventions. The study's objectives were to explore the prevalence of UTIs in Bangladeshi women, analyze the relationship between early UTIs and endometriosis, examine how these conditions affect fertility, and investigate the role of socioeconomic factors in their prevalence. The findings highlight the importance of early diagnosis and treatment of UTIs and addressing socioeconomic disparities in healthcare access to reduce the long-term impacts on women's reproductive health. Improving access to healthcare and raising awareness about proper hygiene and nutrition are essential to lowering the rates of UTIs, endometriosis, and infertility. This research offers valuable insights that could inform public health policies aimed at improving reproductive outcomes for women in Bangladesh.

Dedication

This work is dedicated to one and only Allah who has blessed me with knowledge and arranged for me to study at Brac University. I would never have been able to do this alone without Allah. Then I would like to thank my parents who have sacrificed their lives for me in every way. Special gratitude to my parents, sister and beloved ones. Especially my mother DR. Sanowara Imam for being a shining example all throughout my life and made sacrifices to make this journey easier for me.

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List of acronyms:

UTI – Urinary Tract Infection

BMI – Body Mass Index

POF – Premature Ovarian Failure

PID - Pelvic Inflammatory Disease

PCOS – Polycystic Ovarian Syndrome

WHO – World Health Organization

CNS – Central Nervous System

PNS – Peripheral Nervous System

FSH – Follicle Stimulating Hormone

LH -Luteinizing Hormone

AMH - Anti-Mullerian hormone

MDR - Multidrug-Resistant

ASIR - Age-Standardized Incidence Rate

DIE - Deep Infiltrating Endometriosis

MRI – Magnetic Resonance Imaging

Chapter 1

Introduction

Reproduction is a fundamental process that distinguishes living organisms from non-living entities, ensuring the continuity of species through the generation of offspring **(Fusco & Minelli, 2023)**. This biological mechanism can be classified into two main types: asexual reproduction and sexual reproduction. In humans, sexual reproduction involves the combination of genetic material from two parents, leading to the formation of a unique offspring. This process is critical for maintaining genetic diversity and the survival of species. Reproduction is a fundamental biological process that distinguishes living organisms from non-living entities, ensuring the continuation of species across generations. This process can occur through either asexual or sexual reproduction, with humans, like other mammals, relying on sexual reproduction. This involves the combination of genetic material from two parents, a male and a female, resulting in the formation of a zygote that ultimately develops into an embryo. The complexity of the female reproductive system, which plays a pivotal role in this process, necessitates meticulous care to prevent infections, injuries, and other health issues that could potentially impair fertility **(Fusco & Minelli, 2023)**. Reproductive health, as defined by the World Health Organization (WHO), encompasses a state of complete physical, mental, and social well-being in all matters relating to the reproductive system and its functions. This definition underscores that reproductive health is not merely the absence of disease or infirmity but a holistic state of well-being (World Health Organization, 1946). The maintenance of reproductive health is crucial for ensuring a healthy sexual life and the proper functioning of reproductive organs, which is essential for the conception and healthy development of offspring.

Infertility, a significant global health concern, affects approximately 15% of couples worldwide, making it a critical area of focus within reproductive health **(Brugo-Olmedo et al., 2001)**. Infertility can arise from a multitude of factors, including hormonal imbalances, age-related decline in reproductive function, lifestyle factors such as smoking and obesity, and underlying reproductive disorders like polycystic ovary syndrome (PCOS) and endometriosis. Endometriosis, in particular, is a prevalent condition that significantly contributes to infertility. It affects roughly 10% of women of reproductive age globally, which translates to approximately 190 million women **(World Health Organization, 2023)**. Endometriosis is characterized by the growth of tissue similar to the endometrium (the lining of the uterus) outside the uterus, leading to chronic inflammation, pain, and the formation of scar tissue. These pathological changes can severely impact reproductive function, leading to difficulties in conception and an increased risk of infertility. Research indicates that endometriosis is present in 25-50% of women who experience infertility, highlighting its substantial role in reproductive challenges **(Bulletti et al., 2010)**.

In addition to endometriosis, urinary tract infections (UTIs) are among the most common bacterial infections worldwide, particularly affecting women due to anatomical factors such as a shorter urethra, which facilitates the easier ascent of bacteria into the urinary tract. UTIs can cause significant discomfort and, if recurrent or inadequately treated, can lead to more severe health complications that may indirectly impact reproductive health. In 2019, it was estimated

that over 404.6 million individuals globally suffered from UTIs, resulting in nearly 236,786 deaths and contributing to a significant number of disability-adjusted life years (DALYs) lost **(Painuli et al., 2023)**. The high incidence of UTIs among women is a cause for concern, as recurrent infections can lead to chronic inflammation and scarring in the urinary tract and adjacent reproductive organs, potentially exacerbating conditions like endometriosis and increasing the risk of infertility. Furthermore, UTIs are responsible for over 8.1 million healthcare visits annually, underscoring their significant burden on healthcare systems **(Zeng et al., 2022)**.

The interplay between UTIs and endometriosis presents a particularly challenging scenario for women's reproductive health. The chronic inflammation and scarring associated with both conditions can lead to significant damage to the reproductive organs, making conception difficult and increasing the risk of infertility. For women who suffer from both UTIs and endometriosis, the combined effects of these conditions can create a vicious cycle, where the presence of one condition exacerbates the other, leading to more severe symptoms and a higher likelihood of fertility issues. Understanding the mechanisms by which these conditions interact and contribute to infertility is crucial for developing effective treatment strategies that can help mitigate their impact on women's reproductive health.

This thesis seeks to explore the complex relationship between UTIs, endometriosis, and infertility, with a particular focus on the combined effects of these conditions on reproductive outcomes. By examining the prevalence, risk factors, and clinical management of UTIs and endometriosis, this research aims to provide a comprehensive understanding of how these conditions contribute to infertility. The ultimate goal is to inform the development of more effective interventions that can improve fertility outcomes for women affected by these conditions, thereby enhancing their overall reproductive health and quality of life.

Chapter 2
Female Reproductive System:

2.1: Introduction

The human body has multiple organ systems. Each organ system possesses intricate anatomical and regulatory mechanisms that give rise to intricate, unpredictable, and non-linear behavior. The human body is an intricate system in which several organ systems interact through feedback mechanisms at different spatial and temporal scales to optimize and coordinate their actions **(Ivanov, 2021)**. The interplay between organ systems is crucial for preserving health and producing different physiological states, such as wakefulness and sleep, as well as different stages of sleep, such as light and deep sleep **(American Association for Laboratory Animal Science, n.d.)**. It is also accountable for both conscious and unconscious states. Disruption or interruption of organ communication can lead to malfunctions in specific systems or a complete breakdown of the entire organism, resulting in symptoms such as fever, hypertension, pneumonia, coma, and multi-organ failure.
The human body consists of 11 distinct organ systems. The items are:

1. The integumentary system:
This pertains to the external layers of the body. The human integumentary system consists of the epidermis, dermis, hair, nails, and other glands. The organs and tissues mentioned here function as the primary barrier against pathogens, as well as protect against harm and sunlight **(Bielitzki, 1998)**. It works in conjunction with other systems in our body to maintain homeostasis.
Functions:

a. Serves as a safeguard against mechanical, thermal, and physical harm, as well as hazardous substances **(Diegel et al., 2018)**.
b. Mitigates the deleterious effects of UV radiation.
c. Functions as both a sensory receptor for touch and temperature.
d. Retains moisture efficiently.
e. Facilitates the maintenance of an optimal temperature.
f. The immunological organ that identifies and reacts to infections and associated disorders **(Diegel et al., 2018)**.

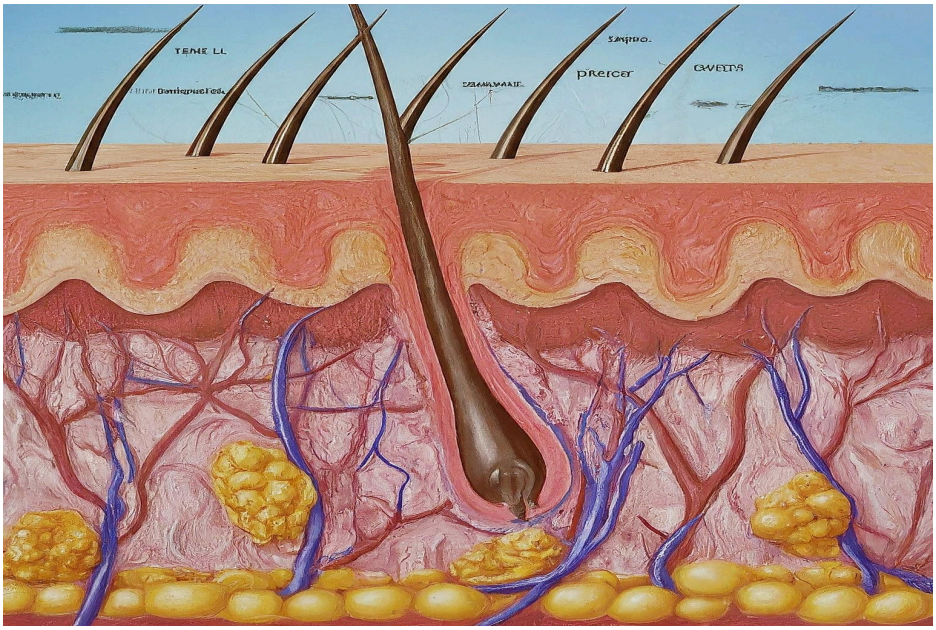


Figure 1 - Integumentary system

2. Skeletal system:

The human skeleton functions as the internal structural support system of the body. This structure consists of multiple distinct bones and cartilages. In addition, there are fibrous connective tissue bands, known as ligaments and tendons, which are intricately connected to various skeletal structures. The musculoskeletal system is an alternative name for this system. The skeletal system comprises seven essential components: the skull, hyoid bone, spine, thorax, shoulder, upper limb, and hip. The skeletal system provides structural support for the body, facilitates mobility, produces blood cells, protects organs, and stores minerals. The human skeleton functions as the internal framework of the body **(*Narayana Health*, n.d.)**. This structure consists of multiple distinct bones and cartilages. Moreover, there is a strong association between fibrous connective tissue bands, ligaments, and tendons with various skeletal components. The musculoskeletal system is an alternative term for this system. The skeletal system comprises seven components: the cranium, hyoid bone, vertebral column, rib cage, shoulder girdle, upper extremity, and pelvic girdle. Functions:

a. The skeletal system serves as the structural framework for the human body.

b. The skeletal system performs several functions, including shaping the body, enabling movement, generating blood cells, safeguarding organs, and storing minerals.

3. **Muscular system:**

The muscular system consists of specialized cells called muscle fibers, which have the main function of contracting. The system in question is vital for facilitating the movement of our bodies, whether it involves controlling the muscles connected to our skeletal structure or those operating within our internal organs and blood vessels **(*Narayana Health*, n.d.)**. Nearly all of our movements are a result of muscular contraction. The primary functions encompass:

a. Muscles facilitate unrestricted movement, communication, and mastication of food.

b. The autonomic nervous system controls vital functions such as heart rate, respiration, and digestion.

4. **The endocrine system:**

The endocrine system comprises glands and organs that secrete hormones directly into the bloodstream. Hormones circulate throughout the body, overseeing crucial functions such as development, metabolism, and reproduction. Endocrine hormones exert diverse effects on several aspects such as mood regulation, growth, development, and the functioning of organs. The mechanism precisely controls the release of every hormone. The primary glands responsible for hormone production include:

a. The hypothalamus, situated within the brain, serves as the primary controller of the endocrine system.
b. The pituitary gland is a small gland, about the size of a pea, that controls the activity of other endocrine glands. The thyroid gland has a butterfly form and is located near the anterior part of the neck. It regulates metabolism.

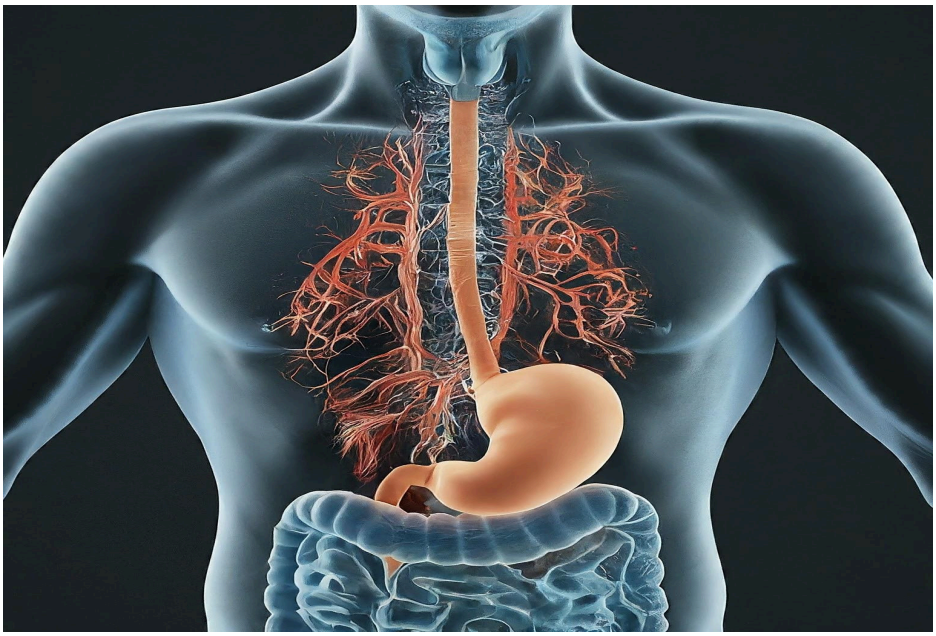


Figure 2 - Endocrine system

5. The cardiovascular system:

The circulatory system facilitates the distribution of nutrients and oxygen throughout the entire body. The structure consists of the heart and an extensive system of blood vessels. Arteries carry blood out from the heart, while veins bring it back. This mechanism carries out a multitude of significant functions:

a. Facilitating oxygen transport and removing carbon dioxide.
b. Supplying cells with vital nutrients.
c. Conveying metabolic waste to excretory organs for elimination.
d. Enhancing the body's immune system's ability to combat infections and diseases.

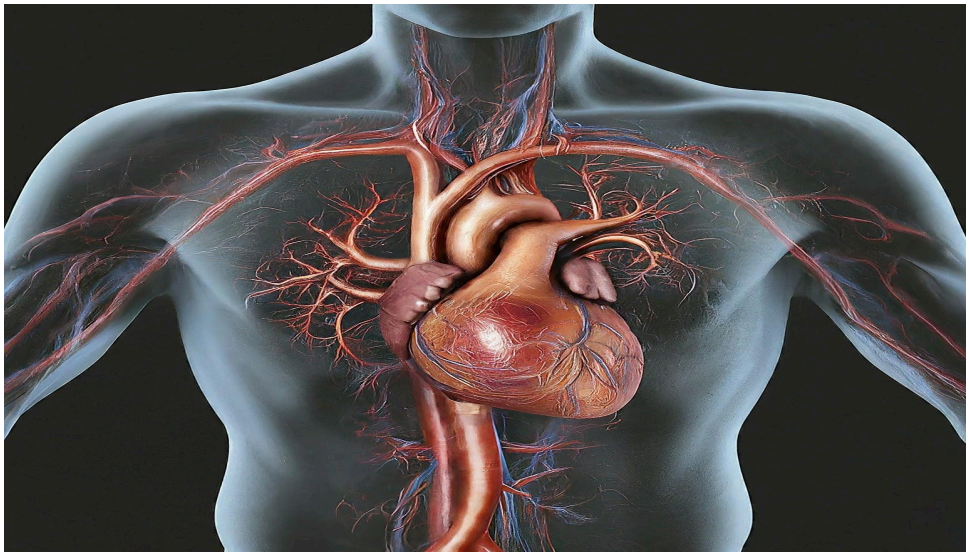


Figure 3 - Cardiovascular system

6. Lymphatic system:

This system is the network of vessels and organs that helps to transport lymph, a fluid containing white blood cells, throughout the body. The lymphatic system functions as the body's waste management system, maintaining fluid equilibrium by removing surplus fluid from tissues. The lymphatic system comprises the bone marrow, spleen, thymus, lymph nodes, and lymphatic veins. These vessels form a network of tiny tubes that transport lymph, a fluid containing white blood cells, throughout the body. These vessels are similar to blood vessels and are necessary for the efficient functioning of both general and specific immune responses. The lymphatic system performs several crucial activities, such as safeguarding against pathogens, maintaining fluid balance, absorbing fat from the digestive tract, and eliminating waste.

7. **Respiratory system:**

The respiratory system comprises a complex network of organs and tissues that collaborate to facilitate respiration. This system consists of the respiratory airways, lungs, and blood vessels. This system comprises the muscles that are accountable for the functioning of the lungs. These components collaborate to ensure the distribution of oxygen throughout the body while eliminating waste gasses, such as carbon dioxide **(*Narayana Health*, n.d.)**. The lungs are the primary organs responsible for respiration, whereas the nose, trachea, and respiratory muscles, such as the diaphragm, play a supportive role. The respiratory system performs a multitude of vital functions:

a. Enhancing the process of gas exchange, namely the transfer of oxygen and carbon dioxide.
b. Regulating the balance of acids and bases in the body.
c. Facilitates the production of speech by phonation.
d. Mitigating respiratory risks.
e. Controlling the process of metabolism and the production of bioactive molecules.

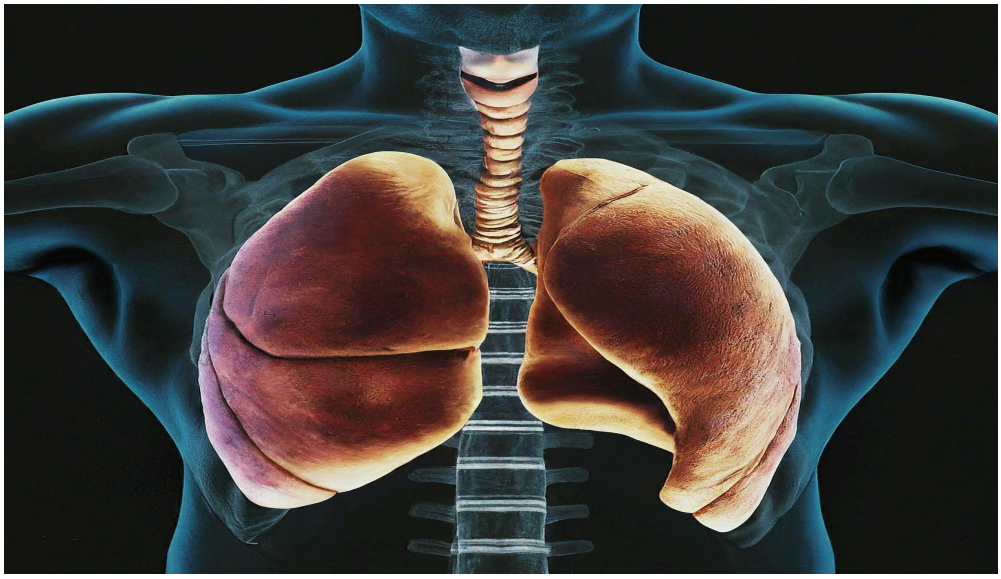


Figure 4 - Respiratory system

8. **Gastrointestinal System:**

The digestive system is responsible for the breakdown of food and fluids, enabling the body to obtain the necessary nutrients for energy, growth, and tissue regeneration. Defecation removes toxic waste from the body. The digestive system comprises essential organs, including the mouth, throat, esophagus, stomach, small and large intestines, rectum, and anus. In addition, it encompasses additional organs such as the salivary glands, liver, gallbladder, and pancreas, which produce digestive fluids and enzymes. The gastrointestinal system, commonly referred to as the digestive system, is responsible for a range of functions including the mechanical breakdown of food, release of digesting materials, and elimination of waste.

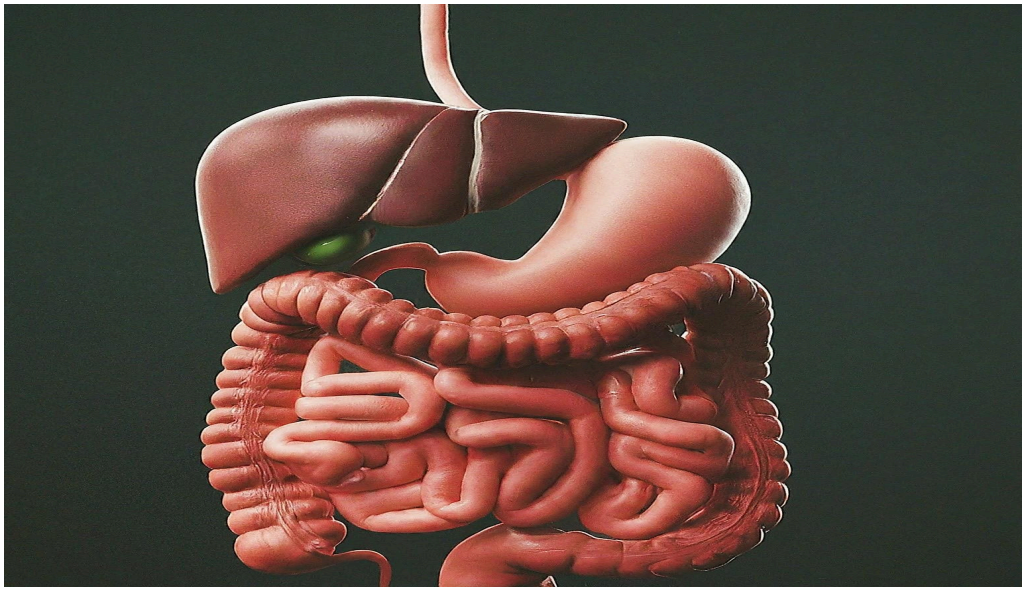


Figure 5 - Digestive system

9. The Urinary System:
The urinary system functions as the body's filtration mechanism, removing toxins and waste through the production of urine. The structure consists of a complex network of tubes and channels that connect to the circulatory and gastrointestinal systems. The renal system comprises the kidneys, ureters, bladder, and urethra, which collaborate to purify blood, preserve essential nutrients, and expel liquid waste. The primary function of the urinary system is to purify the blood and generate urine as a consequence of waste elimination. Additionally, it sustains the volume and pressure of blood, governs the levels of electrolytes and metabolites, and maintains the balance of blood pH.

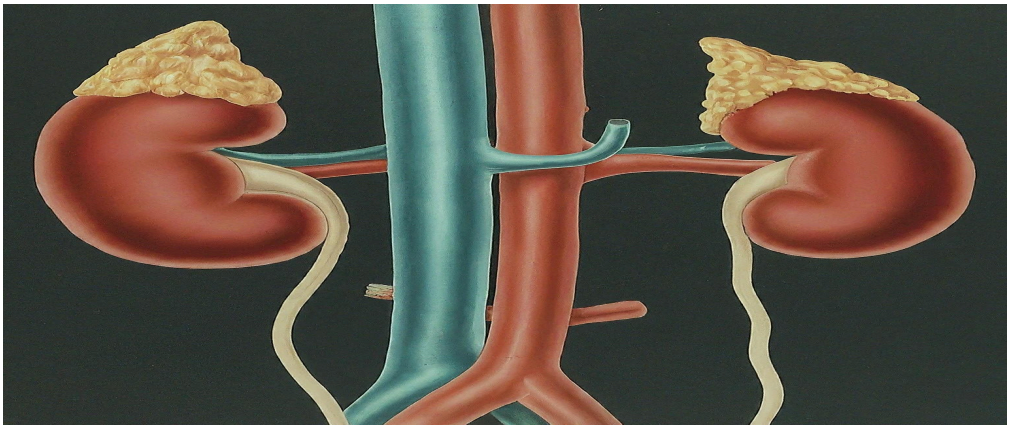


Figure 6 - Urinary System

10. The Nervous System:
The nervous system comprises the brain, spinal cord, and an extensive network of nerves that establish connections between the brain and every organ of the body. The brain functions as the central hub for all physiological processes, while the spinal cord acts as a conduit for communication between the brain and the rest of the body. The nervous system is divided into two main components: the central nervous system (CNS), consisting of the brain and spinal cord, and the peripheral nervous system (PNS), which includes all other nerves. This system carries out multiple essential functions:

a. Sustaining internal equilibrium (homeostasis).
b. Regulating reflex actions through the spinal cord.
c. Enhancing cognitive function and facilitating the process of acquiring knowledge.
d. Facilitating voluntary regulation of movement.

Figure 7 - Nervous system

11. Reproductive system:

The reproductive system is the biological system responsible for the production of offspring.
The reproductive system is vital in human life, as it includes the organs, glands, and tissues that are responsible for the creation and support of offspring. The reproductive system is comprised of two separate components: the male reproductive system and the female reproductive system.

A. The Male Reproductive System:

The male reproductive system comprises organs that also fulfill roles in the urinary system. These organs have the responsibility of performing multiple crucial functions:

a. The process of generating, sustaining, and conveying sperm (the male reproductive cells) in conjunction with seminal fluid, which safeguards and provides nourishment to the sperm.
b. Introducing sperm into the female reproductive system.
c. The body's production and release of androgens, a collection of hormones that are crucial for the development of masculine characteristics and reproductive function.
d. Hormones have a crucial role in the regulation of the male reproductive system. They exert impact over and regulate the functioning of diverse cells and organs. The primary hormones implicated are follicle-stimulating hormone (FSH), luteinizing hormone (LH), and testosterone.
e. The pituitary gland, situated near the cranial base, secretes follicle-stimulating hormone (FSH) and luteinizing hormone (LH) **(Professional, 2024)**. These hormones are essential for spermatogenesis, the process of sperm formation. Luteinizing hormone (LH) promotes the synthesis of testosterone, an essential hormone for spermatogenesis and the development of male attributes, including muscular mass, body fat distribution, bone density, and libido.

B. The Female Reproductive System:

The female reproductive system consists of many organs and structures involved in the production and transportation of eggs, as well as the development and nourishment of a fetus throughout pregnancy.
The female reproductive system is located in the pelvic cavity, namely in the lower abdomen

region. The reproductive system is a sophisticated and comprehensive network that collaborates with other bodily systems to enable reproduction. This system consists of internal and external organs that collaborate to facilitate the reproduction process.

During birth, the female reproductive system is incompletely developed, but it undergoes substantial transformations during adolescence to acquire the ability to generate eggs and facilitate childbirth **(Rosner et al., 2024)**. The internal organs encompass the ovaries, fallopian tubes, uterus, and vagina, whereas the external genitalia are also integral components. Moreover, the adrenal glands have a vital function in controlling hormone levels in this system. The female reproductive system performs multiple essential functions:

A. Oviparous reproduction involves the production of eggs (ova) during the reproductive cycle.
B. The endocrine system releases hormones, such as progesterone and estrogen, to control the reproductive cycle.
C. Creating a conducive environment for the process of fertilization.
D. Facilitating the initial phases of embryonic growth and sustaining gestation.
E. Facilitating embryogenesis refers to the process of supporting the development of a fertilized egg into a fetus.
F. Providing support during the process of labor and delivery.
G. Facilitating postpartum nursing to provide nourishment for the newborn.

The complex anatomy and physiological processes of the female reproductive system highlight its crucial significance in the perpetuation of human existence.

The female reproductive system is an essential element of human biology, serving as a vital factor in both reproduction and overall well-being. Out of the eleven organ systems in the human body, the reproductive system plays a vital role in ensuring the survival and propagation of the species. The reproductive system consists of a collection of organs, glands, and tissues that collaborate to generate, support, and nourish offspring. The female reproductive system comprises the anatomical components that support reproduction in individuals designated female at birth. These structures are situated in the profound depths of the pelvic cavity, which is a component of the lower abdominal region.

The female reproductive system's health is vital not just for reproductive capability but also for overall wellness. Genital infections pose a substantial health risk to women worldwide, with around 10% encountering infections such as bacterial vaginosis or urinary tract infections each year, and 75% having a previous record of such diseases **(Rosner et al., 2024b)**. Pregnancy, menstrual hygiene, and perineal cleanliness are recognized as factors that can heighten the likelihood of developing vaginal infections. Additionally, the reproductive system has an impact on other elements of health. This is because the ovaries generate hormones that govern mood, cholesterol levels, bone density, and cardiovascular well-being.

The female reproductive system performs various roles. It allows for sexual intercourse, aids in reproduction, and controls the menstrual cycle by producing hormones. The process of reproduction commences in the ovaries, where ova are generated. Ovulation is the process in which an egg is released from the ovary and moves via the fallopian tube, where it has the potential to be fertilized by sperm. Upon fertilization, the developing embryo migrates to the uterus, where the lining, which has expanded in response to the hormones of the menstrual cycle,

offers a supportive environment for implantation and growth **(Rosner et al., 2024)**. When fertilization does not take place, the thick uterine lining is expelled through menstruation.
As women enter menopause, the reproductive system gradually reduces its production of the hormones necessary for the monthly cycle. This shift results in erratic menstrual cycles, which ultimately end completely.

2.2: Development of the Female Reproductive System

During the initial 10 weeks of embryonic development, the human fetus possesses the capacity to differentiate into either the female or male sex. The differentiation of the genital system typically occurs during the fifth and sixth weeks of fetal development. During this period, the developing fetus possesses two sets of genital ducts: the mesonephric (Wolffian) ducts and the paramesonephric (Müllerian) ducts. The maturation of the female reproductive system is an intricate process that relies on the existence of a XX genotype.
When the anti-Müllerian hormone (AMH) and the SRY gene are not present, the Wolffian ducts shrink but the Müllerian ducts keep growing. The Müllerian ducts play a crucial role in the development of the female reproductive organs. More precisely, they contribute to the development of the superior portion of the vagina, the cervix, the uterus, and the fallopian tubes **(Sajjad, 2010)**. During the seventh week of development, the coelomic epithelium produces two paramesonephric ducts. Subsequently, these ducts initiate growth in a downward and outward direction from the urogenital ridges.
During the eighth week, the paramesonephric ducts undergo vertical fusion, resulting in the development of the left and right portions of the future uterus. The cranial ends of the Müllerian ducts that have not fused grow into the fallopian tubes, while the lower ends combine to create the upper portion of the vagina. The gubernaculum has a role in the development of both the round and ovarian ligaments in the uterus. During fetal development, the ovary in the female fetus is connected to undifferentiated mesenchymal tissue. The ovary is held in place by the round ligament, which binds it to the uterus. After the initial trimester, the uterus and other anatomical formations originating from the Müllerian ducts have reached complete development.

2.3: Structure of the female reproductive system

The female reproductive anatomy and its various components facilitate women's ability to conceive and sustain pregnancies. The reproductive organs of the female anatomy have distinct responsibilities and also operate as an intricate and interrelated system. The female reproductive system is generally divided into internal and external genitalia.
The internal genitalia of the female reproductive system include the ovary, fallopian tube, uterus, cervix, and vagina.
The external genitalia include the vulva, mons pubis, labia majora, labia minora, clitoris, urethra, hymen, perineum, vestibule, vestibular glands, and vestibular bulbs.

2.3.1 Internal genitalia:

Uterus:

The uterus, commonly referred to as the womb, is a vital component of the female reproductive system. Its primary function is to provide a caring environment for the growth and development of a fetus during pregnancy. It is located in the pelvic cavity, which is a central position in the lower abdomen. The uterus exhibits a pear-shaped morphology and is composed of smooth muscular tissue, facilitating its ability to enlarge during pregnancy and contract during childbirth. The average dimensions of the uterus in an adult female are around 7.6 cm in length, 4.5 cm in width, and 3 cm in depth. The uterus typically exhibits an anteverted posture, with the cervix inclined forward and pointed towards the belly. The placement of the uterus in this case is known as an anteverted uterus, which is the most frequently observed orientation. Nevertheless, there might be deviations in the location of the uterus, resulting in diverse arrangements:

1. **Retroverted uterus:** A condition in which the uterus is tilted backward instead of being in its normal forward position. Referred to as a "tipped" or "tilted" uterus, this disease develops when the uterus inclines in a rearward direction towards the spine. Although less prevalent than the anteverted position, this posture often does not pose any issues unless it leads to discomfort or difficulties.
2. **Anteflexed uterus:** An anteflexed uterus refers to a condition when the uterus is not only tilted forward but also severely curved in the forward direction. This pronounced anterior inclination might provide heightened pressure on the bladder or abdomen, perhaps leading to discomfort or symptoms such as pelvic pain.
3. **Retroflexed uterus**: A retroflexed uterus refers to a condition where the uterus is folded backwards upon itself, resulting in a position that might cause pressure on the lower back. This orientation may be correlated with discomfort or pain in the lumbar region.

The main purpose of the uterus is to create an optimal environment for the growth and development of the fetus. Following ovulation, the endometrium, also known as the uterine lining, undergoes thickening in anticipation of the possible attachment of a fertilized egg. In the absence of fertilization, the egg undergoes disintegration, and the uterine lining is removed after around two weeks. Menstruation, also referred to as a menstrual period, is the shedding process in which the uterine lining disintegrates into blood and is discharged from the body through the vagina.

Upon fertilization, the egg undergoes implantation into the uterine endometrium. Following fertilization, the zygote undergoes cellular division and differentiation, gradually transforming into an embryo and later developing into a fetus. During the developing phase, the fetus obtains vital nutrients and oxygen from the placenta, which is linked to the fetus by the umbilical cord. As the fetus develops and reaches maturity, the uterus experiences substantial modifications to support the growing fetus. During the onset of labor, the uterus commences a sequence of forceful and regular contractions. These contractions help to widen the cervix and aid in the removal of the fetus from the uterus. The process of birthing is a vital function of the uterus, illustrating its role in the concluding phase of pregnancy.

The uterus consists of three different layers, each serving a specialized purpose:

1. **Perimetrium:** The perimetrium is the outermost layer of the uterus that serves as a protective coating. The organ within the pelvic cavity is supported and stabilized by a delicate layer of connective tissue.

2. **Myometrium:** The myometrium consists of smooth muscular tissue, forming the middle layer. The uterine layer is accountable for the extensive enlargement of the uterus during pregnancy and for the vigorous contractions during labor and delivery.
3. **Endometrium:** The endometrium, also known as the uterine lining, is the innermost layer of the uterus where the fertilized egg implants. The endometrial layer experiences periodic alterations throughout the menstrual cycle, becoming thicker in anticipation of pregnancy and then shedding during menstruation if pregnancy does not transpire.

The uterus plays a crucial role in female reproductive health, since it is responsible for several dynamic processes during the reproductive process, including menstruation, pregnancy, and childbirth. Its structural complexity is required to carry out these duties effectively.

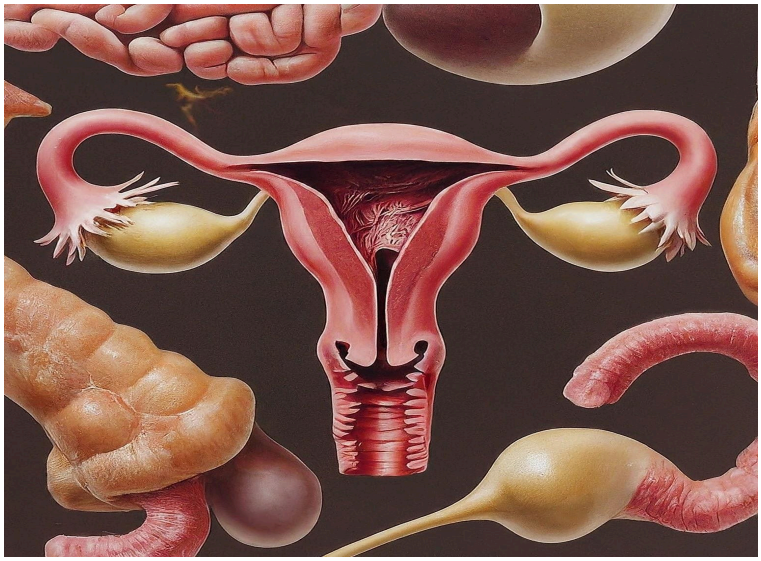


Figure 8 : Uterus system

Ovary:

The ovaries are bilateral, ovoid glands located next to the uterus, serving a vital function in the female reproductive system. Each ovary has a length of around 4 centimeters and is composed of three different layers:

1. The Outer Layer: This layer serves as a protective barrier, much like a capsule. It surrounds the ovary and offers structural reinforcement.
2. The Middle Layer: The ovarian cortex is the middle layer. This layer is composed of connective tissue and serves as a housing for the ovarian follicles, which contain the developing eggs (ova).
3. The Innermost Layer: The medulla, located at the center of the ovary, contains a dense network of blood arteries and lymphatic capillaries. These vessels play a crucial role in transporting nutrients and hormones.

The ovaries have the function of generating and storing eggs, also called oocytes, as well as creating hormones that control the menstrual cycle and aid in pregnancy. Each ovary is initially endowed with roughly 700,000 undeveloped eggs at the time of birth. During adolescence, the eggs start to develop and mature inside the ovarian follicles. Ovulation, a crucial step of the menstrual cycle, involves the release of a single mature egg from the ovary usually once a month. This procedure increases the chances of conception.

Estrogen and progesterone are the two main hormones secreted by the ovaries. These hormones play a crucial role in maintaining reproductive health and regulating the menstrual cycle. Estrogen levels reach their highest point in the first half of the menstrual cycle, just before ovulation occurs. After the release of an egg during ovulation, the levels of progesterone increase to make the uterus ready for the possible attachment of a fertilized egg. In the absence of conception, the levels of both hormones decrease, resulting in the removal of the uterine lining during menstruation. In addition to regulating the menstrual cycle, the hormones released by the ovaries serve other crucial tasks.

1. The development of female secondary sexual characteristics, such as breast development and the distribution of body fat, is influenced by estrogen and progesterone.
2. The hormones facilitate pregnancy and labor by preparing the uterus for pregnancy and supporting the necessary physiological changes for childbirth. Additionally, they have a role in the synthesis of breast milk following childbirth.
3. Estrogen and progesterone are essential for preserving bone density, cardiovascular well-being, liver functionality, and brain health, contributing to overall physical wellness. They have a role in maintaining the health of different tissues throughout the body.
4. The regulation of mood, sleep, and libido is also influenced by these hormones, demonstrating their extensive influence on general health and quality of life.

Studies suggest that the size and functionality of the ovaries often diminish as individuals grow older, usually commencing around the age of 30. Over time, this gradual decrease can have an impact on both fertility and hormonal equilibrium. Therefore, the ovaries are not solely responsible for reproduction, but they also have a wider function in preserving overall health and well-being.

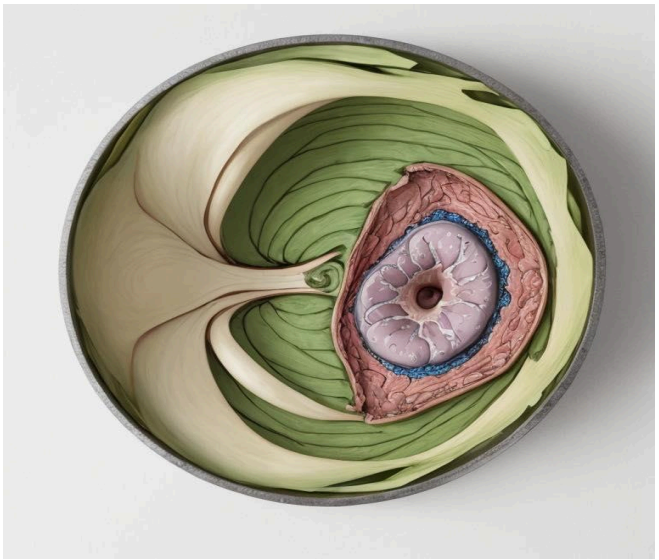


Figure 9 - Ovary

Fallopian tubes:

The fallopian tubes are bilateral, tubular structures located between the ovaries and the uterus. They are composed of smooth muscle and serve a vital function in the fertilization of eggs and the initial stages of pregnancy. The length of each fallopian tube is around 11 to 12 centimeters, and the diameter of its inner cavity is less than 1 millimeter. The tubes consist of several layers, such as a delicate mucous membrane and multiple layers of smooth muscle tissue that aid in their functioning. Each fallopian tube is composed of four unique areas in its structure:

1. Infundibulum refers to the conical end of the fallopian tube that is located closest to the ovary. This section showcases fimbriae, which are elongated projections that reach toward the ovary. Out of all these fimbriae, the fimbria ovarica stands out due to its remarkable length, allowing it to extend and capture the egg that is discharged from the ovary. After ovulation, the fimbriae delicately seize the egg and guide it into the fallopian tube.
2. The ampulla is the main segment of the fallopian tube, located between the infundibulum and the isthmus. The spot where fertilization most commonly occurs is the location where sperm and egg generally meet.
3. The isthmus is a thin segment that links the ampulla to the intramural part of the fallopian tube. It functions as a conduit through which the egg travels from the ampulla to the uterine cavity.
4. The intramural (interstitial) portion refers to the section of the fallopian tube that enters and passes through the wall of the uterus. This segment directly connects to the uterine cavity, creating a route for a fertilized egg to move into the uterus. If implantation takes place, the embryo can attach itself to the uterine lining and initiate the process of transforming into a fetus.

The fallopian tubes play a crucial role in reproduction by facilitating the transportation of the egg from the ovary to the uterus and creating a conducive environment for fertilization to occur. Their complex arrangement and synchronized operation are crucial for achieving successful fertilization and the early phases of gestation.

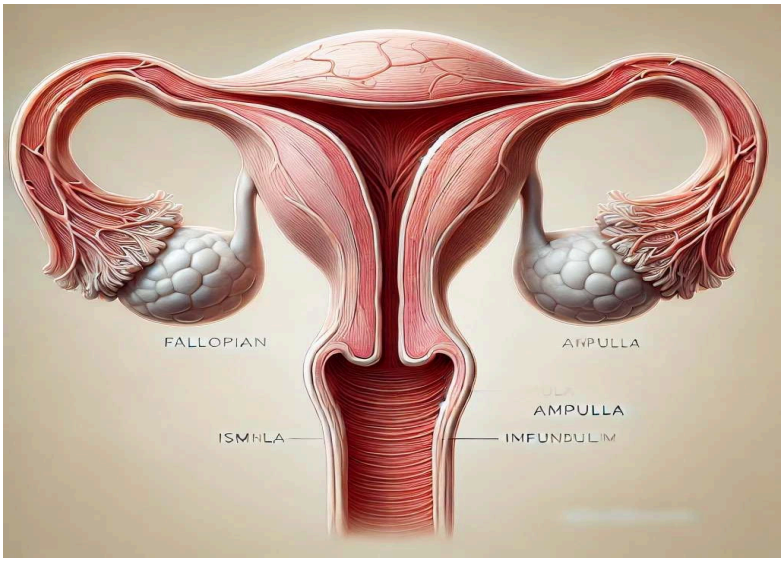


Figure 10 - Fallopian Tube

Vagina:

The vagina, commonly known as the "birth canal," is a pliable and empty tube that stretches from the cervix to the external genitalia. The average length of the vagina is around 6.3 cm (2.5 inches), however, its dimensions and form can vary considerably among individuals. Variables such as age, body weight, and menopausal status can impact the dimensions of it.

The vagina is composed of multiple layers of tissue that include various types of cells, including those responsible for producing secretions that maintain the moisture, elasticity, and health of the vaginal walls. The vaginal epithelial cells exhibit a high degree of sensitivity to the hormone estrogen, which is essential for the maintenance of vaginal health and proper functioning.
It is crucial to differentiate between the vagina and the vulva, as they are frequently mistaken for one another. The vagina is an internal anatomical structure that serves as a channel connecting the cervix, which is the bottom portion of the uterus, to the external section of the body. On the other hand, the vulva specifically denotes the external reproductive components, such as the labia, clitoris, and vaginal entrance. The vagina acts as a channel connecting the internal reproductive organs and the external genitalia. It enables the passage of monthly flow, facilitates childbirth, and also plays a crucial part in sexual intercourse. The dynamic and sensitive character of this organism's tissues is crucial for maintaining its important functions in both reproductive and general health.

Cervix:

The cervix is a crucial element of the female reproductive system, playing various vital roles in both reproductive health and birthing. The cervix is located within the pelvic cavity, approximately 3 to 6 inches within the vaginal canal. It serves as a crucial link between the vagina and the uterus. The cervix is anatomically separated into two distinct pieces as a result of

its connection with the vaginal canal: the upper portion, referred to as the supravaginal cervix, and the lower portion, known as the vaginal cervix. The structure has various crucial elements:

1. The internal OS is the aperture located at the uppermost part of the cervix, serving as an entrance to the uterine cavity.
2. The endocervical canal is a tubular channel that runs from the internal OS to the ectocervix, allowing for the movement of fluids and sperm.
3. The ectocervix refers to the section of the cervix that extends into the upper region of the vagina.
4. The external OS is the aperture located at the lower end of the cervix, which serves as a connection to the vaginal canal.

The cervix consists of resilient fibromuscular tissue, which offers both durability and adaptability. It consists of two main categories of cells:

1. Glandular cells are seen lining the endocervical canal, which is the interior channel of the cervix. Glandular cells are accountable for the production of mucus, which aids in the maintenance of a favorable environment in the cervix.
2. Squamous cells are responsible for covering both the ectocervix and the vaginal section of the cervix. They serve as a defensive barrier against possible pathogens and contribute to the structural strength of the cervix.

The cervix, commonly known as the "neck of the uterus," is essential for reproductive health since it controls the flow of fluids between the uterus and the vagina. During labor, the cervix widens to enable the baby to pass from the uterus into the vaginal canal, thus aiding in the process of birthing. Moreover, the cervix experiences frequent cellular alterations, which can occasionally result in the development of precancerous or cancerous diseases. Regular screening and monitoring are crucial for preserving cervical health and identifying any potential problems at an early stage. The cervix plays multiple roles that highlight its significance in both the reproductive process and the overall well-being of individuals.

2.3.2 External genitalia

Vulva:

The vulva is the exterior part of the female genitalia and has a vital purpose in sexual activity and safeguarding the internal reproductive organs. It comprises multiple structures that collaborate to protect the entrances of the urethra and vagina, as well as the vestibule, which is the area between the labia minora. The vulva consists of various components. The main constituents of the vulva comprise: The vulva consists of numerous separate components:

1. The labia majora refers to the external, bigger skin folds that protect the more fragile inside components. They serve as a defensive barrier and are adorned with pubic hair.
2. The labia minora are the tiny, hairless, and smooth inner folds located within the labia majora. The labia majora encircles the vaginal opening (introitus) and the urethral opening (urethral meatus), offering safeguard and reinforcement to these openings.
3. Vestibule: The vestibule refers to the space that is surrounded by the labia minora. The structure encompasses the vaginal and urethral openings and works as a crucial anatomical pathway for both reproductive and urine processes.

4. The perineum is the anatomical region situated between the vulva and the anus. It offers structural reinforcement and contributes to the process of birthing and other physiological activities.

Mons pubis:

The mons pubis is a convex, adipose protrusion located over the pubic bone (pubis). The female external genitalia is commonly regarded as the most superior and anterior component. The mons pubis is situated in front of the pubic symphysis and pubic tubercles. It is bordered below by the clitoris and above by the pubic hairline and the lower margin of the abdominal wall.

The mons pubis is a localized area that represents the exterior surface of the perineum. It is mainly made up of adipose tissue. The quantity of adipose tissue in this region might differ among individuals and fluctuates with age. Although both males and females possess a mons pubis, it is often more prominent in females as a result of a higher concentration of adipose tissue. During puberty, the area in question undergoes the growth of pubic hair, which is a result of hormonal changes and plays a role in the development of secondary sexual characteristics in females. In summary, the mons pubis plays a crucial role in the female reproductive system by offering safeguarding, assistance, and contributing to sexual and reproductive processes.

Clitoris:

The clitoris is commonly considered the main source of pleasure in the female reproductive system; however, its importance goes beyond the modest outward protrusion that is visible at the top of the vulva. The clitoris is an intricate formation consisting of a vast network of nerves and erectile tissue, which includes both internal and exterior components. The glans, which is the visible portion of the clitoris, represent only a single component of this intricate organ. The complete clitoris extends inside and incorporates supplementary structures known as the crura, which secure its position within the pelvic region. The complete clitoral anatomy has a length ranging from roughly 3.5 to 4.25 inches and a breadth of about 2.5 inches. The glans itself has a diameter that varies between 0.75 and 1 inch. The clitoris consists mainly of erectile tissue, which becomes filled with blood during stimulation, leading to an enlargement of the clitoris and heightened sensitivity. The phenomenon of swelling is essential for the process of sexual arousal. The glans of the clitoris contain a high density of nerve endings, approximately 8,000 of which are concentrated in one specific region. The clitoris is densely populated with sensory nerves, which contributes to its exceptional sensitivity and responsiveness. This highlights its crucial involvement in sexual pleasure and arousal.

Hymen:

The hymen is a fragile and tiny membrane located at the entrance of the vagina. The composition of this structure includes residual tissues from the embryonic stage and exhibits significant variations in its morphology, dimensions, and density among different individuals. While the hymen does not have a defined purpose in the body or reproductive system, it is a typical characteristic of female anatomy. The precise function of the hymen is still unclear; however, several ideas propose that it may offer a level of defense against the infiltration of microorganisms or foreign objects into the vagina. Nevertheless, this hypothesis lacks conclusive proof.

The hymen is usually the same color as the surrounding skin in the vaginal area and is made of elastic tissue, enabling it to stretch. It is crucial to understand that the hymen is not a fixed

structure; its appearance and physical condition can alter over time due to variables such as physical exertion, hormone fluctuations, and sexual intercourse.
Hymens are classified into various categories according to their anatomical structure:

1. An annular or crescent-shaped hymen is a frequently occurring type of hymen. Typically, it encircles the vaginal opening in the form of a ring (annular) or adopts a crescent shape following childbirth. This particular type of hymen is commonly known as a "donut hymen."
2. The cribriform hymen is distinguished by the existence of numerous tiny perforations distributed across the hymen. Although this arrangement permits the passage of menstrual blood, it can provide difficulties when using tampons and may be linked to discomfort.
3. Imperforate Hymen: This condition refers to the total coverage of the vaginal opening by the hymen, which is an uncommon condition that affects approximately 1 in 1,000 girls. This condition can impede the flow of menstrual blood from the vagina, resulting in discomfort and possible consequences.
4. Micro Perforated Hymen: In this condition, the hymen is mostly intact with only a little aperture. The narrow opening permits the passage of menstrual blood but can impede the process of inserting and removing a tampon.
5. The septate hymen is characterized by the presence of an extra band of tissue, which gives the impression of two distinct hymens. The presence of a septate hymen might create difficulties while using tampons and may disrupt the normal flow of menstruation.

Every hymen type has distinct properties and possible implications for menstrual health and comfort. Comprehending these discrepancies is crucial for both healthcare professionals and individuals to effectively treat any associated difficulties.

Urethra:

The urethra is a vital cylindrical organ that facilitates the expulsion of urine from the bladder to the external environment. Located in the pelvic region, this channel functions as the passage through which urine is expelled from the body. The length of the female urethra is quite short, approximately measuring 1.5 inches (3 to 4 cm). The anatomical structure consists of multiple different layers:

1. The inner epithelial lining consists of specialized epithelial cells that create a smooth surface for the flow of urine.
2. The smooth muscle layer is positioned in the middle of the urethra and is composed of smooth muscle cells that contract to aid in the elimination of urine.
3. The submucosa is a porous layer located beneath the epithelial lining of the urethra. It consists of connective tissue that offers both structural support and elasticity to the urethra.
4. The urethra's outermost layer consists of fibroelastic connective tissue, which strengthens the structure of the tube and preserves its form.

Collectively, these layers' function in unison to guarantee the effective and regulated discharge of urine. The urethra is designed in a way that enables it to efficiently carry out its duty while enduring the mechanical pressures that come with the passage of urine.

Labia Majora:

The labia majora, sometimes known as the "large lips," are conspicuous skin folds that delineate the external limits of the vulva. These large skin flaps have an important function in safeguarding the more sensitive parts of the female genitalia. The labia majora are located on the sides, extending from the mons pubis to the anus. They provide cover and protection for the labia minora, clitoris, vulvar vestibule, vestibular bulbs, Bartholin's glands, Skene's glands, urethra, and vaginal opening.

The labia majora are adorned with pubic hair, serving as an extra safeguard against physical friction and possible pathogens. The labia majora are underpinned by a layer of adipose tissue, which enhances their pliability and provides cushioning. The adipose layer serves to absorb impacts and provide insulation to the vulnerable tissues beneath. The main purpose of the labia majora is to act as a safeguard for the inside parts of the vulva, providing the protection and intactness of the more delicate internal structures.

Labia Minora:

The labia minora, sometimes known as the "smaller lips," are the inner skin folds situated below the labia majora. The folds are arranged in a sagittal orientation and form a circular shape around the vaginal opening. The labial frenulum, commonly known as the fourchette, is formed by the joining of the clitoral extensions at the back. The labia minora are anatomically composed of two separate layers:

1. Subordinate Stratum (Middle Segment): The part in question drops below the clitoris and joins with a similar layer on the opposite side to create the frenulum of the clitoris, which is referred to as the clitoral frenulum.
2. The upper layer of the clitoris consists of the clitoral hood, also known as the prepuce. This layer covers the glans of the clitoris and is connected to the upper layer on the opposite side.

The labia minora, in contrast to the labia majora, lacks hair and consists of smooth muscle cells, connective tissue (abundant in elastic fibers), and a network of blood arteries. The labia minora are comparatively smaller and more fragile than the labia majora, and they lack adipose tissue. Sexual stimulation causes the labia minora to fill with blood, which enhances sensitivity and adds to sexual pleasure. The labia minora are lined with a mucous membrane, and the area between them is called the vaginal vestibule.

Vestibule:

The vestibule, a triangle region located between the labia minora, is a significant anatomical component of the female external genitalia. The area acts as a conduit for important structures, namely the urethral orifice and the vaginal orifice, both of which are positioned centrally inside it. In addition, the vestibule contains entrances to four glands: the two larger vestibular (Bartholin's) glands and the two smaller vestibular (Skene's) glands. Hart's lines act as clear boundaries, separating the vestibule from the surrounding labia minora. These lines are important because they indicate the shift from the vestibular area to the labia minora. The vestibule is defined by its unbroken, uninterrupted surface that stretches from the back junction of the labia minora to the upper edge of the clitoris.

Vulva vestibule:

The vulva vestibule is the smooth region that is surrounded by the labia minora. It extends from the back junction of the labia minora to a position slightly below the clitoris. The urethral and vaginal apertures are both located inside this area. The labia minora delineate the external border of the vulva vestibule, while Hart's lines distinctly demarcate the boundary between the vestibule and the labial skin. This transition is characterized by an alteration in the skin's appearance, which indicates the shift from the uniform texture of the vestibule to the more diverse texture of the labia minora.
To summarize, the vestibule is an important anatomical area that contains specialized openings and glands. It is separated from the labia minora by Hart's lines, which mark the boundary between different types of skin in the vaginal region.

Bartholin's Glands:

Bartholin's glands, often referred to as the greater vestibular glands, are little structures about the size of a pea. They are located on both sides near the entrance of the vagina and play an important role in female reproductive health. The function of these glands is to produce a lubricating fluid that helps to retain moisture in the vagina and contributes to creating a pleasant vaginal environment. Bartholin's glands, initially documented by Danish anatomist Caspar Bartholin Secundus in 1677 **(Bora & Condous, 2009)**, play a crucial role in preserving vaginal moisture and overall functionality. The secretion generated by these glands is sent to the vaginal opening via narrow channels. Nevertheless, if these ducts get blocked, fluid may gather inside the glands, which could potentially result in discomfort or infection. This excreted fluid is also crucial for preserving the acidic pH of the vagina, which usually ranges around pH 4.5 or below. This state aids in safeguarding against infections.

Skene's Glands:

Skene's glands, often referred to as the minor vestibular glands, are a pair of tiny glands located on both sides of the female urethra. The glands discovered by Alexander Skene in 1880 were shown to include prostatic glandular tissue, indicating the existence of a female counterpart to the male prostate **(Dagur et al., 2016)**. Skene's glands primarily secrete a fluid that lubricates the urethral opening. This fluid is also thought to have antibacterial characteristics, which assist prevent urinary tract infections. The precise function of Skene's glands in female physiology, especially their probable involvement in female ejaculation during sexual arousal, remains incompletely comprehended. Ongoing research is investigating the specific functions of these factors and their impact on female sexual health and urinary tract protection.

Chapter 3

About the Disease:

3.1 Introduction to Endometriosis and Urinary Tract Infections (UTIs):

Endometriosis is a severe medical condition which involves the growth of tissue resembling the uterine lining (endometrium) outside the uterus. This abnormal growth causes severe pelvic pain and can potentially result in fertility issues. The condition can appear as soon as an individual experiences their initial menstrual period and may continue until menopause. Endometrial-like tissue's abnormal growth creates inflammation and can lead to the development of scar tissue (adhesions) in the pelvic area and, in exceptional instances, other body regions. Despite careful examination, the precise origin of endometriosis remains unclear and a definitive remedy is currently unavailable. Nevertheless, the symptoms of the condition can be controlled with drugs or, in certain instances, surgical procedures to relieve discomfort and address infertility that may be related to it **(World Health Organization, 2024)**.

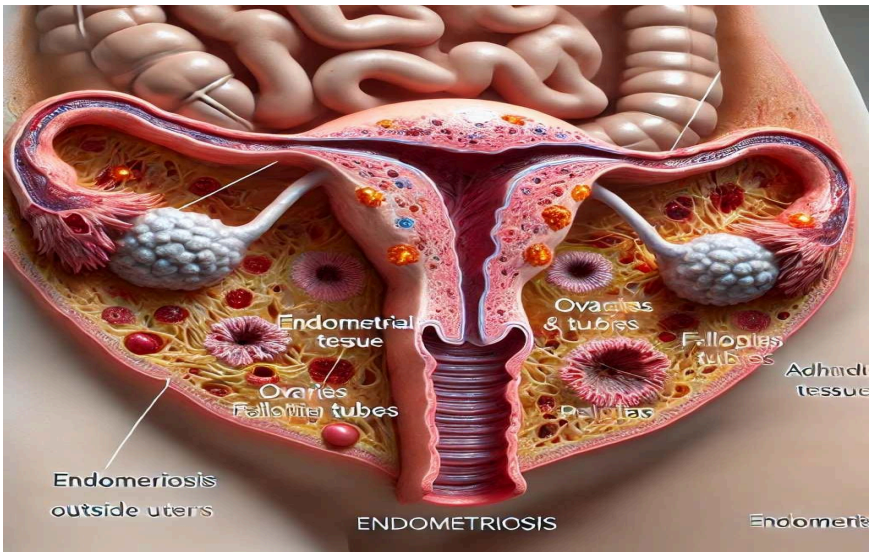


Figure 11 - Endometriosis

Urinary Tract Infections (UTIs) lead to bacterial infections that occur in many regions of the urinary system, such as the kidneys, ureters, bladder, and urethra. Urinary tract infections (UTIs) are more common in women because they have a shorter urethra, which allows bacteria to more easily enter the bladder or kidneys. Although the majority of urinary tract infections (UTIs) are limited to the bladder and urethra and may be cured with medicines, if not treated, they can result in severe health issues, especially when the infection progresses to the kidneys. Adopting preventive measures, such as maintaining good hygiene and staying well hydrated, is crucial for minimizing the likelihood of urinary tract infections (UTIs). However, it is important to note that the issue of antibiotic resistance is becoming increasingly concerning when it comes to treating these infections **(Mayo Clinic, 2023; NHS, 2023)**.

The simultaneous presence of endometriosis and UTIs might worsen a patient's clinical symptoms, especially when considering infertility. Both disorders can autonomously lead to chronic pelvic pain, inflammation, and scarring, which can hinder reproductive function and complicate treatment strategies.

3.2 Worldwide Situation of Endometriosis, UTIs, and Their Impact on Infertility:

3.2.1 Urinary Tract Infections (UTIs) Worldwide:

Urinary tract infections (UTIs) are highly prevalent worldwide and have substantial implications for public health and economic costs. The global prevalence of urinary tract infections (UTIs) in 2019 was expected to be over 404.6 million, leading to over 236,786 fatalities. The data indicates a significant worldwide impact, resulting in 5.2 million Disability-Adjusted Life Years (DALYs), which is a measure of the overall disease burden **(Painuli et al., 2023).** UTIs are still prevalent, with almost 150 million new cases reported worldwide each year **(Zeng et al., 2022)**.

UTIs have a greater impact on women, as approximately 60% of them will experience at least one UTI in their lifetime, in contrast to only 12% of men. The primary cause of this gender imbalance can be attributed to physical distinctions, specifically the comparatively shorter female urethra. This anatomical feature enhances the admission of microorganisms into the urinary tract **(NHS, 2023)**. Urinary tract infections (UTIs) are a prominent reason for seeking medical care, resulting in about 8.1 million visits to healthcare providers annually in the United States alone **(Mayo Clinic, 2023)**. African countries have recorded the highest occurrence of UTIs, with South Africa having the highest frequency at 67.6%, followed by Nigeria at 43.65% and Zambia at 38.25% **(Greenbox, 2024)**.

The emergence of multidrug-resistant (MDR) microorganisms has worsened the worldwide problem of urinary tract infections (UTIs). According to projections by **(Painuli et al.2023)**, by 2050, infections caused by MDR bacteria, including those that cause UTIs, might lead to a yearly mortality toll of up to 10 million. The increasing opposition highlights the pressing necessity for improved methods of prevention, diagnosis, and treatment.

3.2.2 Endometriosis Worldwide:

Endometriosis is a persistent inflammatory disorder that impacts around 5-10% of women in their reproductive years, totaling roughly 190 million women worldwide **(World Health Organization, 2024)**. The illness is defined by the proliferation of endometrial-like tissue outside the uterus, resulting in intense pelvic discomfort, exhaustion, and psychological disorders like sadness and anxiety. The effect on quality of life is severe, especially because of the related infertility, which impacts a substantial number of women with endometriosis.

The countries with the greatest age-standardized incidence rate (ASIR) of endometriosis in 2019 were New Zealand (86.42 per 100,000 population), Afghanistan (71.83 per 100,000 population), and the Solomon Islands (71.01 per 100,000 population). Studies have shown that the occurrence

of endometriosis differs across different ethnic groups. across Asian women, the general prevalence is higher, with estimations ranging from 6.8% to 15.7% **(Zondervan et al., 2020)**.

Endometriosis is a major factor in causing infertility, with estimates indicating that 30-50% of women with endometriosis have trouble getting pregnant. The persistent and incurable nature of the ailment makes it a major public health issue, especially in areas with limited availability of specialized healthcare services.

3.2.3 Co-occurrence of UTIs and Endometriosis in the Context of Infertility:

The simultaneous presence of urinary tract infections (UTIs) with endometriosis creates a complicated clinical situation, especially when considering infertility. Each of these disorders individually contributes to inflammation and scarring in the pelvic region, which can negatively affect reproductive function. Recurrent urinary tract infections can worsen the scarring caused by endometriosis due to prolonged inflammation, which can further complicate reproductive outcomes **(Moradi et al., 2014)**.
The worldwide prevalence of these illnesses is especially worrisome due to their significant influence on women in the age group capable of reproduction. The coexistence of endometriosis and recurrent UTIs heightens the likelihood of infertility, necessitating healthcare systems to tackle both illnesses with coordinated and comprehensive care techniques.

3.3 Endometriosis with UTI patients:

Some women with endometriosis may be unaware of the potential impact of the condition on their urinary tract. Women with urinary tract endometriosis typically experience minimal or no symptoms. Some individuals experience infertility. Some individuals may encounter symptoms such as a sense of urgency, frequent urination, discomfort during urination, pain in the side or back, and recurring urinary tract infections. Some women experience hematuria during menstruation. Other women report a previous medical history of undergoing surgery, such as a hysterectomy, for endometriosis several years ago. The precise prevalence is uncertain, however it may manifest in 1-4% of all instances of endometriosis. Endometriosis commonly affects the bladder and the ureter.

Endometriosis intercepting with UTI patients:

Endometriosis and urinary tract infections (UTIs) are separate medical disorders, but they can overlap in ways that complicate the process of diagnosing and treating affected persons. Endometriosis is a persistent medical disorder characterized by the growth of tissue resembling the endometrium, the inner lining of the uterus, outside the uterus. This abnormal growth leads to symptoms such as discomfort, inflammation, and in some cases, infertility. Urinary tract infections (UTIs) are bacterial infections that specifically target various components of the

urinary system, such as the bladder and urethra. This results in symptoms such as discomfort while urinating, a frequent need to urinate, and urine that appears dark.

Studies indicate that people with endometriosis may have a higher likelihood of experiencing repeated urinary tract infections (UTIs). This could be attributed to several causes, such as the positioning of endometrial tissue, which might encompass the bladder and other components of the urinary system. Bladder involvement of endometrial lesions can cause symptoms resembling a urinary tract infection (UTI), including pelvic pain, painful urination (dysuria), and frequent urine. The similarity in symptoms might create challenges in differentiating between the two disorders, which may result in misdiagnosis or delayed treatment.

A study conducted by Hsu et al. (2018) emphasized that women who have endometriosis affecting their urinary tract, particularly the bladder, have a higher likelihood of experiencing recurrent urinary tract infections (UTIs). Endometrial lesions can lead to inflammation and scarring, which can disrupt the normal functioning of the bladder and urethra. This disruption creates a favorable environment for bacterial development and increases the likelihood of developing infections. In addition, the persistent pelvic discomfort that is linked to endometriosis can obscure the symptoms of a urinary tract infection (UTI), resulting in a reduced reporting or misconception of the seriousness of the infection.

Managing patients with both endometriosis and recurrent UTIs requires a comprehensive approach. Healthcare providers must carefully assess symptoms to differentiate between the two conditions. Imaging studies, such as ultrasound or MRI, may be necessary to identify endometrial tissue in the urinary tract. Additionally, urine cultures can confirm the presence of a UTI and guide appropriate antibiotic therapy. However, treating UTIs in patients with endometriosis can be challenging. Recurrent infections may require prolonged or repeated courses of antibiotics, which can contribute to antibiotic resistance and disrupt the normal microbiome. In cases where endometriosis is the underlying cause of bladder symptoms, surgical intervention to remove endometrial lesions may be necessary to alleviate symptoms and reduce the frequency of UTIs. The coexistence of endometriosis and UTIs presents a complex clinical scenario that requires careful diagnosis and management. Recognizing the potential for overlap in symptoms is crucial for healthcare providers to provide effective treatment and improve the quality of life for affected patients. Further research is needed to fully understand the relationship between these conditions and to develop more targeted treatment strategies.

Endometriosis patients with multiple cases of UTI can cause Infertility:

The occurrence of urinary tract infections (UTIs) in patients with endometriosis can greatly affect fertility, worsening the difficulties faced by individuals trying to conceive. Both urinary tract infections (UTIs) and endometriosis are individually linked to problems with reproductive health. However, when they occur together, they can complicate the clinical situation, making it even more difficult to conceive.

Endometriosis and Infertility:

Endometriosis is a prominent factor contributing to infertility, impacting as many as 50% of women who encounter challenges in conceiving. The disorder is defined by the proliferation of endometrial-like tissue outside the uterus, leading to persistent inflammation, formation of scar tissue (adhesions), and harm to reproductive organs such as the ovaries and fallopian tubes. This can hinder ovulation, decrease sperm motility, and impede embryo implantation, greatly diminishing the likelihood of pregnancy.

Impact of Recurrent UTIs on Fertility:

Recurrent urinary tract infections (UTIs), a frequent occurrence in women with endometriosis, can worsen reproductive problems through various mechanisms. Firstly, recurrent infections can result in persistent inflammation of the urinary tract and adjacent pelvic organs, perhaps extending to the reproductive system. Chronic inflammation has a negative impact on reproductive function by disturbing the delicate conditions required for conception and early embryo development.
Furthermore, endometriosis can lead to physical alterations, such as adhesions affecting the bladder or ureters, which can disrupt normal urine function and increase the vulnerability of the urinary tract to infections. The repeated infections can result in scarring and harm not just in the urinary system but also in adjacent reproductive organs, which can further complicate attempts to conceive.

Combined Effects of Endometriosis and Recurrent UTIs on Fertility:

The combined presence of endometriosis and recurrent urinary tract infections might establish a detrimental cycle that greatly hampers conception. The pelvic pain and discomfort resulting from these disorders might contribute to a decrease in sexual activity, thereby further reducing the likelihood of conception. In addition, the prolonged use of antibiotics to treat recurring urinary tract infections (UTIs) might disturb the vaginal microbiota, which is essential for maintaining reproductive health and facilitating conception. Surgical surgery may be necessary to remove endometriosis lesions in the bladder or ureters and restore normal urine and reproductive function in certain situations. Nevertheless, the surgical procedure itself can include certain hazards, such as the possibility of further adhesions, which can further hinder fertility.

The simultaneous presence of endometriosis and recurrent urinary tract infections (UTIs) can significantly affect fertility. These disorders can greatly decrease the likelihood of conception due to persistent inflammation, anatomical alterations, and recurrent infections. To address these difficulties, it is crucial to adopt a multidisciplinary strategy involving gynecologists, urologists, and fertility experts. This approach is necessary to enhance treatment effectiveness and enhance the chances of successful reproduction.

3.4 Symptom of UTI patients with Endometriosis

Patients with both urinary tract infections (UTIs) and endometriosis may exhibit similar symptoms, leading to challenges in accurately diagnosing and treating the conditions. Differentiating between the two conditions might be difficult due to the similarity of their symptoms.

Symptoms of Patients with Urinary Tract Infections (UTIs):

UTIs primarily affect the urinary system, including the urethra, bladder, ureters, and kidneys. Common symptoms include:

1. Dysuria: A burning sensation or pain during urination is one of the most characteristic symptoms of a UTI **(Stamm & Norrby, 2001)**. Dysuria, or painful urination, is a prevalent symptom of urinary tract infections (UTIs) and is defined by a sensation of burning during the process of urinating. This symptom can be heightened in patients with endometriosis, especially when the endometrial lesions affect the bladder. Endometriosis in the bladder can result in bladder pain and pressure that imitate or exacerbate the symptoms of a urinary tract infection (UTI) (Johnson & Hummelshoj, 2013).

2. Increased Frequency and Urgency: Patients often feel the need to urinate frequently and urgently, even when little urine is produced **(Foxman, 2014)**. This is another symptom that can manifest in both urinary tract infections (UTIs) and endometriosis. In cases of urinary tract infections (UTIs), the frequent sensation of needing to urinate is typically accompanied with the release of tiny volumes of urine. In cases of endometriosis, this symptom may arise as a result of the presence of endometrial tissue on the bladder, causing irritation and heightened sensitivity of the bladder **(Salvador & Best, 2015)**.

3. Hematuria: The presence of blood in the urine can occur, giving the urine a pink, red, or cola-colored appearance **(Gupta et al., 2017)**. Hematuria, or the presence of blood in the urine, is commonly associated with urinary tract infections (UTIs), especially severe or recurring ones. However, it can also occur in cases of endometriosis when the tissue from the lining of the uterus (endometrium) invades the bladder. As a result, blood may be present in the urine, which might be misinterpreted as a symptom exclusively related to a urinary tract infection **(Hsu et al., 2018)**.

4. Pelvic Pain: In women, UTIs may cause discomfort in the pelvic region, particularly around the pubic bone **(Hooton, 2012)**. Chronic pelvic discomfort is a prominent symptom in women with endometriosis and can be worsened by recurrent urinary tract infections (UTIs). The pain is commonly situated in the lower abdomen and may follow a

cyclical pattern, intensifying during menstruation. Nevertheless, in the presence of UTIs, the pain may intensify and persist, especially during urination **(Hsu et al., 2018)**.

5. Cloudy or Strong-Smelling Urine: Changes in urine appearance or odor often accompany UTIs, reflecting the presence of bacteria or white blood cells **(Stamm & Norrby, 2001).**

Symptoms of Patients with Endometriosis:

Endometriosis, a condition where endometrial-like tissue grows outside the uterus, manifests primarily through pelvic symptoms, though systemic effects can also occur. Common symptoms include:

1. Chronic Pelvic Pain: Persistent pain in the pelvic area is a hallmark of endometriosis, often worsening during menstruation **(Giudice, 2010).**

2. Dysmenorrhea: Painful menstruation is commonly reported, with the pain often starting before the period and lasting several days **(Vercellini et al., 2011)**.

3. Dyspareunia: Pain during intercourse is frequently associated with endometriosis, especially deep pelvic pain during or after sex **(Missmer et al., 2004)**.

4. Infertility: Endometriosis is a significant cause of infertility, affecting 30%-50% of women with the condition **(Barnhart et al., 2002)**.

5. Menorrhagia: Heavy menstrual bleeding is also a common symptom, leading to potential anemia and fatigue **(Giudice, 2010)**.

6. Gastrointestinal Symptoms: Some patients may experience bloating, constipation, diarrhea, or nausea, particularly during menstrual periods **(Ballard et al., 2008).**

Symptoms of Patients with Both UTI and Endometriosis

When a patient suffers from both UTIs and endometriosis, the symptoms of each condition can overlap, making diagnosis more complex. These patients may experience:

1. Exacerbated Pelvic Pain: The presence of both conditions can lead to more intense and persistent pelvic pain, which may be difficult to attribute solely to endometriosis or a UTI **(Moradi et al., 2014)**.

2. Increased Urinary Symptoms: Women with endometriosis involving the bladder or pelvic floor may experience symptoms similar to UTIs, such as urinary urgency, frequency, and dysuria, even without an active infection **(Garry, 2004)**.

3. Bladder Pain Syndrome: Some patients may develop bladder pain syndrome (interstitial cystitis), where they experience chronic bladder pain, often mistaken for recurrent UTIs, in conjunction with endometriosis **(Aerts et al., 2018)**.

4. Systemic Symptoms: Fatigue, nausea, and generalized malaise may be more pronounced in patients with both conditions, potentially due to chronic pain, inflammation, and stress **(Missmer et al., 2004)**.

5. Complicated Infertility: The combined impact of UTIs and endometriosis can exacerbate infertility issues, as chronic inflammation and pelvic pain complicate natural conception and may affect the outcomes of fertility treatments **(Giudice, 2010)**.

The similarity in symptoms between urinary tract infections (UTIs) and endometriosis might result in the incorrect identification or delayed identification of either ailment. An example of this is when a patient with a history of endometriosis experiences ongoing pelvic discomfort and urinary symptoms. In such cases, there is a risk of mistakenly attributing these symptoms to recurring urinary tract infections, without considering the possibility that endometriosis may be the underlying cause. Thorough diagnostic methods, including imaging investigations and urine cultures, are necessary to accurately distinguish between the two illnesses and to determine the appropriate treatment.

3.5 Risk factors:

The prevalence of urinary tract infections (UTIs) and their relationship with endometriosis and infertility presents a complex interplay of biological, environmental, and lifestyle factors. Nationwide research on the increased rate of UTIs in early age reveals several key risk factors that may elevate the chances of developing both endometriosis and infertility. Below is a detailed examination of these risk factors, their prevalence, and their potential impacts.

1. Age:

Younger, particularly teenage, patients may exhibit a higher susceptibility to UTIs and endometriosis, and potentially worse fertility outcomes.

- **Details:** Adolescents may face an early onset of endometriosis, which could be linked to hormonal fluctuations and early menstrual cycles. Studies suggest that early menstruation and prolonged exposure to menstrual blood in the pelvis could contribute to the development of endometriosis, which may complicate the clinical picture when UTIs are also present. This early exposure could potentially lead to a longer duration of suffering from these conditions, impacting fertility more severely over time **(Johnson & Hummelshoj, 2013)**.
- **Prevalence:** Endometriosis is most commonly diagnosed in women aged 25-35, though it can affect teenagers and older women as well. The prevalence of endometriosis

in teenage girls is estimated to be around 10% to 38% in those presenting with chronic pelvic pain **(Pugsley & Ballard, 2007)**. The incidence of UTIs is also high among younger women, with approximately 50% of women experiencing at least one UTI by the age of 32 **(Foxman, 2014)**.

· **Approximate Patients:** Among teenage girls with chronic pelvic pain, up to 38% may have endometriosis, and many may also experience UTIs.

2. BMI (Body Mass Index):

Variations in BMI categories, particularly overweight and obese patients, may influence the likelihood of developing UTIs and subsequent endometriosis.

· **Details:** Obesity has been associated with an increased risk of both UTIs and endometriosis. High BMI can lead to hormonal imbalances, such as elevated estrogen levels, which are known to exacerbate endometriosis. Obese individuals are also at a higher risk for UTIs due to increased urinary stasis and impaired immune response. Conversely, underweight individuals might experience hormonal imbalances that contribute to irregular menstrual cycles and a higher risk of endometriosis **(Shah et al., 2021)**.

· **Prevalence:** Obesity (BMI ≥30) is a growing global issue, with about 30% of adult women in the U.S. being obese **(Hales et al., 2020)**. Obesity is linked to both an increased risk of UTIs and endometriosis. Around 20% to 30% of women with endometriosis are reported to be overweight or obese **(Shah et al., 2021)**.

· **Approximate Patients:** Considering the prevalence, a significant proportion of women with both UTIs and endometriosis fall into the overweight or obese category.

3. Miscarriage and Stillbirth History:

A history of miscarriage or stillbirth may increase the risks of both UTIs and endometriosis, potentially affecting fertility.

· **Details:** Patients with a history of miscarriages or stillbirths may have underlying reproductive system abnormalities or immune responses that predispose them to both UTIs and endometriosis. Recurrent pregnancy loss has been linked to endometrial dysfunction, which could also be associated with endometriosis. Furthermore, repeated UTIs could lead to chronic inflammation and scarring, further complicating fertility **(Sivieri & Simões, 2015)**.

· **Prevalence:** Miscarriage occurs in about 10% to 20% of known pregnancies, while stillbirth affects approximately 1 in 160 pregnancies (CDC, 2022). Women with a history of miscarriage or stillbirth have been shown to have a higher prevalence of endometriosis, with about 40% of women with infertility issues being diagnosed with endometriosis **(Barnhart et al., 2002)**.

- **Approximate Patients:** Among women with a history of miscarriage or stillbirth, a significant proportion may also have endometriosis, contributing to the risk of infertility.

4. Presence of Endometriosis and UTI Cases:

- Risk Factor: Patients diagnosed with both UTIs and endometriosis concurrently face heightened risks of infertility and complications.
- **Details:** The coexistence of UTIs and endometriosis presents a complex clinical scenario where chronic pelvic pain, inflammation, and scarring can severely impact reproductive organs. The ongoing inflammatory response associated with these conditions may impair ovarian function, disrupt the fallopian tubes, and create an inhospitable environment for conception, leading to increased infertility risks (Hsu et al., 2018).
- **Prevalence:** Approximately 10% of women of reproductive age are affected by endometriosis **(Giudice, 2010)**. UTIs are very common, with about 50-60% of women experiencing a UTI in their lifetime **(Foxman, 2014)**. The exact overlap between endometriosis and recurrent UTIs is not well-documented, but it is suggested that women with endometriosis may have a higher likelihood of developing UTIs due to pelvic inflammation and anatomical changes.
- **Approximate Patients:** While precise numbers are not available, a subset of women with endometriosis also suffer from recurrent UTIs, complicating their condition and increasing the risk of infertility.

5. Type of Infertility

Patients with UTI history along with endometriosis can face primary or secondary infertility. The study shows that 25-35 aged women face secondary infertility because of a long history of UTI and endometriosis.

Prevalence: Infertility affects about 15% of couples, with endometriosis being a contributing factor in up to 50% of these cases (Barnhart et al., 2002).

Approximate Patients: Among women with infertility issues, a significant percentage may have endometriosis as a primary or contributing factor, along with potential complications from UTIs.

6. Menstrual Cycle Regularity:

Irregular menstrual cycles or no period cycle may indicate underlying hormonal imbalances, exacerbating the risks of both UTIs and endometriosis.

- **Details:** Irregular menstrual cycles can be a sign of hormonal disturbances such as polycystic ovary syndrome (PCOS), which is associated with both endometriosis and recurrent UTIs. Hormonal imbalances can lead to conditions like estrogen dominance, which exacerbates endometriosis, and increased glucose levels, contributing to UTI risk **(Ballard et al., 2008)**.
- **Prevalence:** Irregular menstrual cycles affect about 14% to 25% of women in their reproductive years, with a higher prevalence among those with conditions like PCOS, which is associated with both endometriosis and recurrent UTIs **(Ballard et al., 2008)**.
- **Approximate Patients:** Among women with irregular menstrual cycles, a significant number may have concurrent endometriosis and UTIs, impacting their fertility.

7. Presence of Endometriosis Only:

Patients solely presenting with endometriosis may still be at risk of infertility, even without concurrent UTIs.

- **Details:** Endometriosis, by itself, is a significant risk factor for infertility. The presence of endometrial tissue outside the uterus can lead to the formation of adhesions and scarring, which can block the fallopian tubes and disrupt ovarian function. The inflammation and immune response triggered by endometriosis can also affect sperm and egg interaction, reducing the chances of successful fertilization **(Johnson & Hummelshoj, 2013)**.
- **Prevalence:** Endometriosis affects about 10% of women of reproductive age **(Giudice, 2010)**. Among women with infertility, about 25% to 50% have endometriosis **(Barnhart et al., 2002**).
- **Approximate Patients:** A significant portion of women with endometriosis alone is at risk for infertility, independent of UTI presence.

8. Pregnancy Status:

- **Risk Factor**: Pregnancy status can influence the progression and management of UTIs and endometriosis, with potential implications for fertility outcomes.
- **Details:** Pregnancy often induces temporary remission of endometriosis symptoms due to the hormonal environment, but the condition can recur postpartum. UTIs during pregnancy are common and need to be managed carefully to prevent complications. Pregnant patients with a history of endometriosis may face a higher risk of complications such as ectopic pregnancy, preterm birth, or infertility in future pregnancies **(Shah et al., 2021)**.

- **Prevalence:** Pregnancy affects the management and progression of endometriosis and UTIs. About 70% to 80% of women with endometriosis conceive after treatment, but they still face a risk of recurrent pregnancy complications **(Schaeffer & Nicolle, 2016)**.
- **Approximate Patients**: A considerable proportion of women with endometriosis may experience pregnancy-related complications, with UTIs being a common issue during pregnancy.

9. Presence of UTI Without Endometriosis

Women with frequent UTIs but without a diagnosis of endometriosis are still at risk of infertility. Chronic infections can lead to pelvic inflammatory disease (PID), scarring, and damage to reproductive organs.

Prevalence: Recurrent UTIs affect 20-30% of women, and about 10-20% of these patients may develop fertility-related complications due to chronic infection (Hooton et al., 2019).

10. Diabetes

Diabetic women are at an increased risk of developing both UTIs and endometriosis due to impaired immune function and hormonal imbalances. Diabetes can exacerbate inflammation and tissue damage, further complicating fertility.

Prevalence: Diabetic women have a 2-3 fold higher risk of recurrent UTIs and are more likely to experience fertility issues due to endometriosis or other complications (Geerlings, 2008).

Additional Considerations:

Beyond the primary risk factors, several additional considerations can influence the risk of developing UTIs, endometriosis, and infertility. These factors include nutritional status, the number of children, the timing of diagnosis, and the type of infertility a patient experiences.

11. Nutritional Status

- **Details:** Nutritional status plays a significant role in immune function and inflammation, both of which are critical in the context of UTIs and endometriosis. Poor nutrition, including deficiencies in key vitamins and minerals such as vitamin D, zinc, and omega-3 fatty acids, can impair immune response, making the body more susceptible

to infections like UTIs. Inadequate nutrition may also exacerbate the inflammatory processes associated with endometriosis, worsening symptoms and potentially affecting fertility. For instance, diets high in trans fats have been linked to an increased risk of endometriosis, while diets rich in fruits, vegetables, and omega-3 fatty acids have been associated with a reduced risk (**Missmer et al., 2010)**.Lifestyle factors, including smoking, alcohol consumption, diet, and physical activity, play a crucial role in the development and management of UTIs, endometriosis, and infertility. A diet lacking in essential nutrients (such as green vegetables and dairy) or a sedentary lifestyle can increase inflammation and susceptibility to infections and reproductive disorders.

· **Impact on Fertility:** Nutritional deficiencies can lead to hormonal imbalances that impact ovulation and menstrual regularity, further complicating efforts to conceive. Proper nutrition is crucial for maintaining a healthy reproductive system and reducing the inflammation that can exacerbate endometriosis and UTIs.

· **Prevalence**: Nutritional deficiencies are prevalent in the general population, with many women of reproductive age not meeting the recommended intake of essential nutrients. This can exacerbate conditions like endometriosis and UTIs, though specific prevalence rates in this population are not well-defined. Smoking and excessive alcohol consumption are associated with a 2-3 fold increase in the risk of UTIs and endometriosis **(Shah & Farrow, 2021)**. Poor dietary habits and a lack of exercise are significant risk factors in about 35% of women with reproductive health issues.

· **Approximate Patients:** Women with poor nutritional status, especially those with deficiencies in key nutrients, may experience worse outcomes in managing endometriosis and UTIs.

12. Number of Children

· **Details:** The number of children a woman has can be inversely related to her risk of developing endometriosis. This is thought to be due to the extended periods of amenorrhea (absence of menstruation) during pregnancy and breastfeeding, which reduce the exposure to menstrual blood in the pelvic cavity, a key factor in the development of endometriosis. Women who have fewer or no children have more frequent menstrual cycles, potentially increasing the risk of endometriosis and related complications. Additionally, those with endometriosis often face challenges in conceiving, which may limit the number of children they have **(Vercellini et al., 2011)**.

· **Impact on Fertility:** Having fewer children may reflect underlying fertility issues related to endometriosis, where the condition itself hinders the ability to conceive. Moreover, the stress and physical toll of multiple pregnancies can sometimes exacerbate UTIs, particularly if the immune system is compromised.

- **Prevalence**: Women with fewer children or those who have difficulty conceiving due to endometriosis are at increased risk. It's estimated that around 50% of women with endometriosis experience infertility **(Vercellini et al., 2011)**.
- **Approximate Patients**: A large percentage of women with endometriosis may have fewer children than desired due to infertility.

13. Period of Treatment and Received Treatment

- **Details:** The duration since a patient was diagnosed with endometriosis or UTIs can significantly influence the severity of symptoms and the risk of infertility. Patients who have been dealing with endometriosis for a long time may experience more extensive scarring, adhesions, and damage to reproductive organs, which can severely impair fertility. Similarly, recurrent UTIs over an extended period can lead to chronic kidney issues, increased pelvic inflammation, and other complications that can exacerbate the effects of endometriosis **(Giudice, 2010)**.
- **Impact on Fertility:** The longer a patient has been dealing with endometriosis and UTIs, the more challenging it may be to treat these conditions effectively. Early diagnosis and treatment are crucial for preserving fertility and minimizing complications.
- **Prevalence:** The duration of living with endometriosis or UTIs varies, but chronic cases are more likely to lead to complications. It is estimated that many women may suffer from endometriosis for 6-10 years before being diagnosed **(Giudice, 2010)**.
- **Approximate Patients:** Women with a longer history of endometriosis and UTIs are more likely to experience severe symptoms and infertility.

14. Habitation and Social Status

Living in rural versus urban areas can influence hygiene practices, access to healthcare, and overall reproductive health. Women in lower socioeconomic settings may have limited access to treatments for UTIs and endometriosis, increasing their risk of infertility.

Prevalence: About 40% of women in rural areas face delayed or inadequate treatment for reproductive health issues, which can significantly impact their fertility **(United Nations Population Fund, 2017).**

15. Marital and Educational Status

Marital status and educational level can affect awareness, access to healthcare, and the ability to seek timely treatment. Married women or those with higher education levels are more likely to seek medical attention, while those with lower education or single status may face barriers in managing reproductive health conditions.

Prevalence: Approximately 30% of women with lower educational backgrounds and limited healthcare access experience delayed diagnosis and treatment of UTIs and endometriosis, contributing to higher infertility rates **(Chandra et al., 2013).**

3.6 Types:

Types of Endometriosis and Urinary tract infection:

Types of Endometriosis:

Endometriosis is a complex and multifaceted condition characterized by the presence of endometrial-like tissue outside the uterus. The condition is categorized into different types based on the location and nature of the lesions. Understanding these types is essential for accurate diagnosis and treatment.

1. Superficial Peritoneal Endometriosis: This is the most common type of endometriosis, where lesions are found on the surface of the peritoneum, the membrane lining the abdominal cavity. These lesions are typically small, flat, or slightly raised and can appear as clear, white, or red patches **(Giudice, 2010)**. Although superficial, these lesions can still cause significant pain and other symptoms, depending on their location and the extent of inflammation **(Vercellini et al., 2011).**

2. Ovarian Endometriosis: Also known as "chocolate cysts," ovarian endometriosis are cysts filled with old blood, formed when endometrial tissue grows in the ovaries. These cysts can vary in size and may be detected through imaging techniques such as ultrasound **(Zondervan et al., 2020)**. Ovarian endometriosis is associated with a higher risk of infertility and can cause severe pelvic pain, especially during menstruation. They also pose challenges during surgery due to the risk of damaging ovarian tissue **(Barnhart et al., 2002)**.

3. Deep Infiltrating Endometriosis (DIE): DIE is characterized by endometrial lesions that penetrate more than 5 mm below the peritoneal surface, often involving organs such as the bowel, bladder, and ureters. This form of endometriosis is more severe and complex than superficial endometriosis **(Chapron et al., 2003)**. DIE is often associated with more intense pain and a higher likelihood of complications, such as bowel or urinary tract involvement. It can significantly impact a patient's quality of life and fertility **(Giudice, 2010)**.

4. Extra-pelvic Endometriosis: This less common type involves endometrial tissue found outside the pelvic region, such as in the lungs, diaphragm, or even the brain. Extra

pelvic endometriosis is rare but can lead to serious complications depending on the affected organ **(Stewart & Black, 2017)**. The symptoms of extra pelvic endometriosis vary widely based on the location of the lesions and can include respiratory issues, neurological symptoms, or even cyclical hematuria if the urinary tract is involved **(Stewart & Black, 2017)**.

Types of Urinary Tract Infections (UTIs):

Urinary Tract Infections (UTIs) are classified based on the location of the infection within the urinary system. This classification is crucial for guiding treatment and understanding the potential complications associated with each type:

1. Cystitis (Bladder Infection): Cystitis is the most common type of UTI, where the infection is confined to the bladder. It is typically caused by bacteria, most commonly *Escherichia coli*, ascending from the urethra into the bladder **(Hooton, 2012)**. Symptoms include dysuria, increased urinary frequency, urgency, and suprapubic pain. Cystitis is generally considered less serious than other types of UTIs but can cause significant discomfort and, if untreated, can lead to more severe infections **(Foxman, 2014)**.

2. Pyelonephritis (Kidney Infection): Pyelonephritis occurs when the infection ascends from the bladder to the kidneys. This type of UTI is more severe and can lead to permanent kidney damage if not promptly treated **(Foxman, 2014)**. Symptoms include high fever, flank pain, nausea, vomiting, and general malaise. Pyelonephritis often requires more aggressive treatment, including antibiotics and sometimes hospitalization **(Gupta et al., 2017)**.

3. Urethritis: Urethritis is the inflammation and infection of the urethra, often caused by bacterial pathogens such as *E. coli* or sexually transmitted infections (STIs) like *Chlamydia trachomatis* or *Neisseria gonorrhoeae* **(Hooton, 2012)**. Symptoms include pain during urination, discharge, and itching or irritation at the urethral opening. Urethritis can lead to complications if the infection spreads to other parts of the urinary tract or reproductive organs **(Stamm & Norrby, 2001)**.

4. Asymptomatic Bacteriuria: This type of UTI is characterized by the presence of bacteria in the urine without any symptoms. It is more common in certain populations, such as pregnant women and the elderly **(Schaeffer & Nicolle, 2016)**. While asymptomatic bacteriuria often does not require treatment, it can lead to complications in specific groups, particularly pregnant women, where it is associated with an increased risk of pyelonephritis and adverse pregnancy outcomes **(Gupta et al., 2017)**.

3.7 Diagnosis:

Diagnosis of Urinary Tract Infections (UTIs)

Diagnosing a Urinary Tract Infection (UTI) involves a combination of clinical assessment, laboratory testing, and sometimes imaging studies. The goal is to confirm the presence of an infection, identify the causative pathogen, and assess the extent of the infection.

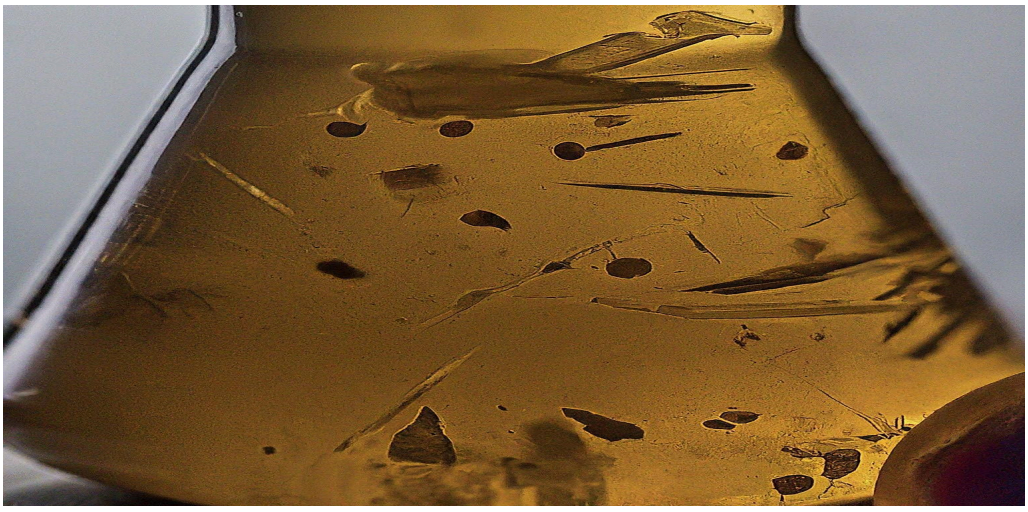
1. Clinical Assessment
    - History and Symptoms: The diagnosis begins with a thorough patient history and symptom review. Key symptoms like dysuria, urinary frequency, urgency, and suprapubic pain suggest a UTI. The patient's history of previous UTIs, sexual activity, and other risk factors is also crucial **(Hooton, 2012)**.
2. Urinalysis
    - Dipstick Test: A common initial test is the dipstick urinalysis, which detects the presence of nitrites (indicating bacteria) and leukocyte esterase (indicating white blood cells), both of which suggest a UTI **(Gupta et al., 2017)**.
    - Microscopic Analysis: Microscopic examination of urine can confirm the presence of pyuria (white blood cells in urine) and bacteriuria (bacteria in urine). This is a critical step in differentiating UTIs from other conditions like interstitial cystitis **(Stamm & Norrby, 2001)**.
    - 

Figure 12 : Urinalysis

3. Urine Culture
    - Definitive Diagnosis: A urine culture is the gold standard for diagnosing UTIs. It identifies the specific bacteria causing the infection and determines their

susceptibility to antibiotics. This is particularly important in recurrent or complicated UTIs, where resistant bacteria may be present **(Foxman, 2014)**.

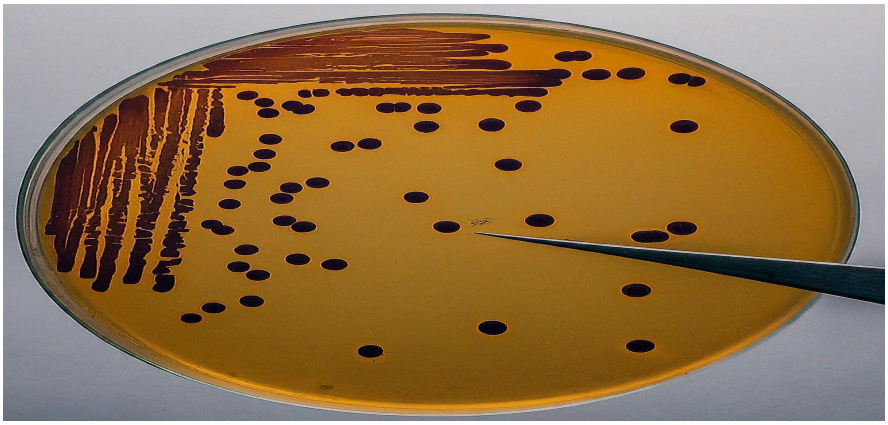


Figure 13 : Urine Culture

4. Imaging Studies
    - Advanced Diagnosis: In cases of recurrent UTIs, or when complications like pyelonephritis are suspected, imaging studies such as ultrasound or CT scans may be used to evaluate the kidneys and urinary tract for structural abnormalities or abscesses **(Gupta et al., 2017)**.

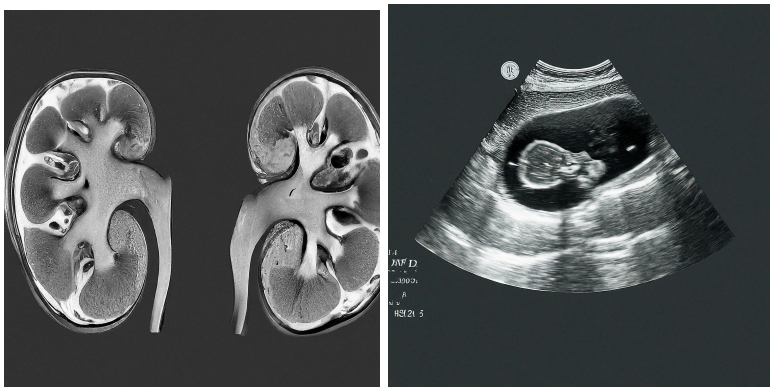


Figure 14 : Imaging Studies

Diagnosis of Endometriosis

Diagnosing endometriosis is more complex due to the variability of symptoms and the fact that definitive diagnosis often requires surgical intervention. The process typically involves clinical evaluation, imaging, and sometimes laparoscopic surgery.

1. Clinical Assessment
    - Symptom Review: A thorough assessment of symptoms such as chronic pelvic pain, dysmenorrhea, dyspareunia, and infertility is essential. The clinician also considers the patient's menstrual history and any family history of endometriosis **(Giudice, 2010).**
2. Physical Examination
    - Pelvic Exam: A pelvic examination can reveal signs of endometriosis, such as tenderness, nodules, or masses in the pelvic region. However, mild cases may not present noticeable signs on physical examination **(Vercellini et al., 2011)**.
3. Imaging Studies
    - Ultrasound: Transvaginal ultrasound is commonly used to detect ovarian endometriosis or large lesions. However, it is less effective in identifying small or superficial lesions **(Zondervan et al., 2020)**.
    - MRI: Magnetic Resonance Imaging (MRI) can provide more detailed images, especially in cases of deep infiltrating endometriosis, and is used when a more comprehensive assessment is needed **(Stewart & Black, 2017)**.

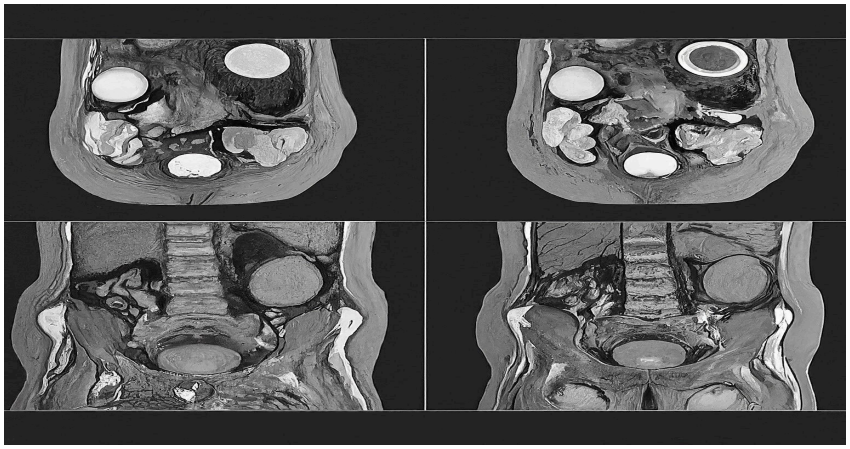


Figure 15: Imaging Studies

4. Laparoscopy
    - Definitive Diagnosis: Laparoscopy is the gold standard for diagnosing endometriosis. It allows direct visualization of the lesions and enables tissue biopsy for histological confirmation. Laparoscopy can also help assess the extent of the disease and guide treatment decisions **(Giudice, 2010)**.

Diagnosis of Patients with Both UTI and Endometriosis

Diagnosing patients with both UTIs and endometriosis can be particularly challenging due to the overlap in symptoms and the potential for one condition to mask the other. A comprehensive approach is required to accurately diagnose and manage these patients.

1. Symptom Differentiation
    - Detailed History: A detailed patient history is crucial for differentiating symptoms attributable to UTIs from those caused by endometriosis. For instance, while both conditions can cause pelvic pain, UTI-related pain is often associated with urination, whereas endometriosis-related pain is typically linked to menstruation and sexual activity **(Moradi et al., 2014).**
2. Concurrent Testing
    - Urinalysis and Culture: In patients presenting with both pelvic pain and urinary symptoms, urinalysis and urine culture should be performed to confirm or rule out a UTI. Persistent urinary symptoms in the absence of infection may indicate bladder involvement in endometriosis, known as bladder endometriosis or interstitial cystitis **(Aerts et al., 2018)**.
3. Advanced Imaging
    - Multimodal Imaging: In cases where both conditions are suspected, combining imaging modalities like ultrasound for endometriosis and MRI for deep infiltrating endometriosis, along with kidney and bladder imaging, may be necessary. This approach helps in the comprehensive evaluation of both the reproductive and urinary systems **(Garry, 2004)**.
4. Laparoscopy with Cystoscopy: Dual Procedure: In some cases, simultaneous laparoscopy (for diagnosing and treating endometriosis) and cystoscopy (for evaluating the bladder and urethra) are performed. This dual approach is particularly useful when bladder endometriosis or interstitial cystitis is suspected **(Giudice, 2010)**.

3.8 Treatment:

Treatment of Patients with UTI and Endometriosis for Infertility

Treating patients who suffer from both Urinary Tract Infections (UTIs) and endometriosis, particularly those facing infertility, requires a multifaceted approach. The treatment plans often involve addressing both conditions simultaneously to improve fertility outcomes, relieve symptoms, and prevent recurrence.

1. Treatment of UTIs in the Context of Infertility

Antibiotic Therapy

· Primary Treatment: The cornerstone of UTI treatment is antibiotics, selected based on urine culture and sensitivity tests. Common antibiotics include nitrofurantoin, trimethoprim-sulfamethoxazole, and fosfomycin **(Gupta et al., 2017)**. For recurrent UTIs, long-term low-dose antibiotic prophylaxis might be recommended, especially during periods of increased risk, such as post-coital or during pregnancy, to reduce the likelihood of recurrence that could impact fertility **(Foxman, 2014).**

· Recurrent UTIs: In cases of recurrent UTIs, which can interfere with conception due to inflammation and discomfort, a longer course of low-dose antibiotics may be prescribed, or post-coital prophylaxis may be recommended **(Foxman, 2014)**.

Addressing Anatomical or Functional Abnormalities in UTI related surgeries:

· Urological Evaluation: For patients experiencing recurrent UTIs, a urological evaluation might be necessary to identify underlying issues, such as urinary tract abnormalities or interstitial cystitis, which could be contributing to both the infections and infertility **(Hooton, 2012)**.

· Advanced Interventions: If recurrent UTIs are due to anatomical abnormalities such as vesicoureteral reflux or urinary obstruction, surgical correction may be necessary. Correcting these issues can help prevent recurrent infections that could complicate fertility **(Hooton, 2012)**.

Adjunctive Therapies

· Probiotics and Cranberry Products: Some evidence supports the use of probiotics and cranberry products to prevent recurrent UTIs. These adjunctive therapies may be used alongside antibiotics to reduce UTI recurrence and thus lower the risk of infections that could interfere with conception or early pregnancy **(Gupta et al., 2017)**.

2. Treatment of Endometriosis for Infertility

Medical Management

· Hormonal Therapies: Hormonal treatments are often used to manage endometriosis symptoms and improve fertility. Options include oral contraceptives, gonadotropin-releasing hormone (GnRH) agonists, and progestins. These treatments work by suppressing ovulation and menstruation, reducing the growth of endometrial lesions **(Vercellini et al., 2011)**. However, they may be limited in their effectiveness for fertility, as they often prevent pregnancy while in use.

· Anti-inflammatory Drugs: Nonsteroidal anti-inflammatory drugs (NSAIDs) are commonly used to manage pain associated with endometriosis, though they do not directly improve fertility **(Giudice, 2010)**.

Surgical Management

· Laparoscopic Surgery: Laparoscopy is both a diagnostic and therapeutic tool for endometriosis. Surgical removal or ablation of endometriotic lesions, adhesions, and ovarian endometriomas can significantly improve fertility outcomes. This approach is particularly beneficial for patients with moderate to severe endometriosis who are trying to conceive **(Giudice, 2010)**.

· Ovarian Reserve Consideration: Surgery must be carefully planned to preserve ovarian function. The potential impact on ovarian reserve is a significant concern, especially in women with ovarian endometriomas, and surgery should be performed by experienced surgeons to maximize fertility outcomes **(Zondervan et al., 2020)**.

· Ovarian Cystectomy: For ovarian endometriomas, cystectomy (removal of the cyst) is preferred over simple drainage, as it reduces the risk of recurrence and improves the chances of spontaneous conception **(Barnhart et al., 2002)**.

Assisted Reproductive Technologies (ART)

· In Vitro Fertilization (IVF): For patients with persistent infertility after surgery or those with severe endometriosis, IVF may be recommended. IVF bypasses the pelvic environment, where endometriosis could impede natural conception, and is often the most effective treatment for endometriosis-related infertility **(Barnhart et al., 2002)**.

3. Combined Treatment of UTI and Endometriosis in the Context of Infertility

Integrated Care Approach

· Multidisciplinary Management: Patients with both UTIs and endometriosis require coordinated care involving urologists, gynecologists, and fertility specialists. The treatment plan must balance the need for infection control with the management of endometriosis to optimize fertility outcomes **(Garry, 2004)**.

Tailored Antibiotic Use

· UTI Management During Fertility Treatments: Antibiotics should be chosen carefully during fertility treatments to avoid any negative impact on ovarian function or early pregnancy. Continuous monitoring and prompt treatment of any UTI episodes are crucial during this period **(Foxman, 2014)**.

Lifestyle and Preventive Measures

· Preventive Strategies: Patients are encouraged to maintain a healthy lifestyle, including proper hydration, hygiene practices, and possibly using non-antibiotic prophylactic measures to prevent recurrent UTIs. Additionally, managing stress and maintaining a healthy weight can help reduce the severity of endometriosis symptoms and improve overall fertility **(Hooton, 2012)**.

· Holistic Approach: Managing both conditions holistically, including lifestyle modifications like diet and stress management, can also support fertility. This approach is essential, as stress and chronic illness can both negatively impact reproductive health **(Vercellini et al., 2011)**.

3.9 Complications of UTI and Endometriosis in the Context of Infertility:

Patients suffering from Urinary Tract Infections (UTIs) and endometriosis, particularly those experiencing both conditions, face several complications that can significantly impact fertility. The interplay between these conditions can exacerbate symptoms, complicate treatment, and ultimately influence reproductive outcomes.

1. Complications from UTIs

Recurrent UTIs and Chronic Pelvic Pain

- Chronic Pelvic Inflammation: Recurrent UTIs can lead to chronic pelvic pain and inflammation, which may indirectly affect fertility by altering the pelvic environment, making it less conducive to conception. Chronic inflammation from recurrent infections can damage the reproductive organs, including the fallopian tubes, which are crucial for fertility **(Foxman, 2014)**.

Kidney Infections and Pyelonephritis

- Upper Tract Involvement: If a UTI progresses to the kidneys (pyelonephritis), it can cause severe systemic infections that require aggressive treatment. Recurrent kidney infections can lead to scarring and impaired renal function, complicating pregnancy and potentially leading to preterm labor or other pregnancy-related complications **(Hooton, 2012)**.

Antibiotic Resistance

- Treatment Challenges: Frequent UTIs often require repeated courses of antibiotics, increasing the risk of developing antibiotic-resistant bacteria. This complicates treatment, prolongs infection duration, and may delay or complicate pregnancy attempts due to the need for more potent antibiotics or longer treatment courses **(Gupta et al., 2017)**.

2. Complications from Endometriosis

Chronic Pelvic Pain and Adhesions

- Tissue Damage: Endometriosis can cause chronic pelvic pain, significant discomfort, and the formation of adhesions (scar tissue) between reproductive organs. These adhesions can distort pelvic anatomy, leading to blocked fallopian tubes or impaired ovarian function, both of which directly hinder fertility **(Giudice, 2010)**.

Ovarian Endometriomas

- Impact on Ovarian Reserve: Ovarian endometriomas ("chocolate cysts") can damage ovarian tissue, reducing the ovarian reserve (the number of available eggs). This reduction in egg quality and quantity is a major factor contributing to infertility in women with endometriosis **(Zondervan et al., 2020)**.

Increased Risk of Miscarriage

- Early Pregnancy Loss: Women with endometriosis have a higher risk of miscarriage. This is thought to be due to a hostile pelvic environment, immunological factors, or impaired implantation caused by endometrial lesions **(Vercellini et al., 2011)**.

3. Complications from Both UTI and Endometriosis

Exacerbation of Symptoms

- Mutual Aggravation: When a patient suffers from both UTIs and endometriosis, the symptoms of one condition can exacerbate the other. For example, chronic pelvic pain from endometriosis can be aggravated by recurrent UTIs, leading to a vicious cycle of pain and inflammation that is difficult to manage and significantly impairs quality of life and fertility **(Aerts et al., 2018)**.

Chronic Inflammation and Scar Tissue Formation

- Pelvic Adhesions: Both UTIs and endometriosis contribute to chronic inflammation in the pelvic region, which can lead to extensive scar tissue formation. This scarring can cause pelvic organs to stick together (adhesions), which is a significant barrier to natural conception and can complicate assisted reproductive techniques like IVF **(Giudice, 2010)**.

Increased Risk of Ectopic Pregnancy

- Tubal Damage: Both conditions can lead to damage of the fallopian tubes—UTIs through infection and scarring, and endometriosis through inflammation and adhesions. Damaged fallopian tubes increase the risk of ectopic pregnancy, a serious complication where the embryo implants outside the uterus, typically in the fallopian tube, which is a life-threatening condition that requires immediate medical intervention **(Stewart & Black, 2017)**.

Psychological Impact and Stress

Mental Health Challenges: The chronic nature of both UTIs and endometriosis, combined with the stress of dealing with infertility, can lead to significant psychological distress, including anxiety and depression. Mental health issues can further complicate the treatment and management of infertility, as stress itself is a known factor that can negatively impact fertility (**Moradi et al., 2014).**

3.10 Prevention of UTI and Endometriosis in the Context of Infertility:

Preventing Urinary Tract Infections (UTIs) and endometriosis, particularly in the context of infertility, involves a combination of lifestyle modifications, medical interventions, and regular monitoring. By addressing the underlying causes and risk factors, it is possible to reduce the incidence of these conditions and their impact on reproductive health.

1**. Prevention of UTIs in the Context of Infertility**

Hydration and Hygiene Practices

- Increased Fluid Intake: Adequate hydration is essential for preventing UTIs. Drinking plenty of water helps flush out bacteria from the urinary tract, reducing the likelihood of infection. This is particularly important for women trying to conceive, as recurrent UTIs can lead to complications that affect fertility **(Hooton, 2012)**.
- Proper Hygiene: Practicing good genital hygiene, including wiping from front to back after using the toilet and urinating after intercourse, can prevent the introduction of bacteria into the urinary tract, thereby reducing the risk of UTIs **(Foxman, 2014)**.

Prophylactic Antibiotics

- Low-Dose Antibiotic Prophylaxis: For women with recurrent UTIs, especially during attempts to conceive or during pregnancy, low-dose antibiotics may be prescribed as a preventive measure. This approach is used cautiously to avoid the development of antibiotic resistance and ensure the safety of both the mother and potential fetus **(Gupta et al., 2017)**.

Dietary Considerations

- Cranberry Products: Some studies suggest that cranberry juice or supplements may help prevent UTIs by preventing bacteria from adhering to the bladder wall. While the evidence is mixed, cranberry products are a common non-pharmacological option for UTI prevention, particularly in women with a history of recurrent infections **(Jepson et al., 2012)**.

2. Prevention of Endometriosis in the Context of Infertility

Hormonal Management

- Hormonal Contraceptives: Long-term use of hormonal contraceptives, such as oral contraceptives, can suppress menstruation and reduce the risk of endometriosis by limiting the growth of endometrial tissue outside the uterus. This preventive measure is especially relevant for women with a family history of endometriosis or early signs of the disease **(Vercellini et al., 2011)**.

Regular Monitoring and Early Intervention

- Routine Gynecological Exams: Early detection of endometriosis through regular pelvic exams and timely imaging studies (such as ultrasound or MRI) can prevent the progression of the disease. Early intervention can mitigate the impact of endometriosis on fertility by preserving ovarian function and preventing extensive adhesions **(Giudice, 2010)**.

Lifestyle Modifications

- Diet and Exercise: Maintaining a healthy body weight through a balanced diet and regular exercise can help manage the symptoms of endometriosis and possibly reduce its progression. A diet rich in fruits, vegetables, and omega-3 fatty acids may have

anti-inflammatory effects that could lower the risk of endometriosis **(Parazzini et al., 2013)**.

3. **Prevention for Patients with Both UTI and Endometriosis**

Comprehensive Lifestyle and Health Management

- Integrated Care: Women who are at risk for both UTIs and endometriosis should follow an integrated care plan that addresses both conditions. This includes regular monitoring, lifestyle adjustments, and the use of preventive medications as necessary. Maintaining a healthy diet, staying hydrated, and managing stress are crucial components of this plan **(Garry, 2004)**.

Avoidance of Risk Factors

- Modifying Risk Behaviors: Patients are advised to avoid activities that could exacerbate either condition. For example, avoiding the use of irritating feminine hygiene products and practicing safe sex can help reduce UTI risk, while minimizing exposure to environmental toxins may help prevent endometriosis **(Moradi et al., 2014).**

Preconception Counseling

Fertility Planning: Women with a history of UTIs or endometriosis should engage in preconception counseling to develop a plan that minimizes the impact of these conditions on fertility. This may include timing intercourse around periods of low infection risk and using fertility-preserving treatments for endometriosis **(Zondervan et al., 2020)**.

3.11 Epidemiology:

1. Urinary Tract Infections (UTIs) and Infertility

UTIs are common bacterial infections, particularly among women, and can have implications for fertility, especially when infections are recurrent or chronic.

Prevalence and Impact on Fertility

- Global Incidence: UTIs are one of the most common infections worldwide, with an estimated 150 million cases annually **(Stamm & Norrby, 2001)**. In women, the lifetime

risk of experiencing a UTI is over 50%, with the highest incidence occurring during the reproductive years **(Foxman, 2014)**.

- Infertility Link: While UTIs alone do not typically cause infertility, recurrent or untreated infections can lead to complications such as chronic pelvic pain and inflammation, which may indirectly affect reproductive health by creating an inhospitable environment for conception or increasing the risk of scarring in the reproductive tract **(Hooton, 2012)**.

2. Endometriosis and Infertility

Endometriosis is a significant cause of infertility, with a strong epidemiological link between the condition and difficulties in conception.

Prevalence in Infertile Women

- Global Burden: Endometriosis affects approximately 10% of women of reproductive age globally, which equates to about 190 million women **(Zondervan et al., 2020)**. However, the prevalence is much higher among women with infertility, where it is observed in 20-50% of cases **(Giudice, 2010)**.
- Infertility Impact: Endometriosis is one of the leading causes of infertility. It is estimated that 30-50% of women with endometriosis experience infertility. The mechanisms include pelvic adhesions, altered ovarian function, and a hostile inflammatory environment that impairs fertilization and implantation **(Vercellini et al., 2011)**.

3. Co-occurrence of UTIs and Endometriosis in the Context of Infertility

The co-occurrence of UTIs and endometriosis can exacerbate fertility challenges.

Overlap and Fertility Implications

- Compounded Risk: Women suffering from both recurrent UTIs and endometriosis may face compounded risks of infertility. The chronic inflammation associated with both conditions can lead to scarring and adhesions in the reproductive tract, which can obstruct the fallopian tubes or impair ovarian function, directly contributing to infertility **(Moradi et al., 2014)**.

Symptom Overlap and Misdiagnosis: The overlap in symptoms, such as pelvic pain, can lead to misdiagnosis or delayed diagnosis of one or both conditions, further complicating the management of infertility **(Zondervan et al., 2020)**.

Chapter 4

Infertility

4.1 Introduction

Infertility is a widespread health problem that affects a substantial number of people at their reproductive age **(World Health Organization: WHO, 2024)**. Infertility is a medical condition that impacts the reproductive system of both males and females. It is characterized by the inability to conceive a pregnancy while regularly engaging in unprotected sexual intercourse for a duration of 12 months or longer. The results might encompass considerable anguish, societal criticism, and financial difficulties, which can negatively impact persons' mental and emotional well-being. Infertility is typically described as the inability to achieve pregnancy (conception) after engaging in unprotected sexual intercourse for a period of one year or more. Healthcare experts evaluate and manage the reproductive health of women aged 35 or older who have been engaging in unprotected sexual intercourse for 6 months, due to the progressive decline in female fertility with age **(Thable et al., 2020)**. Female fertility diminishes progressively with advancing age, particularly in the mid-30s, and experiences a substantial fall after reaching the age of 37 **(Owen et al., 2024)**.

The World Health Organization's International Classification of Diseases offers comprehensive information on the primary and secondary causes of infertility in both males and females. Primary infertility is the condition when a person is completely unable to conceive, whereas secondary infertility is the condition where a person is unable to conceive after having previously successfully conceived. According to WHO studies, infertility has a considerable influence on a significant number of individuals over the course of their lives. Infertility affects around 17.5% of the adult population worldwide, which is equivalent to around one in every six individuals **(World Health Organization: WHO, 2023)**. This highlights the pressing need to provide inexpensive and high-quality reproductive treatment to people in need. Recent research suggests that the prevalence of infertility shows little difference among different locations. The rates for high-income, middle-income, and low-income nations exhibit a notable similarity, indicating that this is a substantial worldwide health concern. In high-income nations, the lifetime prevalence rate was 17.8%, while in low- and middle-income countries, it was 16.5%.

4.2 Etiology of male infertility:

Approximately 14% of couples suffer from infertility, which means they are unable to conceive a child even after having frequent, unprotected sexual intercourse for one year or more **(World Health Organization: WHO, 2024b)**. Male infertility could be a contributing factor to the infertility of around 50% of these couples. Male infertility can result from issues such as decreased sperm production, diminished sperm function, or obstructions in sperm movement. Male infertility can result from a range of issues, such as illnesses, injuries, persistent medical conditions, lifestyle choices, and other influencing variables.

4.3 Etiology of female infertility:

Ovulatory dysfunction is the main factor responsible for female infertility, impacting 40% of women who are incapable to carry out pregnancy **(Johnson, n.d.)**. Ovarian or gynecological diseases such as primary ovarian insufficiency (POI) or polycystic ovary syndrome (PCOS) can also lead to infertility. Ovulatory abnormalities are the main cause of female infertility. Various factors, including age, hormone imbalances, weight, exposure to toxins or radiation, and cigarette smoking, might influence fertility. Ovulation abnormalities frequently contribute to infertility, as they entail challenges in the consistent release of an egg from the ovaries. Some barriers can prevent the full release of an egg, while others may only limit its release in specific cycles. Polycystic ovary syndrome (PCOS) can lead to challenges in ovulation. Irregular ovulation, obstructed fallopian tubes, and uterine anomalies including fibroids and endometriosis are common factors that can cause infertility in women. Surgery, hormone therapy, and in vitro fertilization (IVF) are all effective treatment modalities. According to the World Infertility Survey, the infertility rate for couples in Bangladesh is 4%, with 15% of this being caused by women aged 45 to 49 who are nearing the end of their reproductive years **(Gm et al., 2018)**.

4.4 The following are some prevalent issues related to infertility:

4.4.1 Endometriosis:

Endometriosis is a pathological condition characterized by the development of abnormal endometrial tissue, which resembles the lining of the uterus, developing outside of the uterine cavity. It can lead to significant pelvic pain and impede the pregnancy process. This often begins with a person's first onset of menstruation and continues until menopause. Excessive proliferation of endometrial tissue outside the uterus can ultimately lead to the development of cysts, adhesions, and fibrous tissue. This can result in enduring (chronic) pain, particularly during menstruation. A considerable proportion of individuals with endometriosis face difficulties in attaining pregnancy.

Endometriosis is now believed to be caused by:

1. Retrograde menstruation refers to the reversal of the flow of menstrual blood and endometrial cells through the fallopian tubes, causing them to enter the pelvic cavity while blood is concurrently leaving the body through the cervix and vagina. Endometrial-like cells can be carried outside the uterus by retrograde menstruation, during which they have the capacity to attach and multiply.
2. Cellular metaplasia is the process by which cells undergo a change from one state to another **(Peterson et al., 2009)**. Insignificant cells undergo a metamorphosis into cells resembling the endometrium and initiate fast growth.
3. The disease can be activated by stem cells and spread throughout the body through blood and lymphatic channels.

Some of the common symptoms of Endometriosis are:

1. Pain is especially noticeable during menstruation, sexual intercourse, and urine or defecation.
2. Chronic pelvic pain.
3. Some individuals may experience heavy bleeding during or between menstrual cycles.
4. Difficulties dealing with pregnancy.
5. Experiencing bloating in the abdomen or symptoms of nausea.
6. Fatigue
7. Appearance of anxiety or sadness.

Endometriosis has substantial social, public health, and economic consequences. Experiencing severe pain, extreme weariness, deep grief, acute stress, and the inability to conceive can significantly reduce an individual's overall quality of life.

4.4.2. Uterine fibroids:

Uterine fibroids are non-cancerous tumors that commonly form in the uterus during a woman's reproductive age. Uterine fibroids, known as leiomyomas or myomas in medical terms, do not present an increased possibility of uterine cancer and generally do not develop into a malignant state. These are tumors that develop in the uterus of a female. If a fibroid tumor is not causing any pain, significant hemorrhaging, or rapid growth, it may not require surgical removal.

Uterine fibroids, medically referred to as leiomyomas, are the most common type of tumor found in women. Uterine fibroids are tumors that develop from the myometrium, the muscular tissue of the uterus. Fibroids are benign tumors consisting of disorganized smooth muscle cells enveloped by a substantial quantity of extracellular matrix. Cellular proliferation occurs within a live organism, resulting in a steady augmentation in cell count. The proliferation of malignancies is significantly influenced by the development of the extracellular matrix. Uterine fibroids are often noncancerous. These lesions interfere with the normal functioning of the uterus, causing symptoms like excessive uterine bleeding, anemia, problems with embryo implantation, repeated pregnancy loss, premature labor, difficult labor, pelvic discomfort, urinary incontinence, and occasionally resembling or imitating malignant tumors. By the age of 50, around 70% of Caucasian women and more than 80% of African American women would have encountered at least one fibroid **(Landau, 2024)**. Severe symptoms occur in 15 to 30% of these women. Upon diagnosis, black women exhibit significantly larger uterine fibroids in comparison to white women. Individuals with this condition are identified at an earlier stage of life, exhibit more intense symptoms, and have a prolonged period of continuous growth.

Typical indications of uterine fibroids may include:
1. Excessive bleeding from the vagina. Experiencing an abundance or longer duration of menstrual bleeding is a commonly recognized symptom.
2. Pelvic discomfort and pain.
3. Issues related to the urinary system.
4. Lower back ache.
5. Rectal pressure sensation.
6. Sensations of discomfort or pain felt during sexual intercourse.

Fibroids, regardless of their size or position, can have a paracrine molecular impact on the nearby endometrium, leading to substantial uterine bleeding or hindered implantation.

4.4.3 Premature ovarian failure (POF):

Premature ovarian failure (POF), or primary menopause, is a disorder characterized by the early malfunction of the ovaries, occurring before the age of 40. During this event, the ovaries interrupt the synthesis of the hormone estrogen and the normal ovulation of eggs. This disorder, typically known as premature ovarian failure, frequently results in infertility. This is a condition that affects a small percentage of women, specifically around 1-2% of women under the age of 40 and 0.1% of women under the age of 30s **(Vegetti et al., 2000b)**. POF is marked by reduced levels of gonadal hormones (estrogens and inhibin) and elevated levels of gonadotropins (LH and FSH) (hypogonadotropic amenorrhea). Premature ovarian failure can be caused by iatrogenic factors such as chemotherapy, radiation therapy, and surgery, as well as autoimmune illnesses, X-chromosome abnormalities, and autosomal genetic concerns. These conditions can lead to irreversible damage to the ovaries. The cause of POF is mostly unknown, with only a small group of patients identified in scientific studies **(Ebrahimi & Asbagh, 2011)**. Women who are diagnosed with Premature Ovarian Failure (POF) experience menopausal symptoms that are comparable to those observed during natural menopause. These symptoms include hot flushes, night sweats, and vaginal dryness **(Ebrahimi & Asbagh, 2011)**. POF is associated with a decrease in fertility, primarily due to either the lack of follicles or the inability of existing follicles to react to stimulation.

Furthermore, a prolonged period of reduced estrogen exposure increases the probability of getting osteoporosis. Treatment is linked to the management of menopausal symptoms, mitigation of osteoporosis risk, and addressing the loss in fertility. Similar to many health conditions, there is frequently a genetic component that can either trigger the ailment in specific individuals or increase their likelihood of developing it later in life **(Shelling, 2009)**. Given the genetic origin of POF, it is clear that several genetic abnormalities may play a role in or be linked to the development of POF.

4.4.4 Pelvic inflammatory disease (PID):

This is a gynecological condition that specifically targets the female reproductive organs. Pelvic inflammatory disease is an inflammatory disorder affecting the upper female reproductive system, which includes the endometrium, fallopian tubes, ovaries, and pelvic peritoneum. It is caused by an infection. It can appear in several forms. Endometritis is an intermediate stage in the progression of a disease that spreads from the vagina or cervix to the upper reproductive system. Pelvic inflammatory disease is a major concern since it can lead to long-lasting reproductive problems, such as infertility, ectopic pregnancy, and chronic pelvic pain. Following the introduction of laparoscopy in the 1960s, there was a substantial increase in study on pelvic inflammatory disease throughout the subsequent decades (1970s, 1980s, and 1990s) **(Alkatout et al., 2021)**. As a result, there were notable breakthroughs in comprehending the microbiological roots of the illness, its association with reproductive dysfunction, and the development of uniform antibiotic therapy.

Endometritis is an intermediate stage in the progression of a disease that spreads from the vagina or cervix to the upper reproductive system. Pelvic inflammatory disease is defined as pelvic pain accompanied by inflammation of the lower genital tract. Women afflicted with this illness frequently encounter moderate symptoms and indications. A considerable proportion of women experience clinically silent infection that extends to the upper genital canal, resulting in subclinical pelvic inflammatory disease.

Infertility will be experienced by 10% of women with PID. Pelvic inflammatory disease (PID) can result in fallopian tube damage **(Website, 2023)**. Formation of scar tissue can block the fallopian tubes, hindering the process of fertilizing an egg. Scarring caused by pelvic inflammatory disease (PID) can impede the movement of a fertilized egg to the uterus, resulting in the development of an ectopic pregnancy.

4.4.5 Polycystic Ovarian Syndrome (PCOS):

Sterility is the state of being unable to conceive. Female sterilization obstructs the transit of ova through the fallopian tubes, which serve as the capillaries between the ovaries and the uterus. This indicates that the eggs and sperm of a female organism are incapable of combining, leading to the inhibition of fertilization. Ovaries will experience regular ovulation, but the woman's body will naturally absorb the eggs.

Polycystic Ovarian Syndrome (PCOS) is a common endocrine disorder that primarily affects women and is characterized by many cysts on the ovaries. It is one of several reproductive disorders that can be effectively managed. Polycystic ovarian syndrome (PCOS) disrupts the hormonal balance in humans, which hinders the growth and release of eggs from the ovaries, resulting in irregular ovulation. Polycystic ovarian syndrome (PCOS) is a prevalent medical disorder that affects 10% of women during their reproductive years **(Ndefo et al., 2013)**. Women

with Polycystic Ovary Syndrome (PCOS) experience imbalances in their hormones and metabolic processes, which can affect their overall health and physical appearance. Polycystic ovary syndrome (PCOS) presents a potential threat to women from diverse racial and cultural backgrounds. Individuals who are overweight or have a family history of PCOS, particularly if their mother, sister, or aunt has been diagnosed with the disorder, have an increased likelihood of having PCOS.

Chapter 5

Literature review

(a)

The study titled "**Association Between Body Mass Index (BMI) and Urinary Tract Infection (UTI)**" conducted by Mohammad Nassaji et al. has yielded inconsistent findings. Some research indicates a possible connection to this, while others do not uncover any notable correlation between the two.

The study was conducted by analyzing data from 116 patients with urinary tract infections (UTIs) and 156 individuals without UTIs (controls). The study ensured compatibility between these groups by matching them based on age, gender, and history of diabetes mellitus. The findings contribute to the ongoing discussion on the influence of BMI on the risk of urinary tract infections (UTIs). The study revealed that patients with urinary tract infections (UTIs) had a slightly higher average body mass index (BMI) of 25.2 ± 4.0 kg/m² compared to the control group, which had an average BMI of 25.1 ± 3.6 kg/m². An empirical analysis revealed that there is no substantial correlation between BMI and the occurrence rate of UTIs (P = 0.757). This indicates that BMI may not be a key determinant in determining the likelihood of developing a urinary tract infection (UTI). Individuals diagnosed with upper urinary tract infection (UTI) exhibited a marginally elevated mean body mass index (BMI) of 25.6 ± 4.1 kg/m², in contrast to those suffering from lower UTI, who had a slightly lower average BMI of 24.9 ± 4.0 kg/m². Nevertheless, the observed distinction was not statistically meaningful (P = 0.573), indicating that BMI might not have a major impact on the development or severity of UTIs.

The research evaluation provides evidence that BMI did not significantly increase the probability of getting UTIs, as there was no notable disparity in BMI between UTI patients and controls. This conclusion aligns with larger-scale studies, indicating that BMI does not serve as a primary risk factor for UTI. When evaluating the risk of urinary tract infection (UTI), healthcare professionals should include additional established risk factors such as patient age, gender, diabetes status, and structural abnormalities of the urinary system, in addition to body mass index (BMI). Further research is required to examine the intricate relationship between BMI and UTI, particularly among diverse populations and in various clinical contexts.

(b)

The study titled "**Urinary Tract Infection Among Females of Reproductive Age Group in Tertiary Care Teaching Hospital, Dhaka, Bangladesh**" was conducted by Saber et al. Urinary tract infection (UTI) is regarded as one of the most common bacterial infections encountered in primary care. A urinary tract infection (UTI) is characterized by the presence of an infection in any component of the urinary system, including the kidneys, ureters, urinary bladder, and urethra. The majority of infections mostly affect the lower urinary system, which includes the urinary bladder and the urethra. Women between the ages of 15 and 44 are more susceptible to

having urinary tract infections (UTIs) compared to men. The aim of this study is to establish the prevalence rate of urinary tract infections (UTIs) among females in the reproductive age group and to investigate the correlation between socio-demographic parameters within the study population.

The cross-sectional observational study was conducted at a tertiary care teaching hospital located in Dhanmondi, Dhaka. Here, a cohort of 250 women in the reproductive age group was included in the study. The data gathering process involved utilizing a planned interview schedule, followed by the collection of a urine sample for microscopic analysis and culture. The data was analyzed using the SPSS 15 program. The prevalence of urinary tract infections (UTIs) among the study population was determined using a percentage calculation. Additionally, the study analyzed the strength of correlation between socio-demographic parameters. The study population had a UTI prevalence rate of 41.20%. A significant correlation was found between marital status (p values <0.05), the educational attainment of the study population (p value <0.05), and the urine culture reports of UTI patients (p value 0.001).

Currently, untreated urinary tract infections (UTIs) can be regarded as one of the most significant public health issues. Early detection and rapid treatment are critical in preventing the future development of complexity in UTI. It is imperative to increase the dissemination of educational programming on UTI prevention, not only to alleviate patient suffering and reduce hospital stays, but also to mitigate economic losses.

Chapter 6

Methodology

6.1: Introduction

The term "research methodology" relates to the systematic procedure of gathering data, assessing its validity, and deriving logical inferences on the issue under investigation. A research technique is a crucial element of any study plan. Creating and perfecting a systematic approach is essential in attaining the goals of a research project.

An effective and dependable research technique guarantees that the results made are grounded in robust scientific evidence. In addition, the precise particulars of the plan enable researchers to maintain focus, leading to a more streamlined and less burdensome procedure overall. The researcher's methodology offers a glimpse into the cognitive process and systematic steps that led to the study's discoveries.

6.2 Aim of the study

1. Investigate the incidence and patterns of urinary tract infections (UTIs) in Bangladeshi women, taking into account the demographic variables that affect susceptibility as well as the frequency of occurrence.

2. Analyze the relationship between UTIs and the onset of endometriosis, specifically looking at whether younger women who have UTIs have a higher chance of developing endometriosis in their later reproductive years.

3. Examine how endometriosis affects Bangladeshi women's fertility rates, taking into account the severity and frequency of endometriosis cases as well as their effects on reproductive health outcomes.

4. Investigate the socioeconomic variables, such as nutritional habits, cleanliness habits, and access to healthcare, that are causing the high prevalence of endometriosis and UTIs in Bangladesh.

6.3 Research Methodology

The data will be analyzed using a cross-sectional methodology, which is a type of descriptive study. In a cross-sectional study, a substantial sample of participants is gathered at a particular time and place. These investigations are non-invasive, meaning they collect information without intentionally altering observable variables.

6.4 Ethical Statement

Patients and/or their legal guardians provided their oral consent to participate in the study (in the case of children). They received a comprehensive overview of the research and its objectives. The identities of the responders were likewise kept hidden.

6.5 Area of Study and Participants

This research was conducted over a ten-month period, from October 2023 to August 2024, at two major healthcare institutions: Kurmitola General Hospital and Rangpur Medical College Hospital. The study focused on exploring the possible association between urinary tract infections (UTIs) and endometriosis in relation to infertility, both primary and secondary. A total of 300 female patients suffering from infertility were selected as participants. The primary objective was to assess whether UTIs, when present alongside endometriosis, contribute to an increased risk of infertility. The research aimed to provide a deeper understanding of these conditions, contributing to improved diagnostic and treatment protocols for women facing infertility. The study was conducted with the full support and collaboration of healthcare professionals, including physicians, nurses, and hospital staff, who assisted in patient screening, data collection, and follow-up. Stringent ethical guidelines were followed throughout the study, with ethical clearance obtained from the concerned institutional review boards (IRBs) prior to the commencement of the research. All participants provided informed consent, ensuring that patient rights and confidentiality were maintained.

6.6 Questionnaire

A questionnaire was designed to gather data, encompassing the participant's age, marital status, socioeconomic background, educational background, menstruation-related information, symptoms, complications, and risk factors. Participants who possessed proficiency in reading were provided with questionnaires to complete and promptly return, whereas those lacking writing abilities had their responses recorded.

6.7 Statistical Analysis

IBM SPSS version 27 was utilized for the purpose of data analysis. The data collected for this investigation was evaluated using descriptive statistics. Descriptive statistics involves the examination and utilization of statistical measures that condense and convey information. A descriptive statistic is a statistical measure that provides a concise description of the characteristics of a dataset.

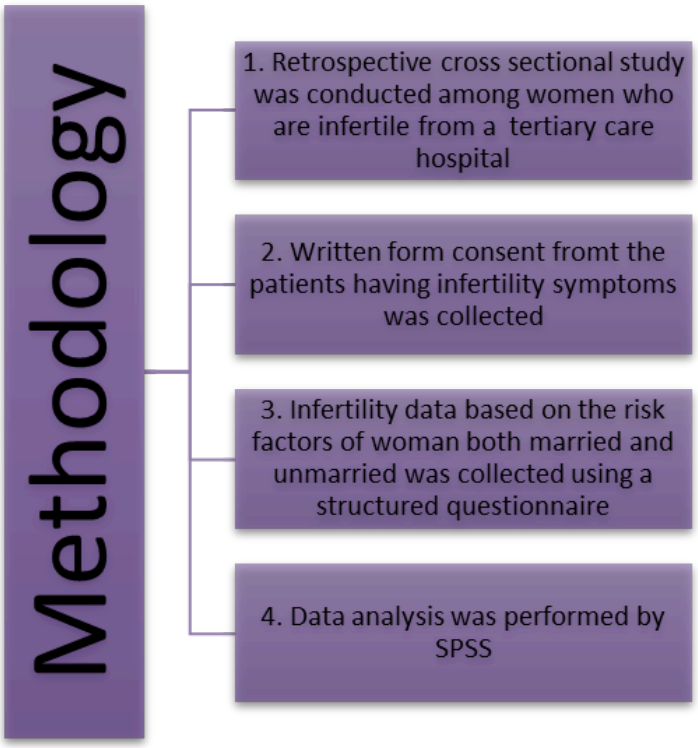


Figure 16 : Flowchart of methodology

Chapter 7
Results

Patient interview data has been combined and examined. The objective of this data analysis is to ascertain the prevalence of specific traits among patients suffering from Urinary Tract Infection and to compare these frequencies across patients with varying parameters.
The total number of participants was 300, comprising patients who tested negative for Urinary Tract Infection (UTI) were omitted from the study. So the total number of patients taken for the study is 286.

Table 1: Frequency table of the patients participated in study

UTI

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	286	95.3	95.3	95.3
	No	14	4.7	4.7	100.0
	Total	300	100.0	100.0	

The table presents the frequency distribution of patients participating in a study who have urinary tract infections (UTI). Out of the total 300 patients, 286 individuals, accounting for 95.3% of the participants, were identified as having a UTI. This high percentage indicates that UTI is a prevalent condition among the study group. Conversely, only 14 patients, representing 4.7%, did not have a UTI. The "Valid Percent" column confirms that these percentages pertain specifically to the valid cases where UTI status was determined, without considering any missing or incomplete data. The "Cumulative Percent" shows that by the end of the table, all 100% of the patients are accounted for, with 95.3% having a UTI and the remaining 4.7% not having one. This distribution highlights the predominance of UTI in the study population.

7.1 Association of Urinary Tract Infection (UTI) with Socio-Demographic Factor:

This study examined the prevalence of Urinary Tract Infection (UTI) in relation to various sociodemographic characteristics, including age, marital status, education, occupation, residence, and social status.

7.1.1 Distribution of Urinary Tract Infection Patient Based on Age:

Table 2: Frequency Table Distribution of Age Among UTI patient

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	12-15 (preteen)	4	1.4	1.4	1.4
	15-18	18	6.3	6.3	7.7
	18-25	59	20.6	20.6	28.3
	25-35	66	23.1	23.1	51.4
	35-45	116	40.6	40.6	92.0
	45-60	19	6.6	6.6	98.6
	60+	4	1.4	1.4	100.0

	Total	286	100.0	100.0	

The frequency distribution of age among UTI patients reveals that the largest proportion of cases occurs in adults aged 35-45, with 116 patients, representing 40.6% of the total sample. This is followed by the 25-35 age group, comprising 66 patients (23.1%). Together, these two age groups make up 63.7% of all cases. The 18-25 age group accounts for 59 patients (20.6%), while 18 patients (6.3%) are in the 15-18 age range. The 45-60 age group represents 19 patients (6.6%), and the least affected groups are preteens aged 12-15 and seniors aged 60 and above, each contributing only 4 patients (1.4%). Cumulatively, by the time the 35-45 age group is reached, 92% of all UTI cases are covered, with the remaining 8% distributed across the younger and older age brackets. The distribution shows that UTI occurrences are most common in adults aged 35-45, while preteens and seniors are the least affected.

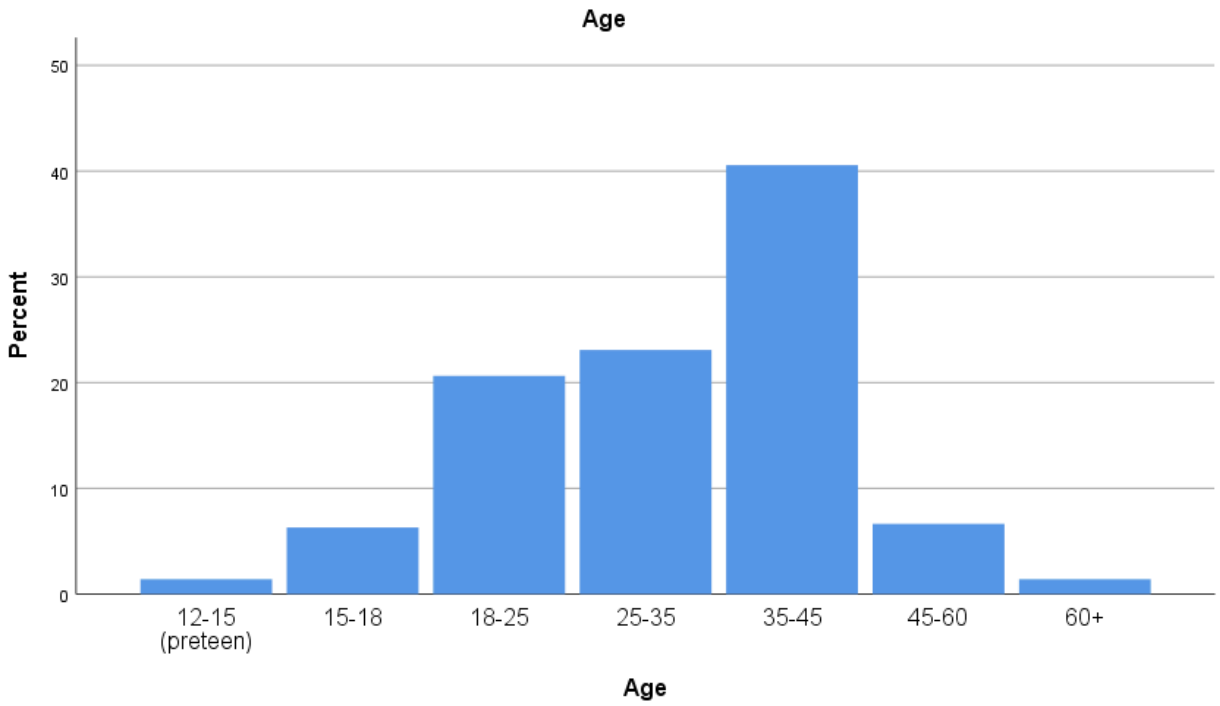


Figure 17: Distribution of Age Among UTI patient

7.1.2 Distribution of UTI Patient Based on marital status:

Table 3: Frequency Table Distribution of marital status Among UTI patient

Marital_status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Married	273	95.5	95.5	95.5
	Unmarried	13	4.5	4.5	100.0
	Total	286	100.0	100.0	

The table provides a distribution of UTI patients based on their marital status, with a total sample size of 286 patients. The vast majority of the patients, 273 (95.5%), are married, indicating that UTIs are most common in this demographic group. The remaining 13 patients, making up 4.5% of the total sample, are unmarried. The cumulative percentage shows that by accounting for the married patients, 95.5% of the cases are covered, and with the addition of the unmarried patients, the total reaches 100%. This suggests that UTI occurrences are overwhelmingly higher among married individuals in this sample, with unmarried individuals representing a small fraction of the total.

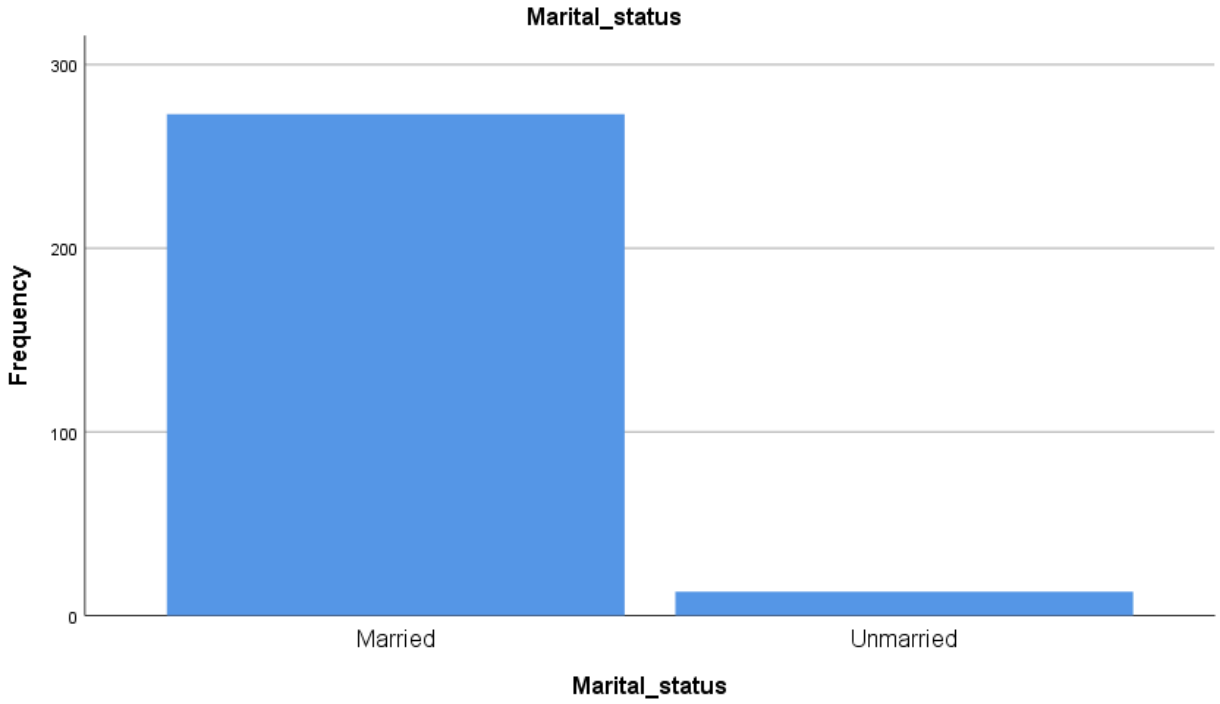


Figure 18: Distribution of Marital Status Among UTI patient

7.1.3 Distribution of UTI Patient Based on Occupation:

Table 4: Frequency Table Distribution of occupation Among UTI patient

Occupation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Housewife	207	72.4	72.4	72.4
	Service Holder	60	21.0	21.0	93.4
	Student	19	6.6	6.6	100.0
	Total	286	100.0	100.0	

The table displays the distribution of UTI patients based on their occupation, with a total of 286 patients. The majority of the patients, 207 (72.4%), are housewives, indicating a high prevalence of UTIs in this group. Service holders make up the second-largest group, with 60 patients

(21.0%). Lastly, students account for 19 patients, representing 6.6% of the sample. The cumulative percentage shows that after accounting for housewives and service holders, 93.4% of the cases are covered, and with the inclusion of students, the total reaches 100%. This distribution highlights that housewives are the most affected by UTIs, while students are the least affected among the occupations listed.

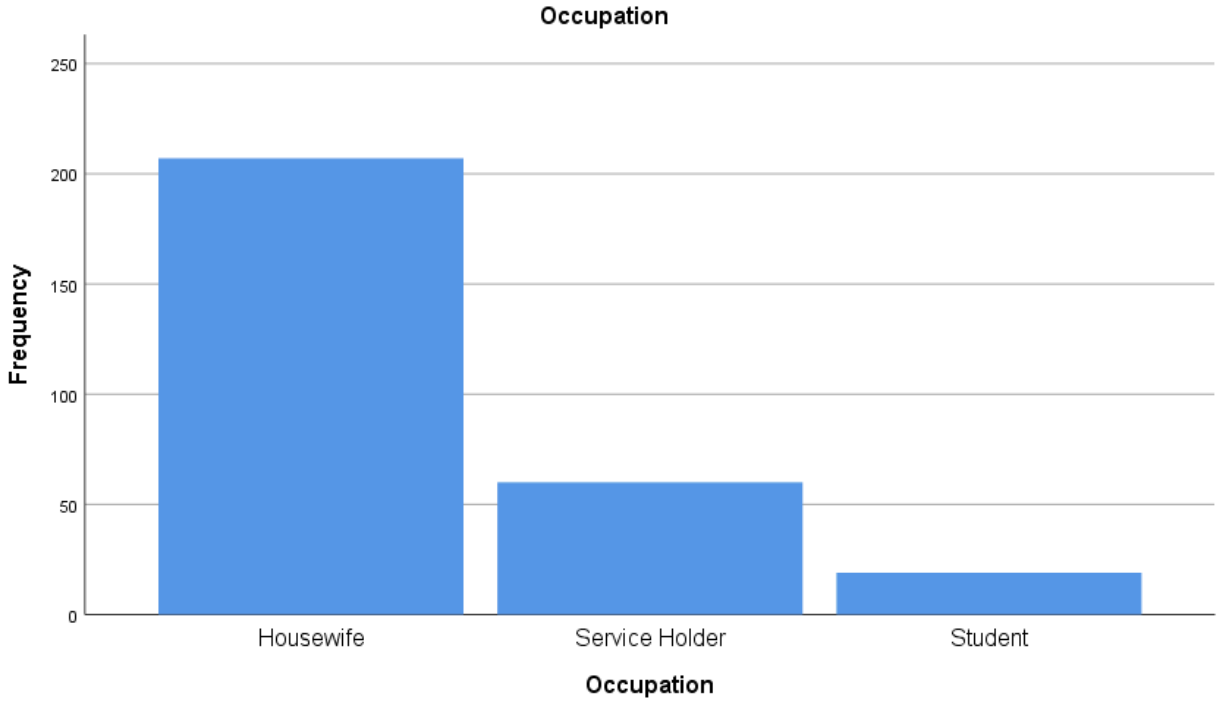


Figure 19: Distribution of Occupation Among UTI patient

7.1.4 Distribution of UTI Patient Based on Habitation:

Table 5: Frequency Table Distribution of habitation Among UTI patient

Habitation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Urban	169	59.1	59.1	59.1
	Rural	117	40.9	40.9	100.0
	Total	286	100.0	100.0	

The table presents the distribution of UTI patients based on their habitation, with a total sample size of 286 patients. The majority of the patients, 169 (59.1%), reside in urban areas, indicating that UTIs are more prevalent among urban dwellers. On the other hand, 117 patients (40.9%) come from rural areas. The cumulative percentage shows that 59.1% of the cases are from urban areas, and with the addition of rural patients, the total reaches 100%. This distribution suggests a higher occurrence of UTIs in urban populations compared to rural areas, though a significant portion of cases still come from rural regions.

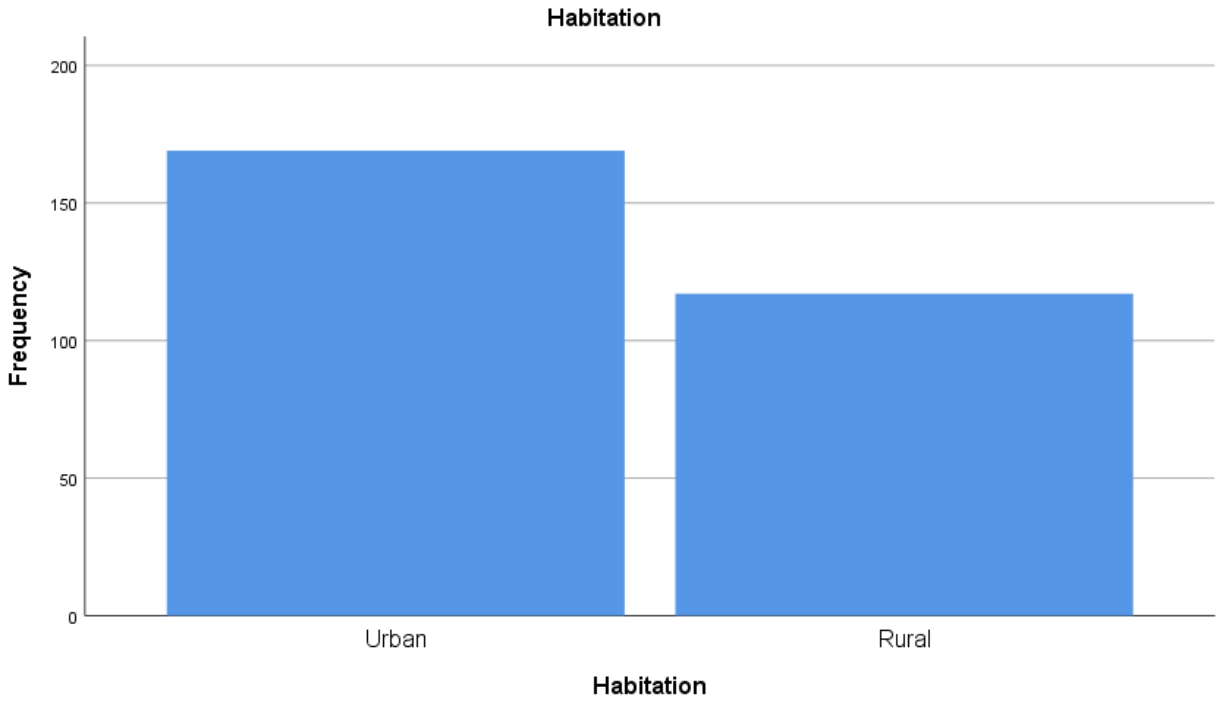


Figure 20: Distribution of Habitation Among UTI patient

7.1.5 Distribution of UTI Patient Based on Social status

Table 6: Frequency Table Distribution of Social Status Among UTI patient

Social_status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	upper class	16	5.6	5.6	5.6
	middle class	114	39.9	39.9	45.5
	lower middle class	156	54.5	54.5	100.0
	Total	286	100.0	100.0	

The table illustrates the distribution of UTI patients based on their social status, with a total of 286 patients. The largest proportion of patients, 156 (54.5%), belongs to the lower middle class, suggesting that UTIs are most prevalent in this group. The middle class accounts for 114 patients (39.9%), bringing the cumulative percentage to 45.5%. The upper class constitutes the smallest group, with only 16 patients (5.6%). The cumulative percentage reaches 100% with the inclusion of all social groups. This distribution indicates that UTI cases are more concentrated among the lower middle and middle classes, while the upper class has a significantly lower representation among UTI patients.

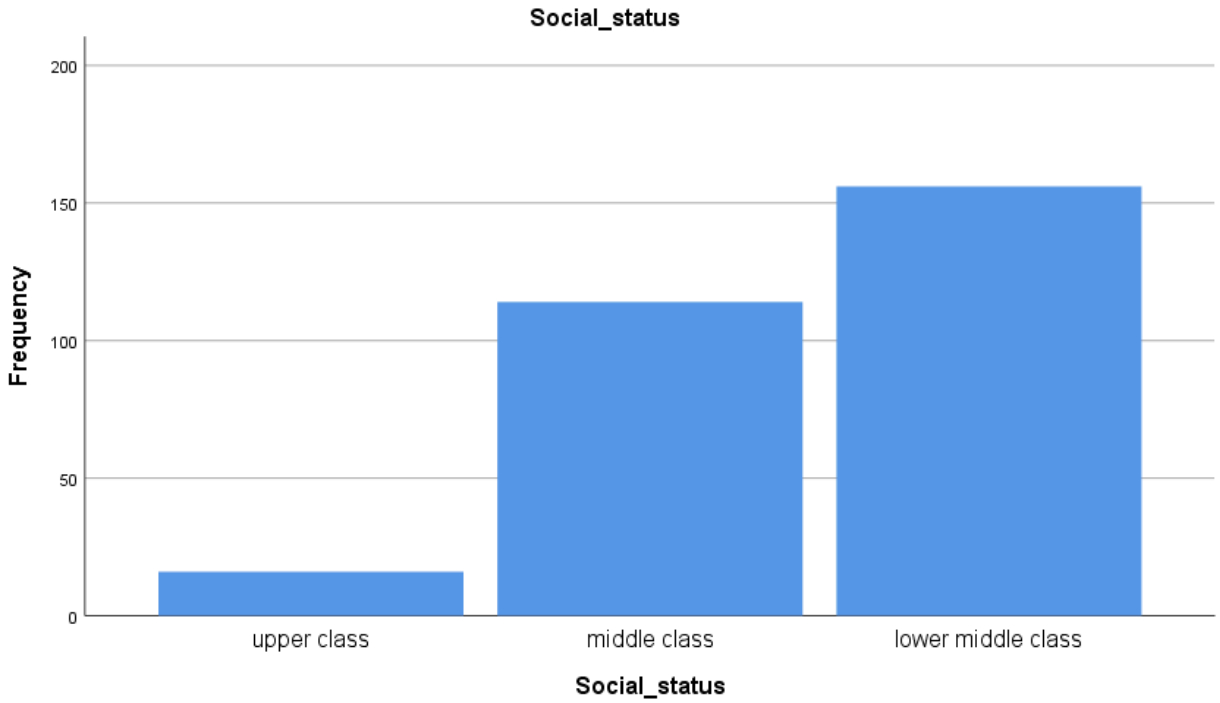


Figure 21: Distribution of Social Status Among UTI patient

7.1.6 Distribution of UTI Patient Based on Education

Table 7: Frequency Table Distribution of Education Among UTI patient

Educational_status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Primary	100	35.0	35.0	35.0
	Secondary (SSC)	106	37.1	37.1	72.0
	Higher Secondary (HSC)	44	15.4	15.4	87.4
	Graduate	25	8.7	8.7	96.2
	Post Graduate	11	3.8	3.8	100.0
	Total	286	100.0	100.0	

The table outlines the distribution of UTI patients based on their educational status, with a total sample of 286 patients. The largest group consists of patients with a secondary education (SSC), totaling 106 patients (37.1%). Following closely are those with primary education, accounting for 100 patients (35.0%). Together, these two groups make up 72.0% of the total. Patients with higher secondary education (HSC) represent 44 individuals (15.4%), while 25 patients (8.7%) hold a graduate degree. The smallest group consists of postgraduates, with only 11 patients (3.8%). The cumulative percentage reaches 100% after including all educational levels. This distribution indicates that the majority of UTI patients have a primary or secondary level of education, with fewer cases among individuals with higher education levels.

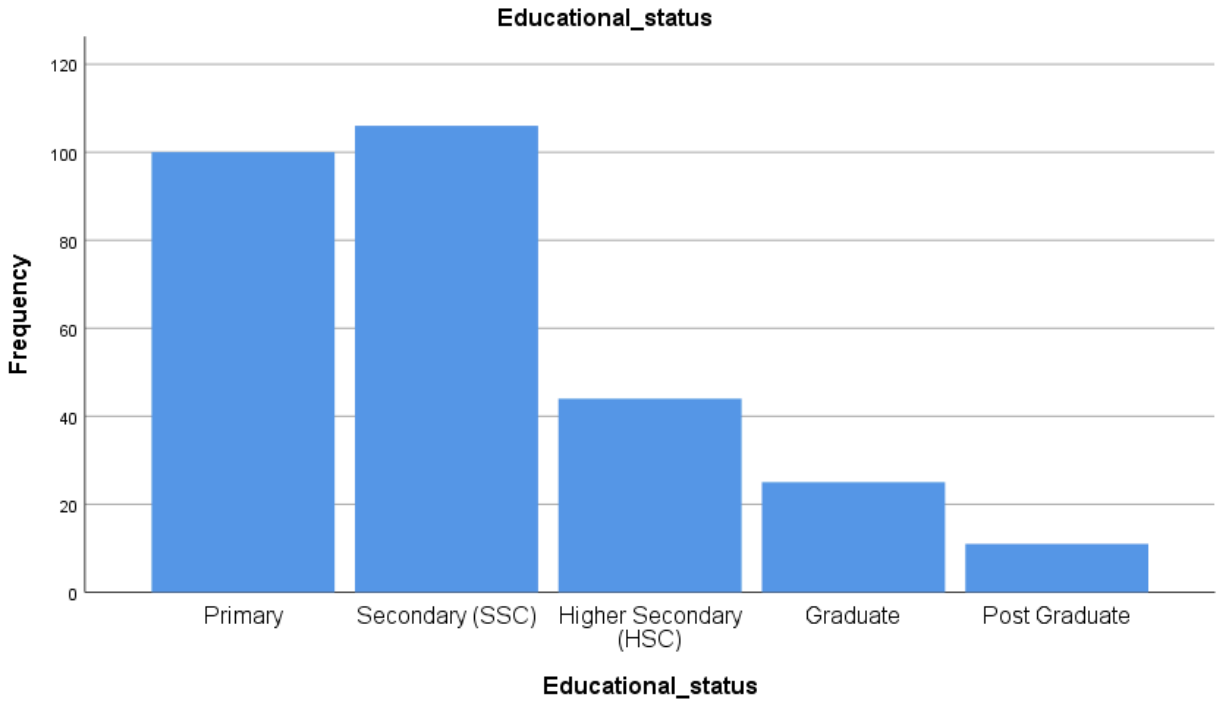


Figure 22: Distribution of Educational status Among UTI patient

7.2 Distribution of study Population according to Socio-demographic variables:

Table 8: Frequency Table Distribution according to Socio-demographic variables

Statistics

		Social_status	Educational_status	Occupation	Marital_status	Habitation	Age
N	Valid	286	286	286	286	286	286
	Missing	0	0	0	0	0	0
Mean		2.49	2.09	1.34	1.05	1.41	4.21
Mode		3	2	1	1	1	5
Minimum		1	1	1	1	1	1
Maximum		3	5	3	2	2	7

The table provides a statistical summary of the study population according to various socio-demographic variables: social status, educational status, occupation, marital status, habitation, and age. The total number of valid cases for each variable is 286, with no missing data.

Social status: The mean value is 2.49, and the mode is 3, indicating that the lower middle class (coded as 3) is the most common group. The minimum value is 1 (upper class), and the maximum is 3 (lower middle class).

Educational status: The mean is 2.09, and the mode is 2, which corresponds to secondary education (SSC). The educational levels range from 1 (primary education) to 5 (postgraduate).

Occupation: The mean is 1.34, and the mode is 1, indicating that housewives (coded as 1) represent the majority of the population. The range for occupation is from 1 (housewife) to 3 (student).

Marital status: The mean is 1.05, and the mode is 1, signifying that most patients are married (coded as 1). The marital status variable ranges from 1 (married) to 2 (unmarried).

Habitation: The mean is 1.41, and the mode is 1, indicating that urban residents (coded as 1) are more prevalent. The minimum value is 1 (urban), and the maximum is 2 (rural).

Age: The mean age group is 4.21, and the mode is 5, which corresponds to the 35-45 age group. Age ranges from 1 (12-15 years) to 7 (60+ years).

This summary highlights that the study population predominantly consists of lower middle-class housewives with secondary education, most of whom are married and reside in urban areas. The most common age group is 35-45 years.

7.3 Association of Urinary Tract Infection (UTI) with Risk Factors:

7.3.1 Distribution of UTI Patient Based on Age:

Table 9: Frequency Table Distribution of UTI Patient Based on Age:

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	12-15 (preteen)	4	1.4	1.4	1.4
	15-18	18	6.3	6.3	7.7
	18-25	59	20.6	20.6	28.3
	25-35	66	23.1	23.1	51.4
	35-45	116	40.6	40.6	92.0
	45-60	19	6.6	6.6	98.6
	60+	4	1.4	1.4	100.0
	Total	286	100.0	100.0	

The table presents the distribution of Urinary Tract Infection (UTI) patients across various age groups. A total of 286 patients were analyzed. The majority of patients (40.6%) fall within the 35-45 age group, followed by 23.1% in the 25-35 age group, and 20.6% in the 18-25 age group. Smaller proportions of patients are seen in the 45-60 (6.6%) and 15-18 (6.3%) age ranges. The youngest group, aged 12-15, and the oldest group, aged 60 and above, each account for only 1.4% of the total patients. The cumulative percentage indicates that 92% of the patients are within the age range of 12 to 45 years. These figures provide insights into the prevalence of UTI among different age groups, showing a peak in the 35-45 age range.

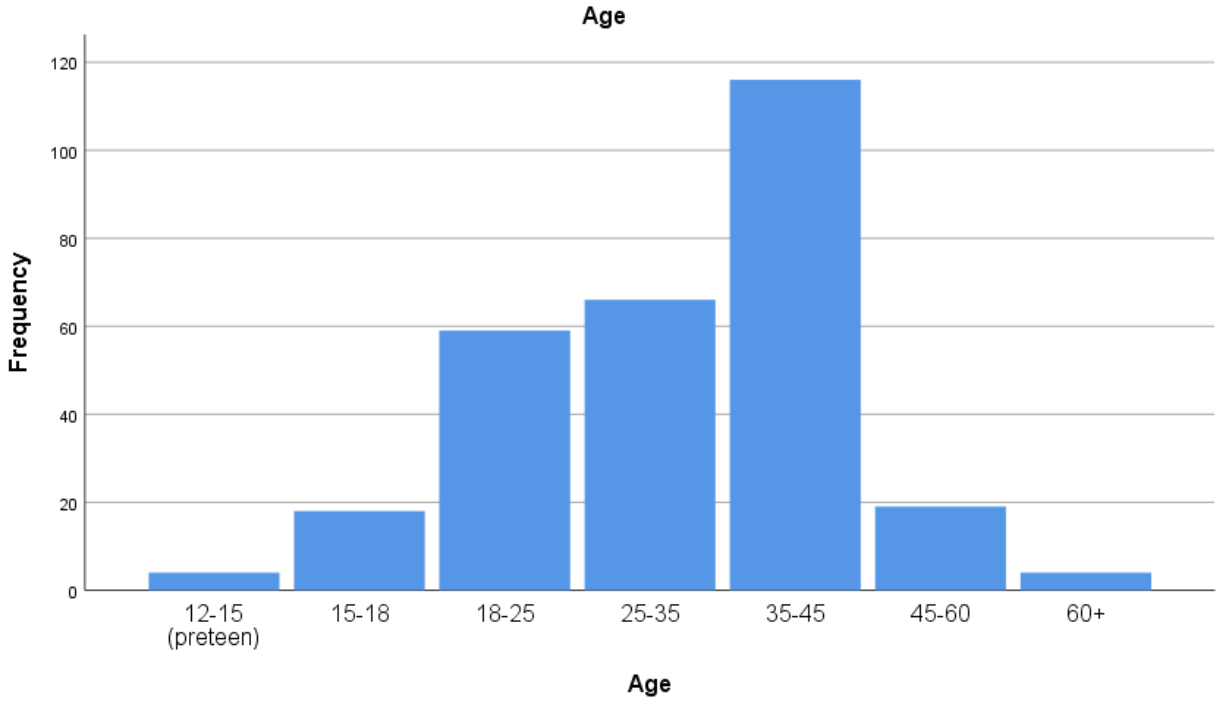


Figure 23: Distribution of UTI Patient Based on Age

7.3.2 Distribution of UTI Patient Based on Body Mass Index (BMI):

Table 10: Frequency Table Distribution of UTI Patient Based on BMI:

BMI

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Underweight	45	15.7	15.7	15.7
	Normal Weight	84	29.4	29.4	45.1
	Overweight	156	54.5	54.5	99.7
	Obese	1	.3	.3	100.0
	Total	286	100.0	100.0	

The table provides the distribution of Urinary Tract Infection (UTI) patients based on their Body Mass Index (BMI). Out of 286 total patients, the majority fall into the "Overweight" category, comprising 54.5% of the sample. The next largest group, at 29.4%, is those with a "Normal Weight." "Underweight" patients make up 15.7% of the total, while only 0.3% of patients are classified as "Obese." The cumulative percentage shows that by including overweight patients, 99.7% of the total patients are accounted for. This indicates that the majority of UTI patients in this sample are either overweight or of normal weight.

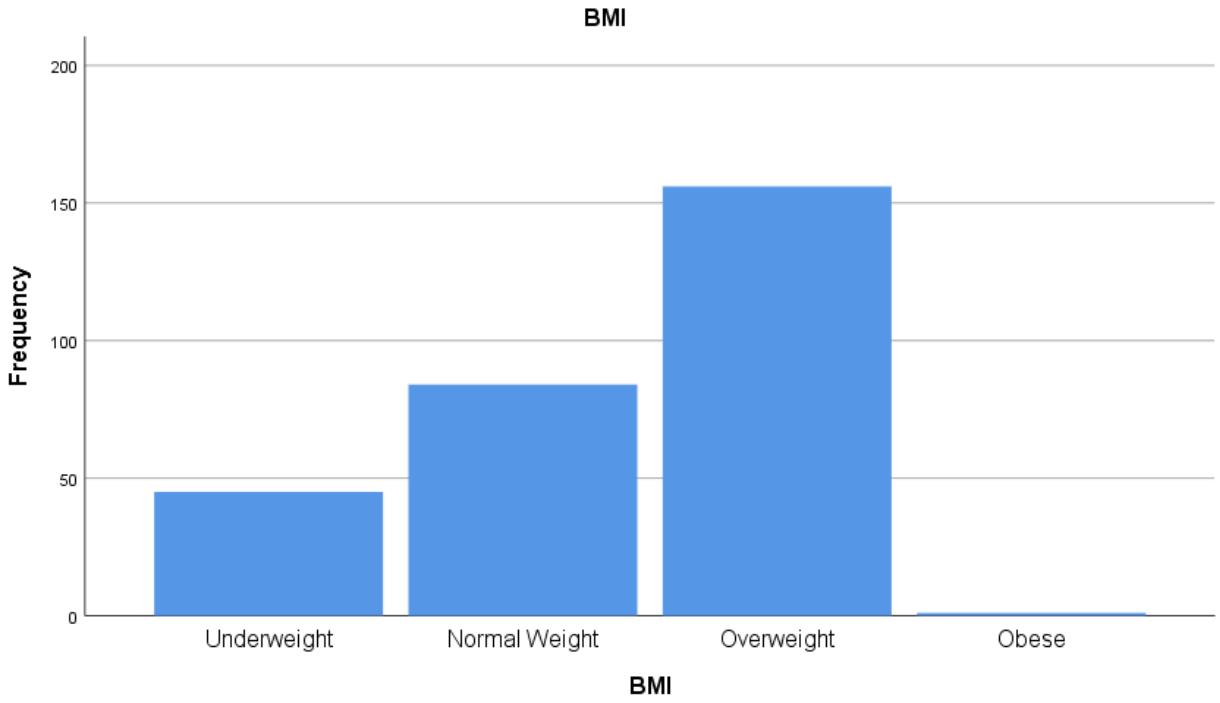


Figure 24: Distribution of UTI Patient Based on BMI

7.3.3 Distribution of UTI Patient Based on Miscarriages or stillbirth:

Table 11: Frequency Table Distribution of UTI Patient Based on Miscarriages or stillbirth:

Miscarriages_or_Stillbirth

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Miscarriage	129	45.1	45.1	45.1
	Stiibirth	20	7.0	7.0	52.1
	No	89	31.1	31.1	83.2
	Both	48	16.8	16.8	100.0
	Total	286	100.0	100.0	

The table illustrates the distribution of Urinary Tract Infection (UTI) patients based on their history of miscarriages or stillbirths. Out of 286 total patients, 45.1% have experienced a miscarriage, while 7.0% have had a stillbirth. Another 31.1% of the patients have not experienced either a miscarriage or stillbirth. Additionally, 16.8% of the patients have experienced both a miscarriage and a stillbirth. The cumulative percentages reveal that by including those with no such history, 83.2% of the total patients are accounted for. The data highlights that nearly half of the UTI patients in this sample have experienced a miscarriage, while a smaller percentage have experienced stillbirth or both events.

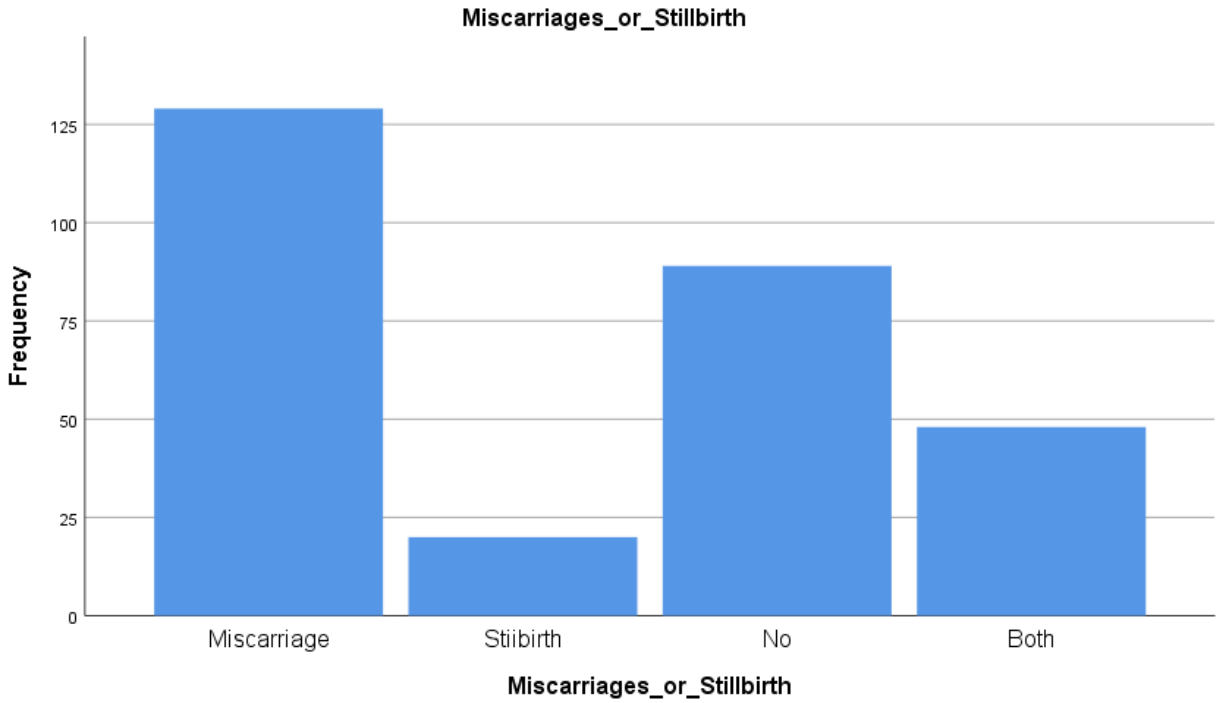


Figure 25: Distribution of UTI Patient Based on Miscarriages or Stillbirth

7.3.4 Distribution of UTI Patient Based on Cases of UTI with Endometriosis:

Table 12: Frequency Table Distribution of UTI Patient Based on Cases of UTI with Endometriosis:

cases_of_UTI_with_endometrosis

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	256	89.5	89.5	89.5
	no	30	10.5	10.5	100.0
	Total	286	100.0	100.0	

The table displays the distribution of Urinary Tract Infection (UTI) patients based on whether they also have endometriosis. Out of 286 patients, a significant majority, 89.5%, have UTI cases associated with endometriosis. In contrast, only 10.5% of the patients do not have endometriosis. The cumulative percentage indicates that by the inclusion of the patients without endometriosis, 100% of the total patients are accounted for. This data suggests a strong correlation between UTI cases and the presence of endometriosis within this patient sample.

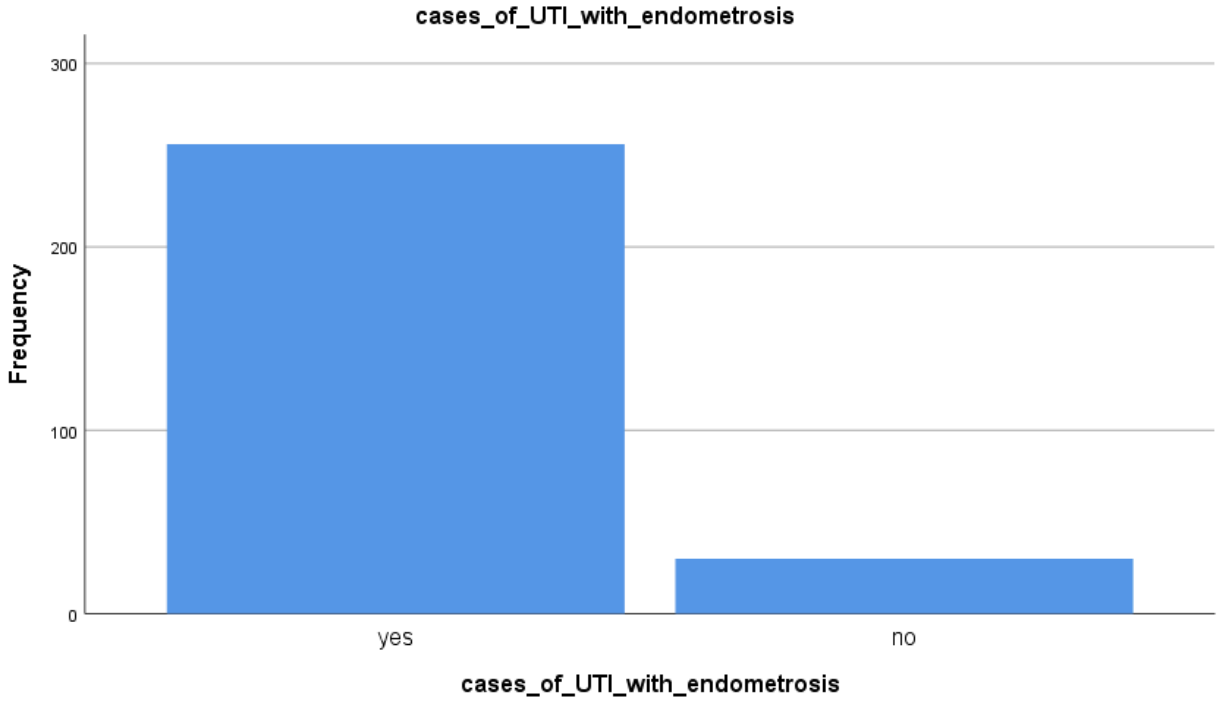


Figure 26: Distribution of UTI Patient Based on Cases of UTI with Endometriosis

7.3.5 Distribution of UTI Patient Based on Type of menstrual cycle:

Table 13: Frequency Table Distribution of UTI Patient Based on Type of menstrual cycle:

Type_of_menstrual_cycle

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Irregular	237	82.9	82.9	82.9
	Regular	44	15.4	15.4	98.3
	no period	5	1.7	1.7	100.0
	Total	286	100.0	100.0	

The table provides a detailed distribution of Urinary Tract Infection (UTI) patients based on their type of menstrual cycle. Out of 286 patients, a substantial majority, 82.9%, report having irregular menstrual cycles, making this the most common type among UTI patients. Meanwhile, 15.4% of the patients have regular menstrual cycles, and a small proportion, 1.7%, do not have a menstrual period at all. The cumulative percentages indicate that by including those with regular menstrual cycles, 98.3% of the patients are accounted for. The total percentage reaches 100% after including those without a period. This distribution highlights that irregular menstrual cycles are predominant among UTI patients, with significantly fewer reporting regular cycles or no periods.

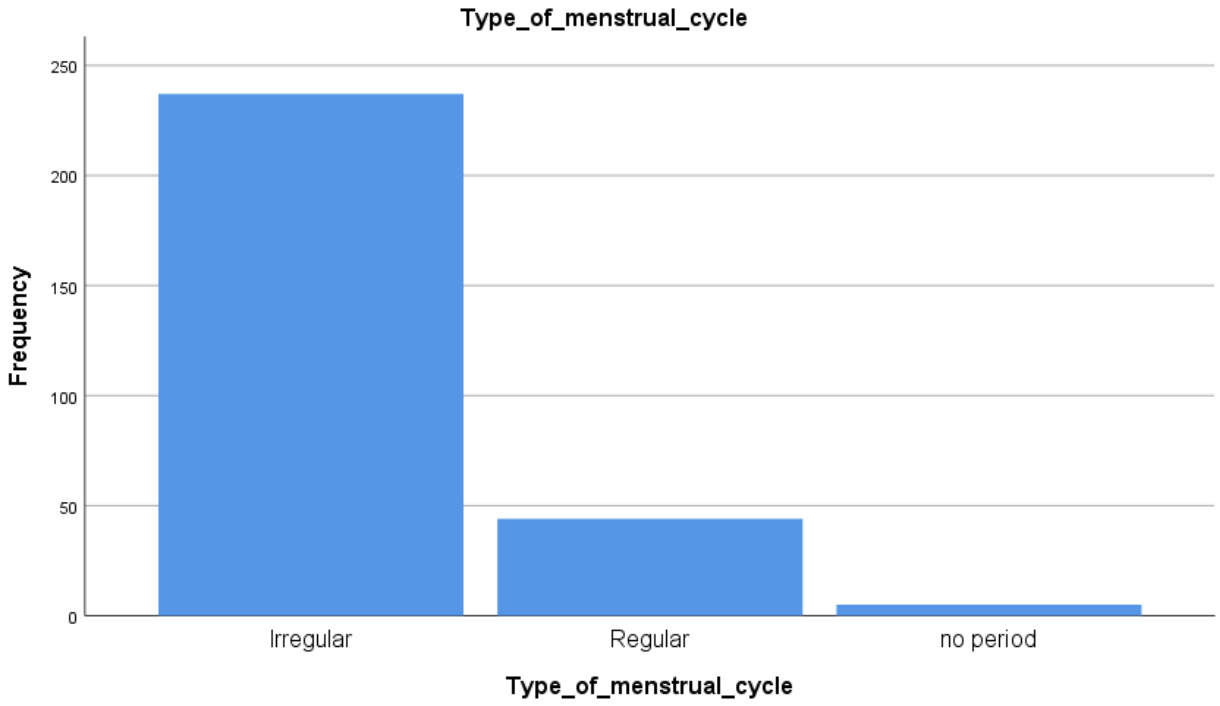


Figure 27: Distribution of UTI Patient Based on Type of menstrual cycle

7.3.6 Distribution of UTI Patient Based on Type of Infertility:

Table 14: Frequency Table Distribution of UTI Patient Based on Type of Infertility:

Type_of_infertilty

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Primary Infertility	57	19.9	19.9	19.9
	secondary infertilty	229	80.1	80.1	100.0
	Total	286	100.0	100.0	

The table presents the distribution of Urinary Tract Infection (UTI) patients based on their type of infertility. Out of 286 patients, the majority, 80.1%, suffer from secondary infertility, which occurs when a patient has had at least one successful pregnancy but is now unable to conceive. In contrast, 19.9% of the patients experience primary infertility, which refers to the inability to conceive a child after trying for a year without success. The cumulative percentage reaches 100% once secondary infertility cases are included. This data reveals that secondary infertility is significantly more prevalent among UTI patients in this sample than primary infertility.

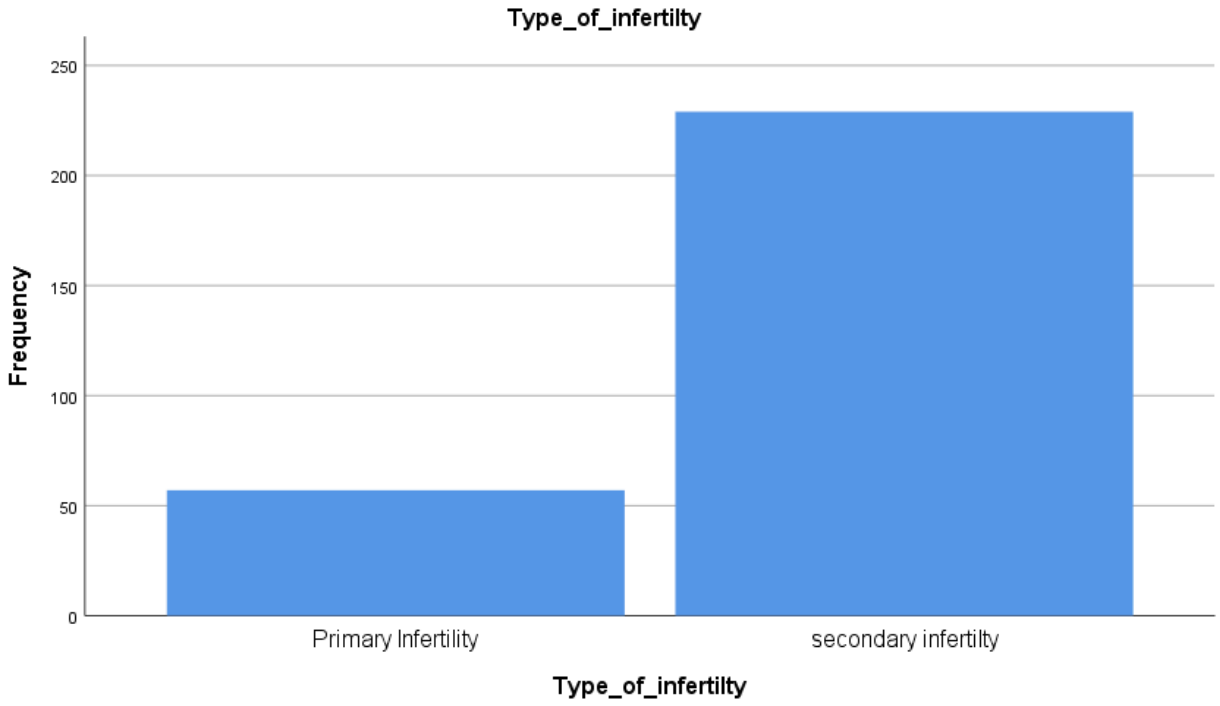


Figure 28: Distribution of UTI Patient Based on Type of Infertility

7.3.7 Distribution of UTI Patient Based on Presence of Diabetes:

Table 15: Frequency Table Distribution of UTI Patient Based on Presence of Diabetes:

Diabetes

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	144	50.3	50.3	50.3
	No	142	49.7	49.7	100.0
	Total	286	100.0	100.0	

The table details the distribution of Urinary Tract Infection (UTI) patients based on whether they have diabetes. Among the 286 patients, 144 (50.3%) have diabetes, while 142 (49.7%) do not have diabetes. The table shows that the valid percentage of patients with diabetes is 50.3%, and those without diabetes is 49.7%. The cumulative percentage reaches 100% after including both groups, indicating that all patients are accounted for. This data reveals a near-even distribution between diabetic and non-diabetic UTI patients, with exactly half of the patients having diabetes.

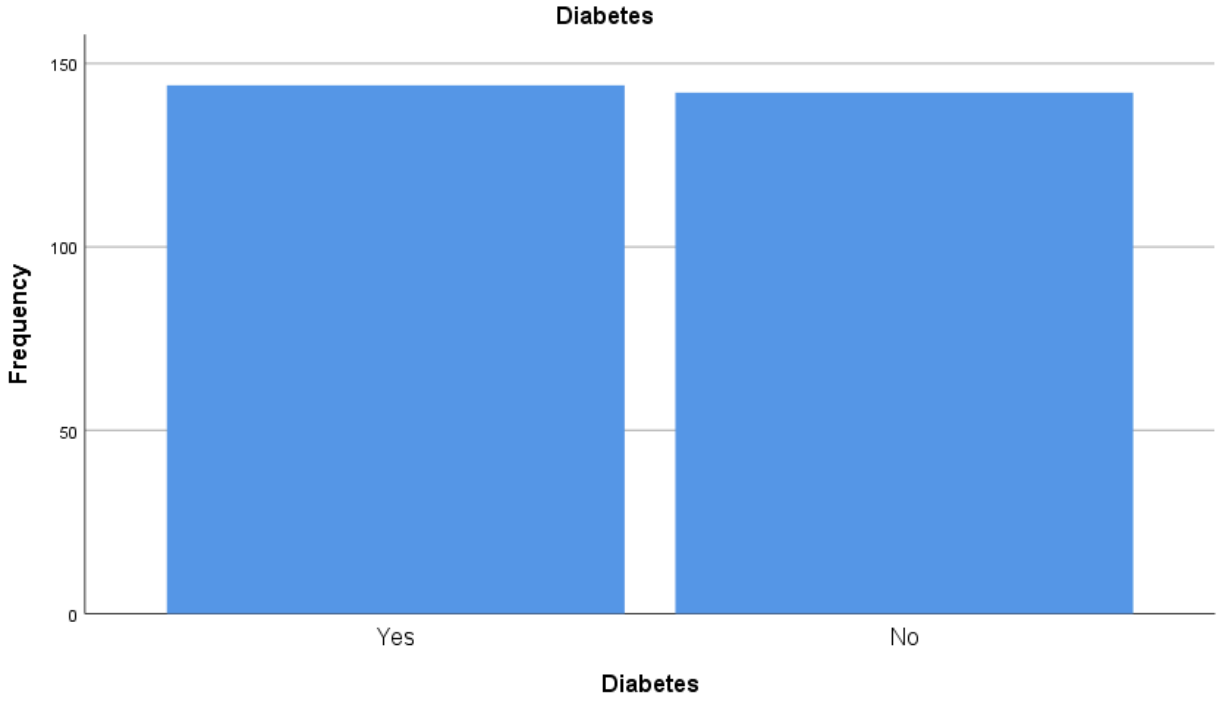


Figure 29: Distribution of UTI Patient Based on Diabetes

7.3.8 Distribution of UTI according to the Received treatment:

Table 16: Frequency Table Distribution of UTI Patient Based on Their Received Treatment:

Recieved_treatment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	229	80.1	80.1	80.1
	no	57	19.9	19.9	100.0
	Total	286	100.0	100.0	

The table provides a breakdown of Urinary Tract Infection (UTI) patients based on whether they received treatment. Out of the total 286 patients, 229 (80.1%) received treatment for their UTI, while 57 (19.9%) did not receive any treatment. The valid percentage reflects that 80.1% of the patients received treatment, whereas 19.9% did not. The cumulative percentage reaches 100% when including both those who received treatment and those who did not, indicating that the entire sample is accounted for. This data highlights that the majority of UTI patients in this sample have received treatment, with a smaller proportion not having undergone any treatment.

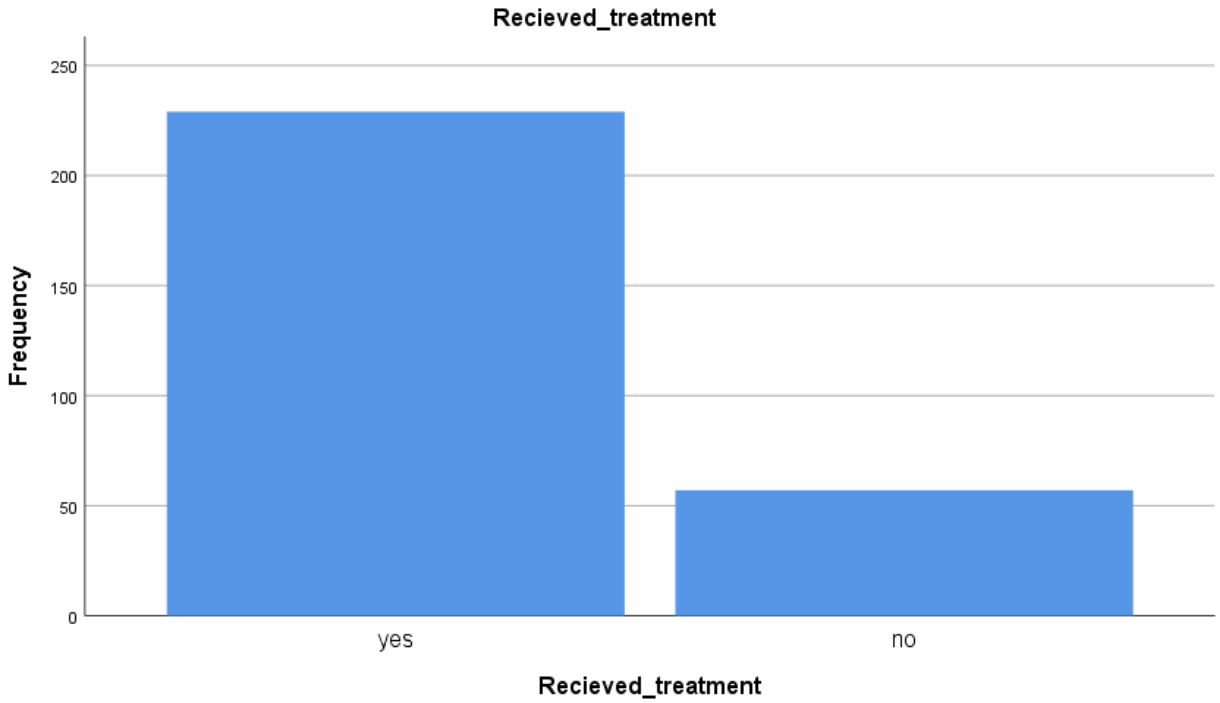


Figure 30: Distribution of UTI Patient Based on Received Treatment

7.3.9 Distribution of UTI according to Pregnant or not:

Table 17: Frequency Table Distribution of UTI Patient Based on Pregnant or not:

pregnant_or_not

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Pregnant	25	8.7	8.7	8.7
	Not pregnant	261	91.3	91.3	100.0
	Total	286	100.0	100.0	

The table shows the distribution of Urinary Tract Infection (UTI) patients based on their pregnancy status. Out of 286 patients, 25 (8.7%) are pregnant, while the majority, 261 (91.3%), are not pregnant. The valid percentage indicates that 8.7% of the patients are pregnant, and 91.3% are not. The cumulative percentage reaches 100% when including both pregnant and non-pregnant patients, ensuring the entire sample is accounted for. This distribution reveals that a very small proportion of the UTI patients are pregnant, with the vast majority being non-pregnant.

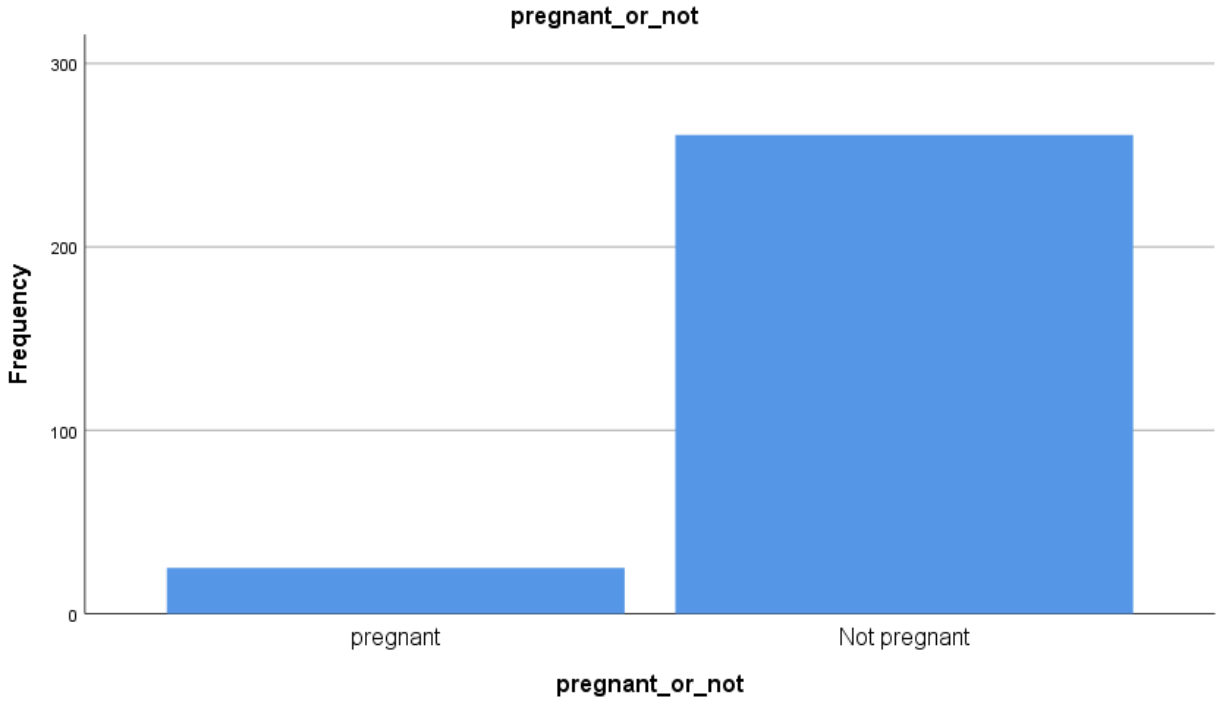


Figure 31: Distribution of UTI Patient Based on Pregnant or not

7.3.10 Distribution of UTI according to How long ago you were diagnosed with:

Table 18: Frequency Table Distribution of UTI Patient Based on How long ago you were diagnosed with:

How_long_ago_you_were_diagonized_with

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 month - 4 months	265	92.7	92.7	92.7
	5 months - 8 months	7	2.4	2.4	95.1
	9 months - 1 year	3	1.0	1.0	96.2
	2 years - 5 years	8	2.8	2.8	99.0
	6 years - 9 years	3	1.0	1.0	100.0
	Total	286	100.0	100.0	

Table 18 provides the distribution of UTI patients based on how long ago they were diagnosed with the condition. Out of the total 286 patients, 265 individuals (92.7%) reported being diagnosed within the past 1 to 4 months, indicating that the majority of patients experienced a recent diagnosis. A smaller percentage, 7 patients (2.4%), were diagnosed 5 to 8 months ago, while 3 patients (1.0%) were diagnosed 9 months to 1 year ago. Additionally, 8 patients (2.8%) had been diagnosed 2 to 5 years ago, and 3 patients (1.0%) were diagnosed 6 to 9 years ago.

This distribution suggests that most patients in the study had recently experienced UTI, with the majority being diagnosed within the past few months. It also highlights that a small percentage of patients have dealt with the condition for several years, potentially pointing to recurring or long-term cases. The cumulative percentage shows that by the time we reach those diagnosed 2-5 years ago, 99% of the patients have been accounted for. Only a small portion of the study population had been managing UTI for over six years.

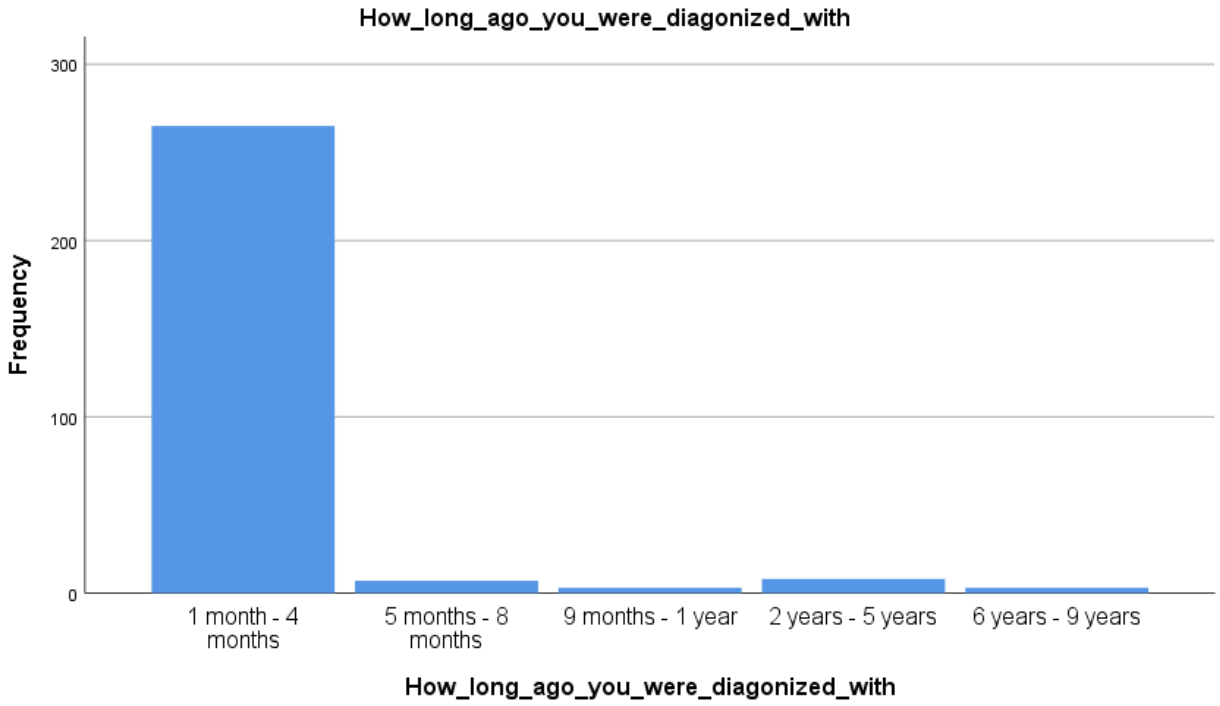


Figure 32: Distribution of UTI Patient Based on how long ago the patient were diagnosed with UTI

7.3.11 Distribution of UTI according to the Risk Factors

Table 19: Frequency Table Distribution of UTI Patient Based on Their Risk Factors:

Variables	Group	N(%)
Age	12-15 (preteen) 15-18 18-25 25-35 35-45 45-60 60+	1.4% 6.3% 20.6% 23.1% 40.6% 6.6% 1.4%

Body Mass Index (BMI)	Underweight Normal weight Overweight obese	15.7% 29.4% 54.5% 3%
Miscarriages or Stillbirth	Miscarriage Still birth None Both	45.1% 7% 31.1% 16.8%
Cases of UTI with Endometriosis	Yes No	89.5% 10.5%
Type of Menstrual Cycle	Regular Irregular No period	82.9% 15.4% 1.7%
Type of Infertility	Primary Secondary	19.9% 80.1%
Diabetes	Present Absent	50.3% 49.7%
Received Treatment	Received Not Received	80.1% 19.9%
Pregnant or not	Yes No	8.7% 91.3%
How long ago the patient was Diagnosed with UTI	1 month – 4 months 5 months – 8 months 9 months – 1 year 2 years – 5 years 6 years – 9 years	92.7% 2.4% 1% 2.8% 1%

Table 19 presents the distribution of UTI patients based on several risk factors. Each variable examined highlights the demographic and health characteristics of the 286 patients in the study.

Age Distribution: The majority of UTI cases fall within the 35-45 age group (40.6%), followed by patients aged 25-35 (23.1%) and 18-25 (20.6%). The older and younger age brackets represent smaller proportions, with 6.6% of patients between 45-60 years, 6.3% between 15-18 years, and a minimal percentage in the 12-15 (1.4%) and 60+ (1.4%) groups.

Body Mass Index (BMI): The most significant portion of the patients fall in the overweight category (54.5%), followed by those with normal weight (29.4%). About 15.7% were classified as underweight, while a small percentage (3%) were considered obese.

Miscarriages or Stillbirths: Around 45.1% of the patients had experienced a miscarriage, while 7% had a stillbirth. 31.1% reported no history of miscarriage or stillbirth, while 16.8% had experienced both.

UTI Cases with Endometriosis: A high proportion of patients (89.5%) had both UTI and endometriosis, while only 10.5% did not have endometriosis.

Type of Menstrual Cycle: The vast majority (82.9%) had an irregular menstrual cycle, while 15.4% reported having a regular cycle, and 1.7% had no period.

Type of Infertility: The data reveals that 80.1% of the patients suffered from secondary infertility, while 19.9% were diagnosed with primary infertility.

Diabetes: The distribution was almost equal, with 50.3% of the patients having diabetes, while 49.7% were free from the condition.

Treatment for UTI: 80.1% of the patients had received treatment for their UTI, whereas 19.9% had not received treatment.

Pregnancy Status: A majority (91.3%) of the patients were not pregnant, with only 8.7% reported being pregnant.

Time Since UTI Diagnosis: The largest group (92.7%) had been diagnosed with UTI in the last 1-4 months, followed by 2.4% who were diagnosed 5-8 months ago, 1% between 9 months and 1 year, 2.8% diagnosed 2-5 years ago, and 1% diagnosed 6-9 years ago.

This table provides a detailed breakdown of the various demographic, health, and treatment-related risk factors affecting the UTI patients in the study, demonstrating how these factors interplay in the incidence and management of UTIs.

7.3.12 Statistical Distribution of UTI according to the Risk Factors

Table 20: Statistical Distribution of UTI according to the Risk Factors

One-Sample Test

	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Age	61.377	285	.000	4.206	4.07	4.34
BMI	54.000	285	.000	2.395	2.31	2.48
cases_of_UTI_with_endometrosis	60.874	285	.000	1.105	1.07	1.14
Diabetes	50.529	285	.000	1.497	1.44	1.55
Type_of_infertilty	76.098	285	.000	1.801	1.75	1.85
Miscarriages_or_Stillbirth	31.383	285	.000	2.196	2.06	2.33
pregnant_or_not	114.319	285	.000	1.913	1.88	1.95
Type_of_menstrual_cycle	46.271	285	.000	1.189	1.14	1.24
Recieved_treatment	50.683	285	.000	1.199	1.15	1.25

Table 20 presents the **Statistical Distribution of UTI according to various risk factors** using **one-sample t-tests**. The table analyzes the relationship between the risk factors and UTI incidence, providing details on the **t-values, degrees of freedom (df)**, **significance (2-tailed)**, **mean differences**, and **confidence intervals** (lower and upper limits) for each risk factor.

1. **Age**: The t-value for age is **61.377** with **285 degrees of freedom (df)**. The p-value (**Sig.**) is **0.000**, which indicates a highly significant difference, with a **mean difference** of **4.206**. The **95% confidence interval** ranges from **4.07 to 4.34**, suggesting that age is a statistically significant factor in UTI cases.
2. **Body Mass Index (BMI)**: BMI also shows a significant relationship with a t-value of **54.000** and a p-value of **0.000**. The **mean difference** is **2.395**, with a **confidence interval** between **2.31 and 2.48**, highlighting the importance of BMI as a risk factor in UTI development.
3. **Cases of UTI with Endometriosis**: The t-value for UTI cases with endometriosis is **60.874**, with a p-value of **0.000**, indicating strong significance. The mean difference of **1.105** and the confidence interval between **1.07 and 1.14** show that endometriosis is closely linked to UTI occurrences.
4. **Diabetes**: Diabetes has a t-value of **50.529**, and its significance level is **0.000**. The **mean difference** is **1.497**, with a confidence interval between **1.44 and 1.55**, demonstrating a significant association between diabetes and UTI risk.
5. **Type of Infertility**: Infertility type, specifically primary versus secondary infertility, is also significant, with a t-value of **76.098** and a p-value of **0.000**. The mean difference of **1.801** and confidence interval between **1.75 and 1.85** highlight a strong link between infertility and UTIs.
6. **Miscarriages or Stillbirth**: The t-value is **31.383**, with a highly significant p-value of **0.000**. The mean difference is **2.196**, and the confidence interval is between **2.06 and 2.33**, indicating that miscarriage or stillbirth history is a considerable risk factor for UTIs.

7. **Pregnancy Status**: Pregnancy status is shown to be a significant factor with a t-value of **114.319** and a p-value of **0.000**. The mean difference of **1.913** and the confidence interval between **1.88 and 1.95** suggest that being pregnant or not is a critical determinant in UTI prevalence.
8. **Type of Menstrual Cycle**: The t-value is **46.271**, and the p-value is **0.000**. The **mean difference** is **1.189**, with the confidence interval ranging from **1.14 to 1.24**, implying that irregular menstrual cycles play a role in UTI development.
9. **Received Treatment**: Treatment for UTI is also highly significant, with a t-value of **50.683** and a p-value of **0.000**. The mean difference of **1.199** and confidence interval between **1.15 and 1.25** confirm that treatment received for UTI significantly influences the health outcomes of patients.

In summary, all of the listed risk factors—age, BMI, endometriosis, diabetes, infertility type, miscarriage or stillbirth history, pregnancy status, menstrual cycle type, and treatment received—are statistically significant in their relationship with UTI prevalence. The p-values of **0.000** across all variables indicate that these factors have a strong and meaningful impact on the likelihood of UTI development. The confidence intervals provide insight into the range within which these differences are observed, further solidifying their importance in understanding UTI risks.

7.4 Cross-tabular analysis of UTI patient's age with the risk factors:

Table 21: Crosstab Distribution of UTI Patient Age with BMI:

Age * BMI Crosstabulation

Count

		BMI				
		Underweight	Normal Weight	Overweight	Obese	Total
Age	12-15 (preteen)	4	0	0	0	4
	15-18	12	5	1	0	18
	18-25	18	26	15	0	59
	25-35	4	25	37	0	66
	35-45	5	22	88	1	116
	45-60	2	5	12	0	19
	60+	0	1	3	0	4
Total		45	84	156	1	286

Table 21 presents a cross-tabulation of urinary tract infection (UTI) patients' age with their Body Mass Index (BMI) categories. The table categorizes patients into four BMI groups: Underweight, Normal Weight, Overweight, and Obese, and breaks down the distribution across various age groups. For the age group 12-15 (preteen), all 4 patients were classified as underweight. In the 15-18 age range, 12 patients were underweight, 5 had normal weight, and 1 was overweight, totaling 18 patients. The 18-25 age group included 18 underweight, 26 normal weight, 15 overweight, and no obese patients, making up 59 patients. Among those aged 25-35, 4 were underweight, 25 had normal weight, 37 were overweight, and none were obese, totaling 66 patients. The 35-45 age group had 5 underweight, 22 normal weight, 88 overweight, and 1 obese patient, totaling 116 individuals. In the 45-60 age range, there were 2 underweight, 5 normal

weight, 12 overweight, and no obese patients, resulting in 19 patients. Finally, for those aged 60 and above, there was 1 patient each in the normal weight and overweight categories, and no underweight or obese patients, totaling 4 patients. Overall, the table includes data on 286 UTI patients distributed across these age and BMI categories.

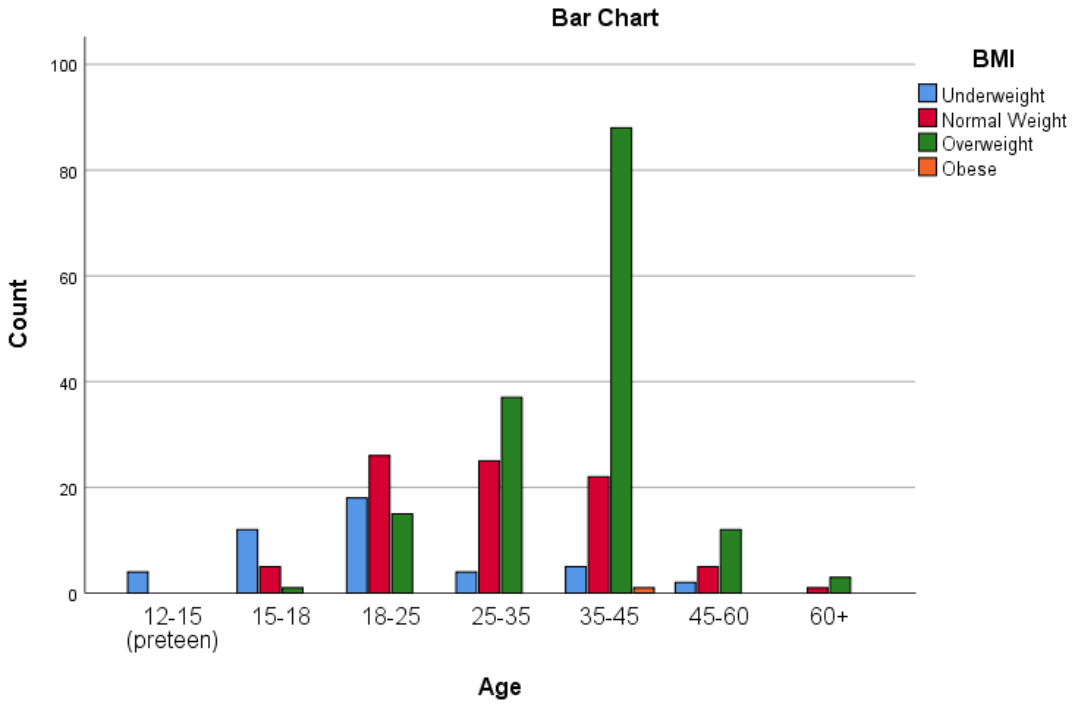


Figure 33: Cross-tabular Distribution of UTI Patient Age with BMI

Table 22: Crosstab Distribution of UTI Patient Age with Miscarriage or stillbirth:

Age * Miscarriages_or_Stillbirth Cross Tabulation

Count

		Miscarriages_or_Stillbirth				
		Miscarriage	Stiibirth	No	Both	Total
Age	12-15 (preteen)	0	0	4	0	4
	15-18	3	0	15	0	18
	18-25	29	4	25	1	59
	25-35	32	5	9	20	66
	35-45	59	9	27	21	116
	45-60	5	2	7	5	19
	60+	1	0	2	1	4
Total		129	20	89	48	286

Table 22 displays the distribution of UTI patients' ages with respect to their history of miscarriage or stillbirth. The table categorizes patients into four groups: Miscarriage, Stillbirth, No history of either, and Both. For the 12-15 age group, all 4 patients had no history of miscarriage or stillbirth. In the 15-18 age range, 3 patients experienced miscarriages, 15 had no

history of either, and none had stillbirths or both conditions, totaling 18 patients. The 18-25 age group includes 29 patients with miscarriages, 4 with stillbirths, 25 with no history, and 1 with both, resulting in 59 patients. Among those aged 25-35, 32 experienced miscarriages, 5 had stillbirths, 9 had no history, and 20 had both, totaling 66 patients. The 35-45 age group had 59 patients with miscarriages, 9 with stillbirths, 27 with no history, and 21 with both conditions, totaling 116 individuals. In the 45-60 age range, 5 had miscarriages, 2 had stillbirths, 7 had no history, and 5 had both, resulting in 19 patients. For those aged 60 and above, 1 patient had a miscarriage, none had stillbirths, 2 had no history, and 1 had both conditions, totaling 4 patients. Overall, the table encompasses data on 286 UTI patients distributed across these age groups and their miscarriage or stillbirth histories.

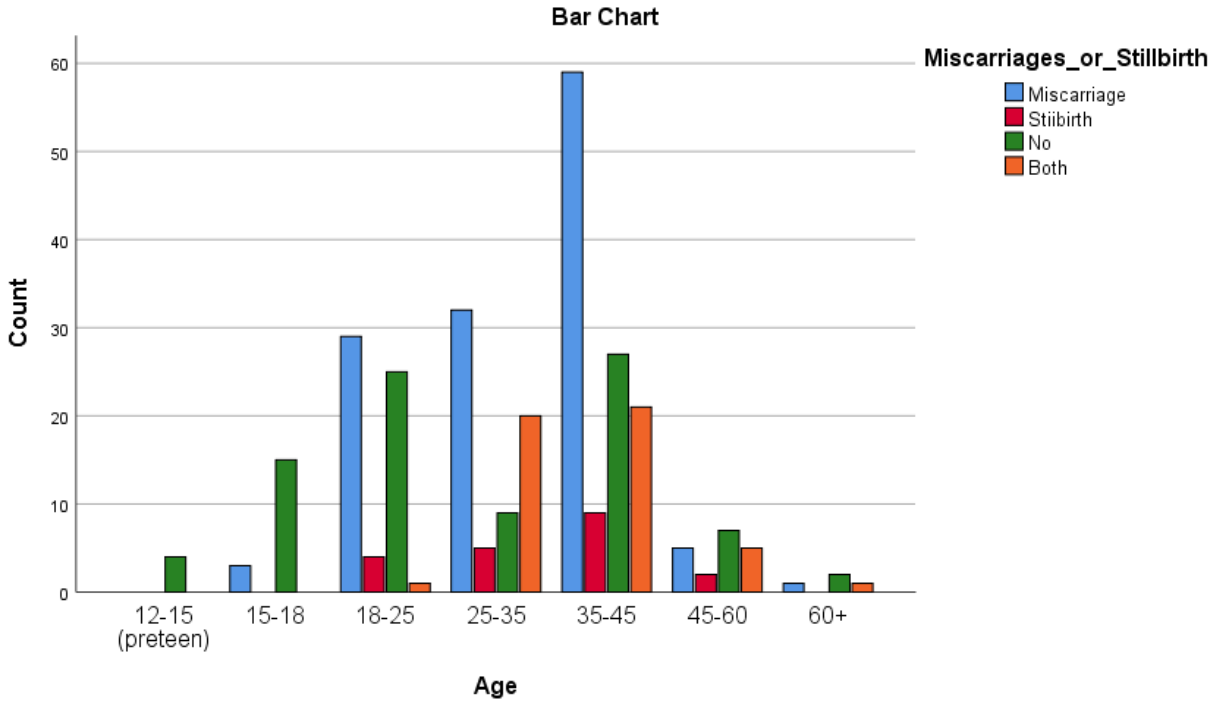


Figure 34: Cross-tabular Distribution of UTI Patient Age with Miscarriage or still birth.

Table 23: Crosstab Distribution of UTI Patient Age with Cases of UTI with Endometriosis:

Age * cases_of_UTI_with_endometrosis Cross Tabulation

Count

		cases_of_UTI_with_endometrosis		
		yes	no	Total
Age	12-15 (preteen)	0	4	4
	15-18	12	6	18
	18-25	52	7	59
	25-35	64	2	66

	35-45	106	10	116
	45-60	18	1	19
	60+	4	0	4
Total		256	30	286

Table 23 provides a cross-tabulation of UTI patients' ages with the presence of endometriosis. The table categorizes patients into two groups: those with cases of UTI associated with endometriosis and those without. For the 12-15 age group, none of the 4 patients had endometriosis. In the 15-18 age range, 12 patients had endometriosis, while 6 did not, totaling 18 patients. Among the 18-25 age group, 52 patients had endometriosis and 7 did not, resulting in 59 patients. In the 25-35 age bracket, 64 patients had endometriosis, and 2 did not, totaling 66 patients. For the 35-45 age group, 106 patients had endometriosis, while 10 did not, making up 116 individuals. In the 45-60 age range, 18 patients had endometriosis and 1 did not, totaling 19 patients. Finally, in the 60+ age group, 4 patients had endometriosis, and none did not, totaling 4 patients. Overall, the table includes data on 286 UTI patients, with 256 having endometriosis and 30 without it.

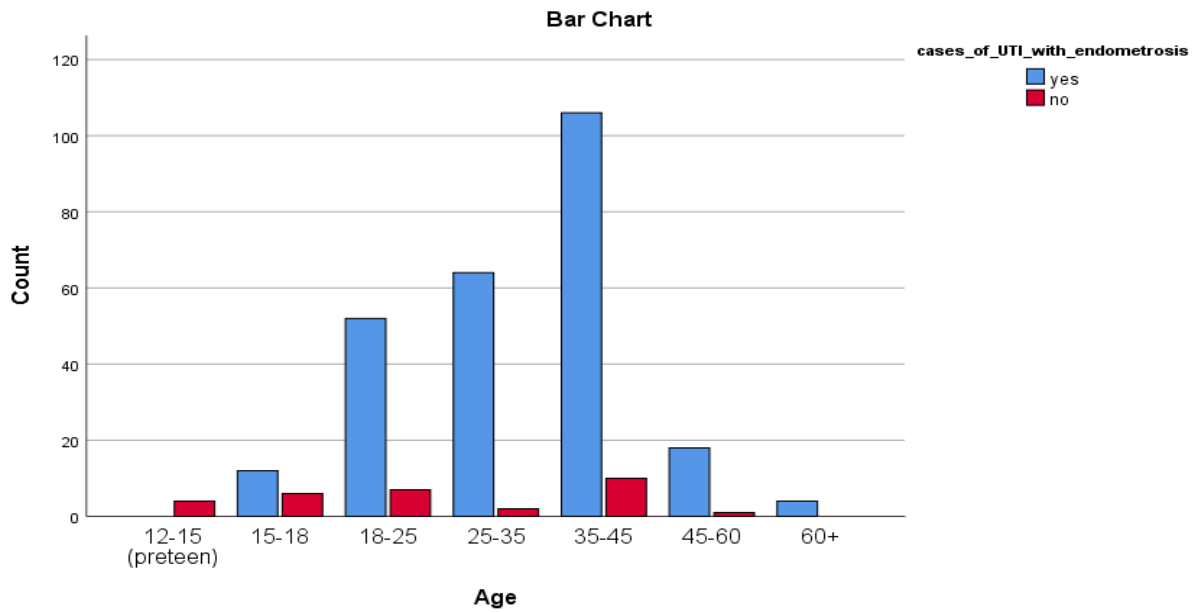


Figure 35: Cross-tabular Distribution of UTI Patient Age with Cases of UTI with Endometriosis

Table 24: Crosstab Distribution of UTI Patient Age with Type of menstrual cycle:

Age * Type_of_menstrual_cycle Cross Tabulation

Count

		Type_of_menstrual_cycle			
		Irregular	Regular	no period	Total
Age	12-15 (preteen)	2	1	1	4
	15-18	14	4	0	18
	18-25	49	10	0	59
	25-35	62	4	0	66
	35-45	95	21	0	116
	45-60	15	3	1	19
	60+	0	1	3	4
Total		237	44	5	286

Table 24 displays the distribution of UTI patients' ages in relation to the type of menstrual cycle they experience. Patients are categorized into three groups: Irregular, Regular, and No Period. In the 12-15 age group, 2 patients had irregular cycles, 1 had a regular cycle, and 1 had no period, totaling 4 patients. For the 15-18 age range, 14 patients had irregular cycles, 4 had regular cycles, and none had no period, resulting in 18 patients. Among the 18-25 age group, 49 patients had irregular cycles, 10 had regular cycles, and none had no period, totaling 59 patients. In the 25-35 age group, 62 patients experienced irregular cycles, 4 had regular cycles, and none had no period, making up 66 patients. The 35-45 age bracket included 95 patients with irregular cycles, 21 with regular cycles, and none with no period, totaling 116 patients. For the 45-60 age group, there were 15 patients with irregular cycles, 3 with regular cycles, and 1 with no period, resulting in 19 patients. In the 60+ age range, none had irregular cycles, 1 had a regular cycle, and 3 had no period, totaling 4 patients. Overall, the table includes data on 286 UTI patients, with 237 having irregular cycles, 44 with regular cycles, and 5 with no period.

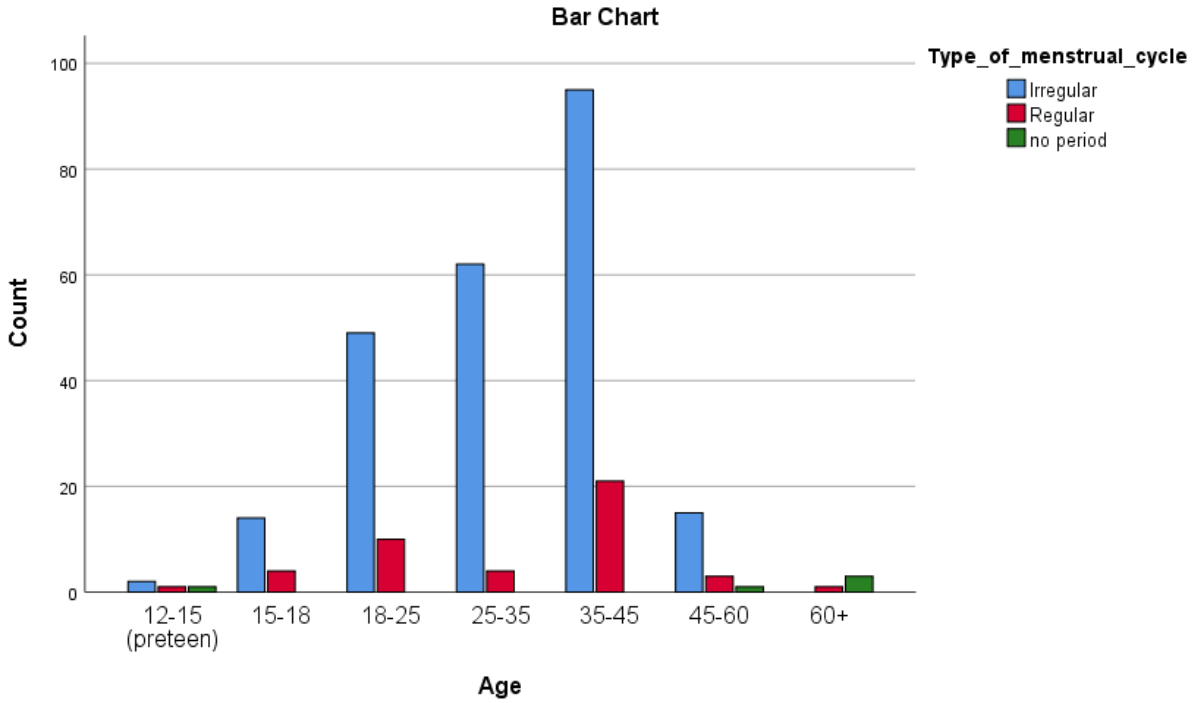


Figure 36: Cross-tabular Distribution of UTI Patient Age with Type of menstrual cycle

Table 25: Crosstab Distribution of UTI Patient Age with Type of Infertility:

Age * Type_of_infertilty Cross Tabulation

Count

		Type_of_infertilty		
		Primary Infertility	secondary infertilty	Total
Age	12-15 (preteen)	4	0	4
	15-18	7	11	18
	18-25	16	43	59
	25-35	4	62	66
	35-45	18	98	116
	45-60	6	13	19
	60+	2	2	4
Total		57	229	286

Table 25 presents the distribution of UTI patients' ages with regard to the type of infertility they experience. Patients are categorized into two types of infertility: Primary Infertility and Secondary Infertility. In the 12-15 age group, all 4 patients had primary infertility and none had secondary infertility. For the 15-18 age range, 7 patients had primary infertility, while 11 had secondary infertility, totaling 18 patients. Among the 18-25 age group, 16 patients had primary infertility and 43 had secondary infertility, resulting in 59 patients. In the 25-35 age group, 4 patients had primary infertility, and 62 had secondary infertility, making up 66 patients. The 35-45 age group includes 18 patients with primary infertility and 98 with secondary infertility, totaling 116 patients. For the 45-60 age range, 6 patients had primary infertility and 13 had secondary infertility, totaling 19 patients. In the 60+ age group, there were 2 patients with primary infertility and 2 with secondary infertility, resulting in 4 patients. Overall, the table encompasses data on 286 UTI patients, with 57 experiencing primary infertility and 229 experiencing secondary infertility.

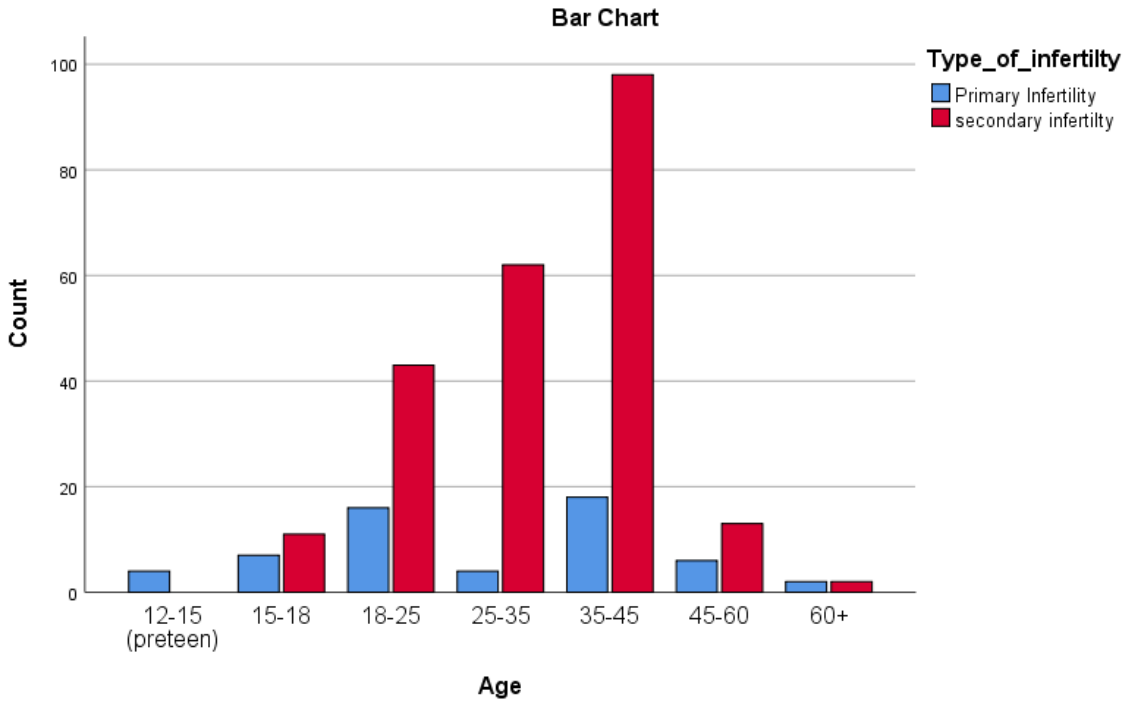


Figure 37: Cross-tabular Distribution of UTI Patient Age with Type of Infertility

Table 26: Crosstab Distribution of UTI Patient Age with Diabetes:

Age * Diabetes Crosstabulation

Count

		Diabetes		
		Yes	No	Total
Age	12-15 (preteen)	0	4	4
	15-18	1	17	18
	18-25	4	55	59
	25-35	36	30	66
	35-45	80	36	116
	45-60	19	0	19
	60+	4	0	4
Total		144	142	286

Table 26 details the distribution of UTI patients' ages in relation to their diabetes status, categorized into two groups: Yes (diabetes) and No (diabetes). In the 12-15 age group, none of the 4 patients had diabetes. In the 15-18 age range, 1 patient had diabetes, while 17 did not, totaling 18 patients. Among the 18-25 age group, 4 patients had diabetes and 55 did not, resulting in 59 patients. For the 25-35 age group, 36 patients had diabetes and 30 did not, making up 66 patients. The 35-45 age group included 80 patients with diabetes and 36 without, totaling 116 patients. In the 45-60 age range, 19 patients had diabetes and none did not, totaling 19 patients. Finally, in the 60+ age group, 4 patients had diabetes, and none did not, totaling 4 patients. Overall, the table shows that out of 286 UTI patients, 144 had diabetes and 142 did not.

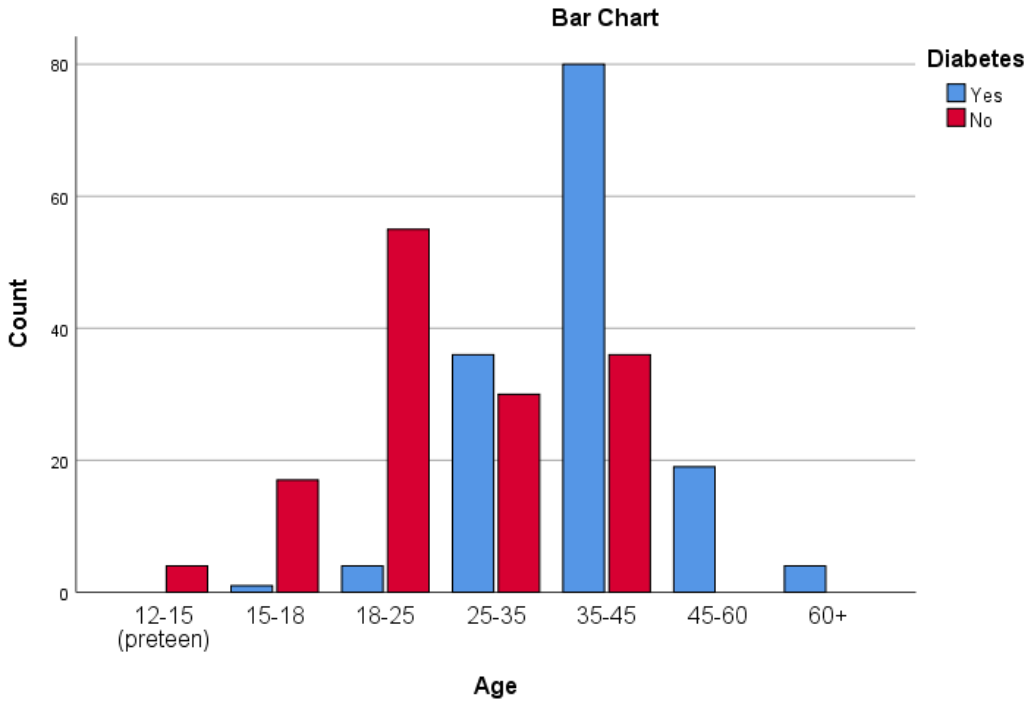


Figure 38: Crosstab Distribution of UTI Patient Age with Diabetes

Table 27: Crosstab Distribution of UTI Patient Age with Received Treatment:

Age * Recieved_treatment Cross Tabulation

Count

		Recieved_treatment		
		yes	no	Total
Age	12-15 (preteen)	2	2	4
	15-18	12	6	18
	18-25	42	17	59
	25-35	54	12	66
	35-45	96	20	116
	45-60	19	0	19
	60+	4	0	4
Total		229	57	286

Table 27 presents the distribution of UTI patients' ages concerning whether they received treatment, categorized into two groups: Yes (received treatment) and No (did not receive treatment). In the 12-15 age group, 2 out of 4 patients received treatment, and 2 did not. For the 15-18 age range, 12 patients received treatment, and 6 did not, totaling 18 patients. Among the 18-25 age group, 42 patients received treatment and 17 did not, resulting in 59 patients. In the 25-35 age group, 54 patients received treatment, and 12 did not, making up 66 patients. The 35-45 age group included 96 patients who received treatment and 20 who did not, totaling 116 patients. For the 45-60 age range, 19 patients received treatment, and none did not, totaling 19 patients. In the 60+ age group, 4 patients received treatment, and none did not, totaling 4

patients. Overall, the table includes data on 286 UTI patients, with 229 having received treatment and 57 having not.

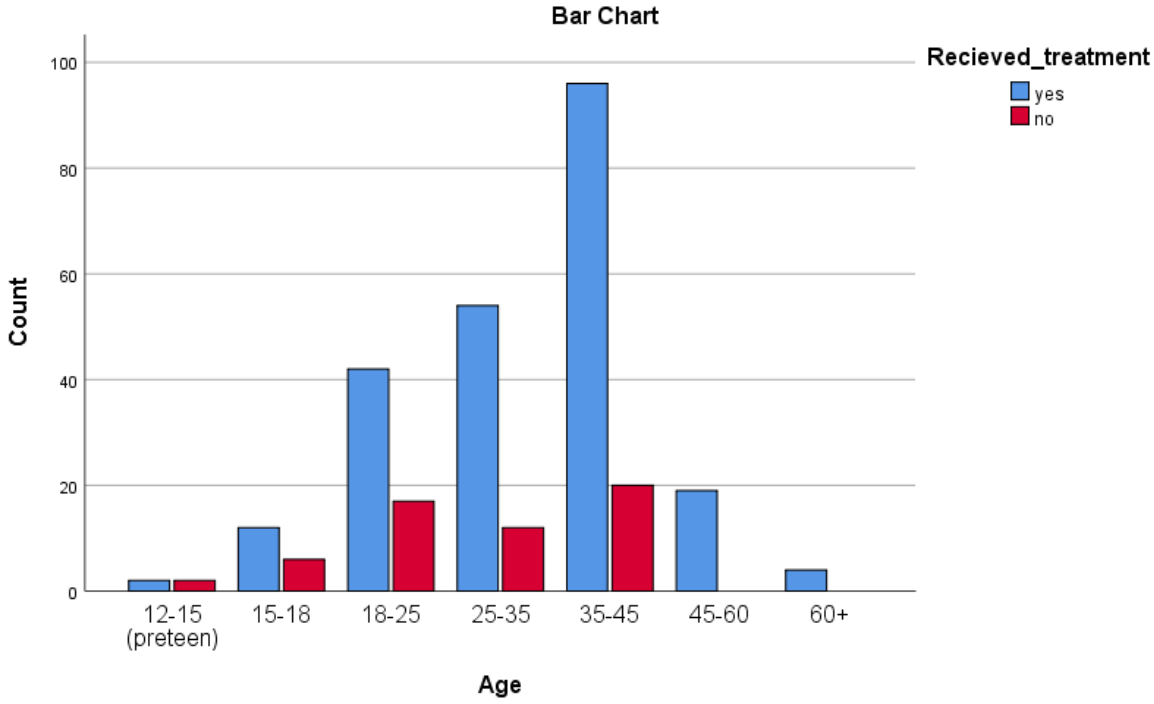


Figure 39: Cross-tabular Distribution of UTI Patient Age with Received Treatment

Table 28: Crosstab Distribution of UTI Patient Age with Pregnant or not:

Age * pregnant_or_not Cross Tabulation

Count

		pregnant_or_not		
		pregnant	Not pregnant	Total
Age	12-15 (preteen)	0	4	4
	15-18	2	16	18
	18-25	2	57	59
	25-35	8	58	66
	35-45	13	103	116
	45-60	0	19	19
	60+	0	4	4
Total		25	261	286

Table 28 shows the distribution of UTI patients' ages in relation to their pregnancy status, categorized into two groups: Pregnant and Not Pregnant. In the 12-15 age group, none of the 4 patients were pregnant, and all were not pregnant. For the 15-18 age range, 2 patients were pregnant, and 16 were not, totaling 18 patients. Among the 18-25 age group, 2 patients were pregnant, and 57 were not, resulting in 59 patients. In the 25-35 age group, 8 patients were pregnant, and 58 were not, making up 66 patients. The 35-45 age group included 13 pregnant

patients and 103 not pregnant, totaling 116 patients. In the 45-60 age range, none of the 19 patients were pregnant, and all were not pregnant. For the 60+ age group, none of the 4 patients were pregnant, and all were not pregnant. Overall, the table covers 286 UTI patients, with 25 being pregnant and 261 not pregnant.

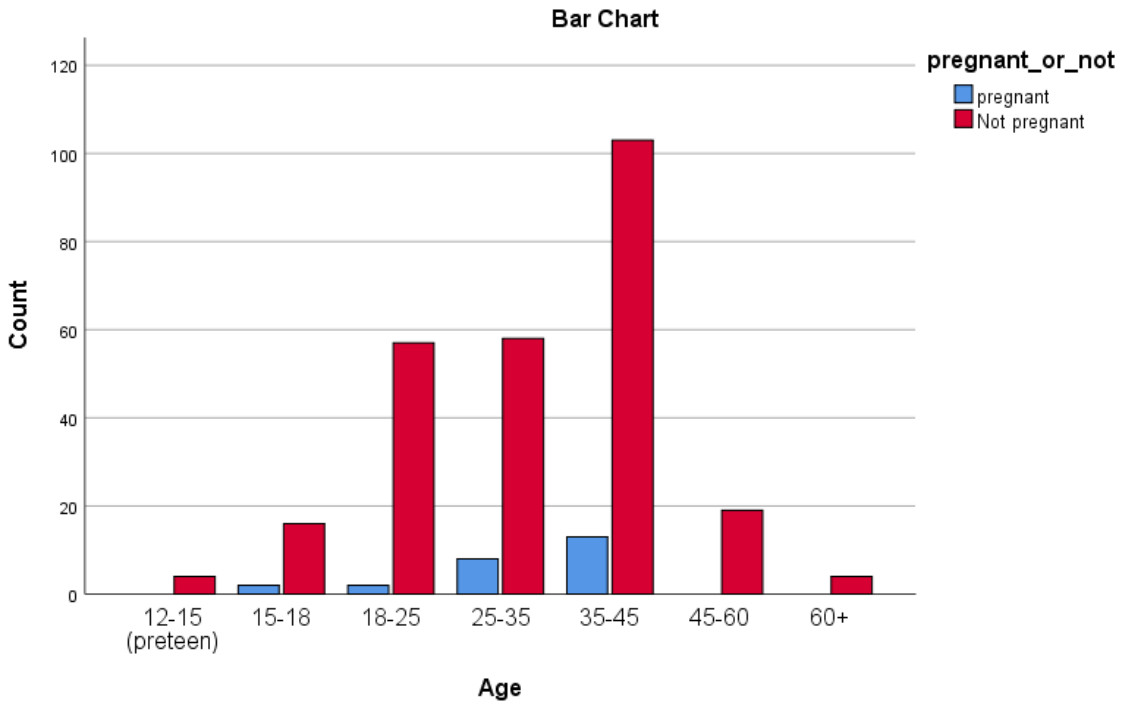


Figure 40: Cross-tabular Distribution of UTI Patient Age with Pregnant or not

Table 29: Crosstab Distribution of UTI Patient Age with How long ago the patient was diagnosed with UTI:

Age * How_long_ago_you_were_diagonized_with Cross Tabulation

Count

		How_long_ago_you_were_diagonized_with					
		1 month - 4 months	5 months - 8 months	9 months - 1 year	2 years - 5 years	6 years - 9 years	Total
Age	12-15 (preteen)	4	0	0	0	0	4
	15-18	17	0	0	0	1	18
	18-25	54	3	1	1	0	59
	25-35	66	0	0	0	0	66
	35-45	105	4	2	4	1	116
	45-60	17	0	0	1	1	19
	60+	2	0	0	2	0	4
Total		265	7	3	8	3	286

Table 29 presents the distribution of UTI patients' ages in relation to the duration since they were diagnosed with a UTI. Patients are categorized based on how long ago they were diagnosed: 1

month - 4 months, 5 months - 8 months, 9 months - 1 year, 2 years - 5 years, and 6 years - 9 years. In the 12-15 age group, all 4 patients were diagnosed 1 month - 4 months ago. For the 15-18 age range, 17 patients were diagnosed 1 month - 4 months ago, and 1 was diagnosed 2 years - 5 years ago, totaling 18 patients. Among the 18-25 age group, 54 patients were diagnosed 1 month - 4 months ago, 3 were diagnosed 5 months - 8 months ago, 1 was diagnosed 9 months - 1 year ago, and 1 was diagnosed 2 years - 5 years ago, resulting in 59 patients. In the 25-35 age group, all 66 patients were diagnosed 1 month - 4 months ago. The 35-45 age group included 105 patients diagnosed 1 month - 4 months ago, 4 diagnosed 5 months - 8 months ago, 2 diagnosed 9 months - 1 year ago, 4 diagnosed 2 years - 5 years ago, and 1 diagnosed 6 years - 9 years ago, totaling 116 patients. In the 45-60 age range, 17 patients were diagnosed 1 month - 4 months ago, 1 was diagnosed 2 years - 5 years ago, and 1 was diagnosed 6 years - 9 years ago, resulting in 19 patients. For the 60+ age group, 2 patients were diagnosed 1 month - 4 months ago, and 2 were diagnosed 2 years - 5 years ago, totaling 4 patients. Overall, the table includes data on 286 UTI patients, with 265 diagnosed 1 month - 4 months ago, 7 diagnosed 5 months - 8 months ago, 3 diagnosed 9 months - 1 year ago, 8 diagnosed 2 years - 5 years ago, and 3 diagnosed 6 years - 9 years ago.

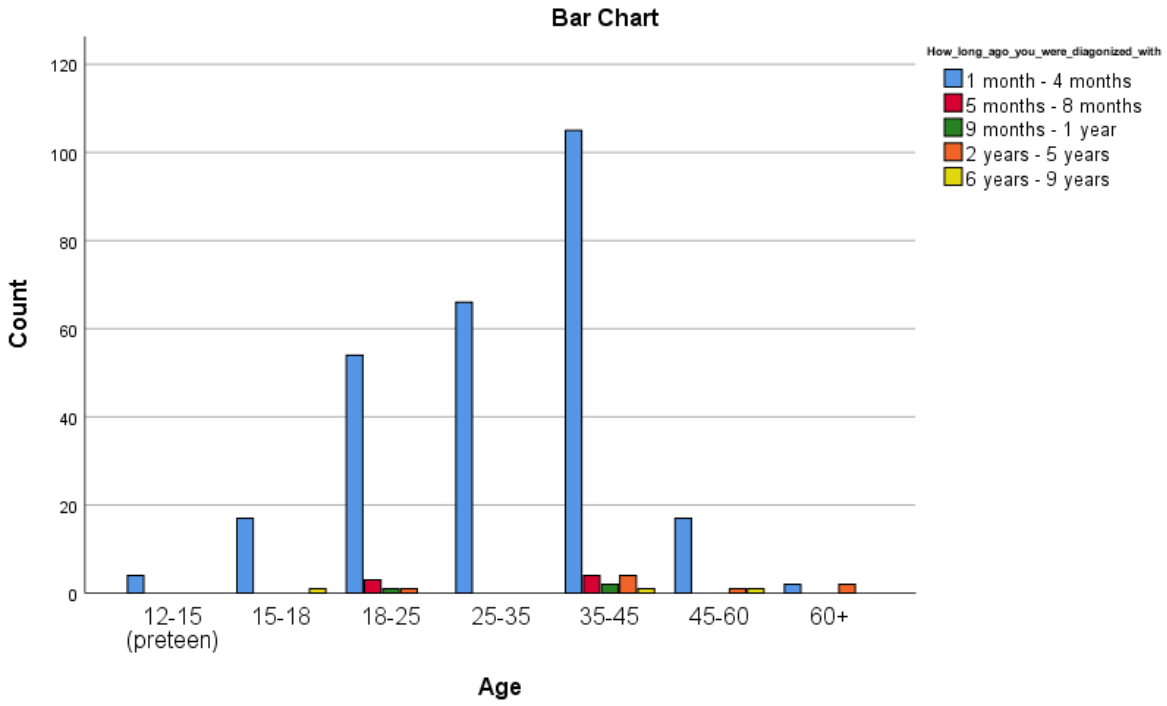


Figure 41: Cross-tabular Distribution of UTI Patient Age with How long ago the patient was diagnosed with UTI

7.5 Cross-tabular analysis of Cases of UTI with Endometriosis patients with the risk factors:

Table 30: Cross-tabular Distribution of Cases of UTI with Endometriosis with Age:

cases_of_UTI_with_endometrosis * Age Crosstabulation

Count

		Age						
		12-15 (preteen)	15-18	18-25	25-35	35-45	45-60	60+
cases_of_UTI_with_endometrosis	yes	0	12	52	64	106	18	4
	no	4	6	7	2	10	1	0
Total		4	18	59	66	116	19	4

Table 30 displays the distribution of UTI patients with endometriosis across different age groups. The table categorizes patients into two groups based on whether they have endometriosis: Yes and No. For the 12-15 age group, none of the 4 patients with UTI had endometriosis, while 4 did not have endometriosis. In the 15-18 age range, 12 patients had endometriosis, and 6 did not, totaling 18 patients. Among the 18-25 age group, 52 patients had endometriosis, and 7 did not, resulting in 59 patients. In the 25-35 age group, 64 patients had endometriosis, and 2 did not, making up 66 patients. The 35-45 age group included 106 patients with endometriosis and 10 without, totaling 116 patients. For the 45-60 age range, 18 patients had endometriosis, and 1 did not, resulting in 19 patients. In the 60+ age group, 4 patients had endometriosis, and none did not, totaling 4 patients. Overall, the table covers 286 UTI patients, with 256 having endometriosis and 30 not having it.

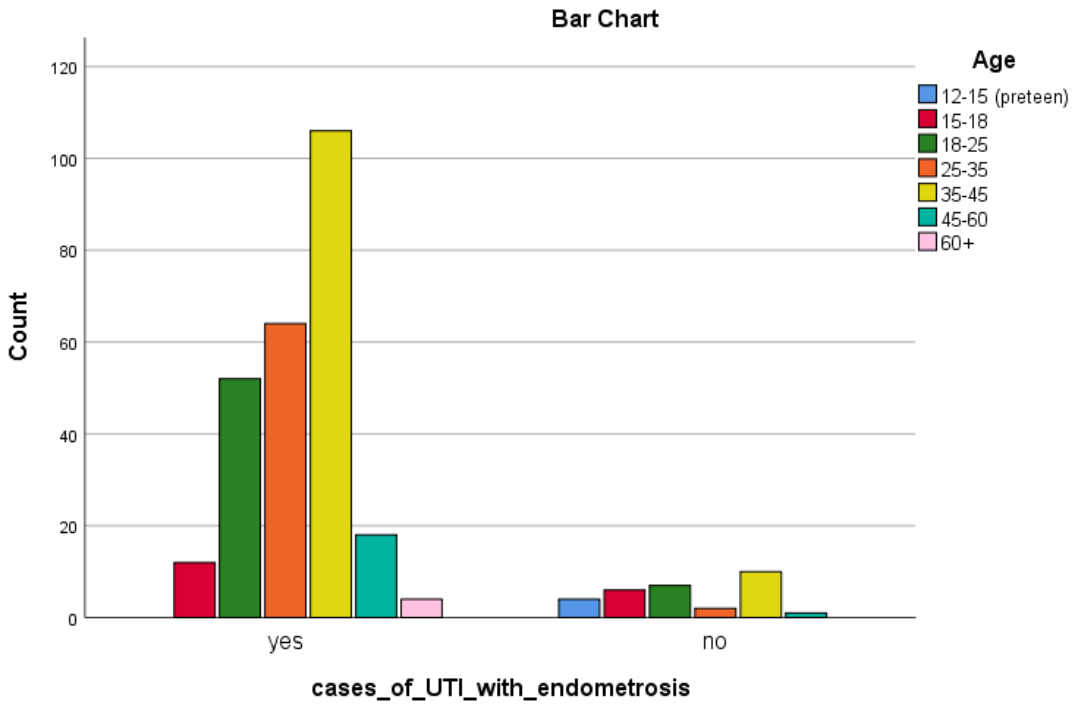


Figure 42: Cross-tabular Distribution of Cases of UTI with Endometriosis with Age

Table 31: Cross-tabular Distribution of Cases of UTI with Endometriosis with BMI:

cases_of_UTI_with_endometrosis * BMI Crosstabulation

Count

		BMI				
		Underweight	Normal Weight	Overweight	Obese	Total
cases_of_UTI_with_endometro	yes	34	77	144	1	256
sis	no	11	7	12	0	30
Total		45	84	156	1	286

Table 31 shows the distribution of UTI patients with endometriosis across different BMI categories. Patients are categorized into four BMI groups: Underweight, Normal Weight, Overweight, and Obese. For patients with endometriosis, 34 are classified as underweight, 77 as normal weight, 144 as overweight, and 1 as obese, totaling 256 patients. In contrast, among patients without endometriosis, 11 are underweight, 7 are normal weight, 12 are overweight, and none are obese, making up 30 patients. Overall, the table includes data on 286 UTI patients, with 256 having endometriosis and 30 not having it.

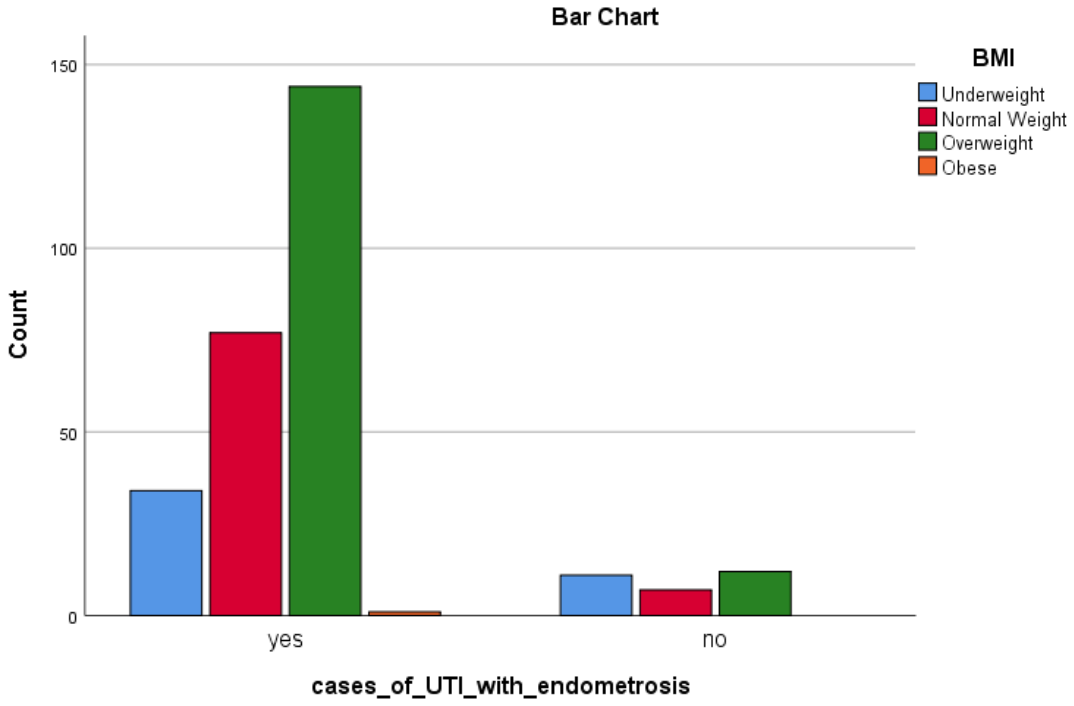


Figure 43: Cross-tabular Distribution of Cases of UTI with Endometriosis with BMI

Table 32: Cross-tabular Distribution of Cases of UTI with Endometriosis with Miscarrages or Still birth:

cases_of_UTI_with_endometrosis * Miscarriages_or_Stillbirth Crosstabulation

Count

		Miscarriages_or_Stillbirth				
		Miscarriage	Stiibirth	No	Both	Total
cases_of_UTI_with_endometro	yes	123	20	71	42	256
sis	no	6	0	18	6	30
Total		129	20	89	48	286

Table 32 details the distribution of UTI patients with endometriosis in relation to their history of miscarriage or stillbirth. Patients are categorized into four groups: Miscarriage, Stillbirth, No history of either, and Both. Among those with endometriosis, 123 patients have a history of miscarriage, 20 have a history of stillbirth, 71 have no history of either, and 42 have both conditions, totaling 256 patients. For patients without endometriosis, 6 have a history of miscarriage, none have a history of stillbirth, 18 have no history of either, and 6 have both conditions, making up 30 patients. Overall, the table includes data on 286 UTI patients, with 256 having endometriosis and 30 not.

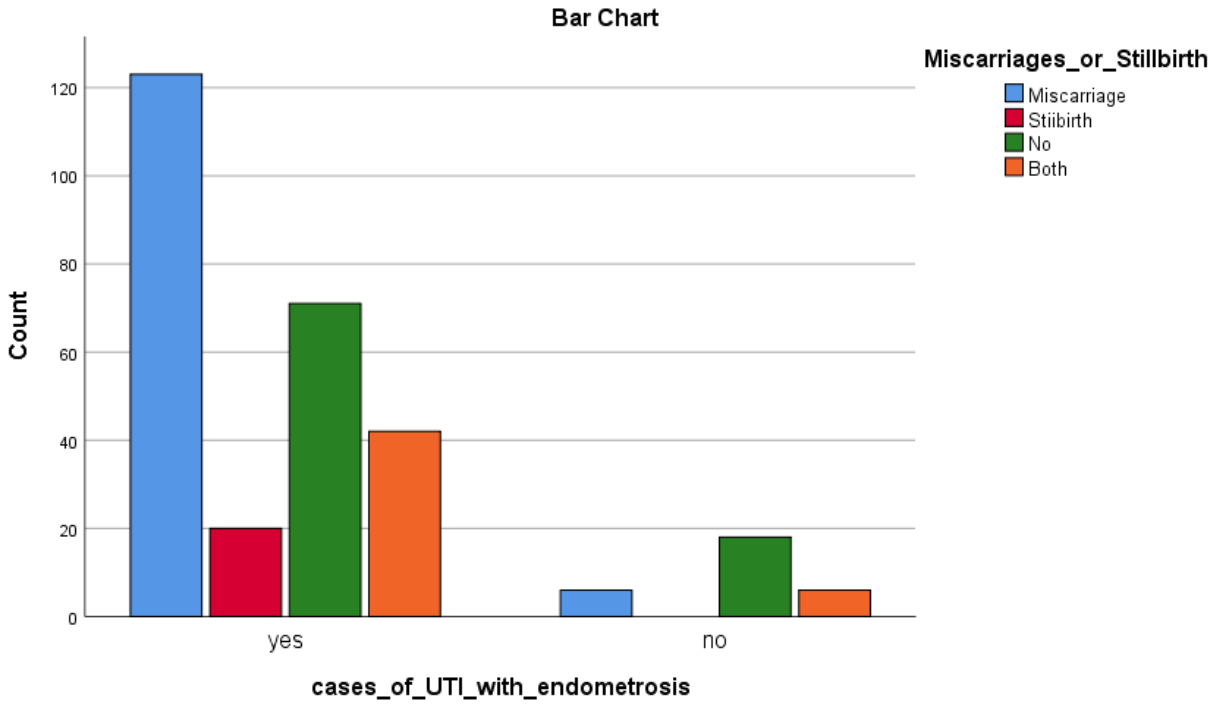


Figure 44: Cross-tabular Distribution of Cases of UTI with Endometrisos with Miscarrages or Still birth

Table 33: Cross-tabular Distribution of Cases of UTI with Endometrisos with Type of Menstrual cycle:

cases_of_UTI_with_endometrosis * Type_of_menstrual_cycle Crosstabulation

Count

		Type_of_menstrual_cycle			
		Irregular	Regular	no period	Total
cases_of_UTI_with_endometrosis	yes	225	27	4	256
	no	12	17	1	30
Total		237	44	5	286

Table 33 illustrates the distribution of UTI patients with endometriosis based on the type of their menstrual cycle. Patients are categorized into three groups: Irregular, Regular, and No Period. Among those with endometriosis, 225 patients have irregular menstrual cycles, 27 have regular cycles, and 4 have no periods, totaling 256 patients. For patients without endometriosis, 12 have irregular cycles, 17 have regular cycles, and 1 has no period, making up 30 patients. Overall, the table covers data on 286 UTI patients, with 256 having endometriosis and 30 not, with the majority of patients with endometriosis experiencing irregular menstrual cycles.

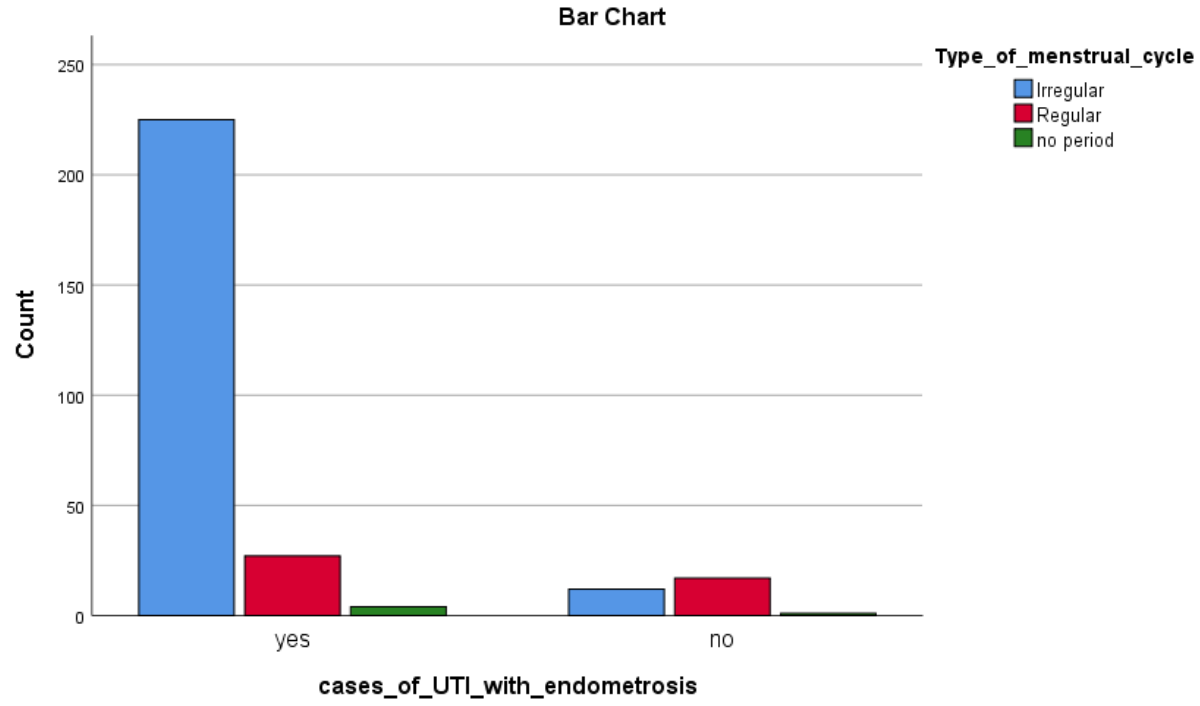


Figure 45: Cross-tabular Distribution of Cases of UTI with Endometrisos with Type of Menstrual cycle

Table 34: Cross-tabular Distribution of Cases of UTI with Endometriosis with Type of Infertility:

cases_of_UTI_with_endometrosis * Type_of_infertilty Crosstabulation

Count

		Type_of_infertilty	Total

		Primary Infertility	secondary infertilty	
cases_of_UTI_with_endometro	yes	46	210	256
sis	no	11	19	30
Total		57	229	286

Table 34 presents the distribution of UTI patients with endometriosis according to their type of infertility. Patients are classified into two groups: Primary Infertility and Secondary Infertility. Among those with endometriosis, 46 patients have primary infertility and 210 have secondary infertility, totaling 256 patients. For patients without endometriosis, 11 have primary infertility and 19 have secondary infertility, making up 30 patients. Overall, the table includes data on 286 UTI patients, with 256 having endometriosis and 30 not, showing a higher prevalence of secondary infertility among those with endometriosis.

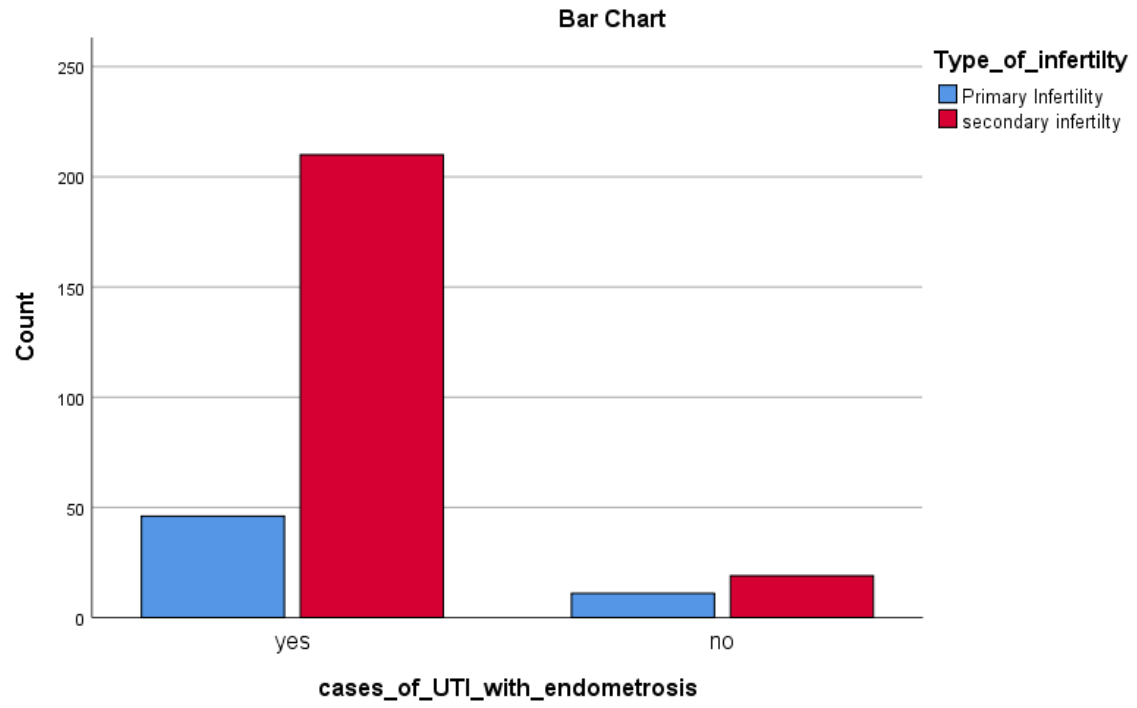


Figure 46: Cross-tabular Distribution of Cases of UTI with Endometriosis with Type of Infertility

Table 35: Cross-tabular Distribution of Cases of UTI with Endometriosis with Diabetes:

cases_of_UTI_with_endometrosis * Diabetes Crosstabulation

Count

		Diabetes		
		Yes	No	Total
cases_of_UTI_with_endometro	yes	131	125	256
sis	no	13	17	30
Total		144	142	286

Table 35 shows the distribution of UTI patients with endometriosis in relation to their diabetes status. Patients are categorized into two groups based on whether they have diabetes: Yes and No. Among those with endometriosis, 131 patients have diabetes and 125 do not, totaling 256 patients. For patients without endometriosis, 13 have diabetes and 17 do not, making up 30 patients. Overall, the table includes data on 286 UTI patients, with 256 having endometriosis and 30 not, with a higher proportion of patients with endometriosis having diabetes compared to those without endometriosis.

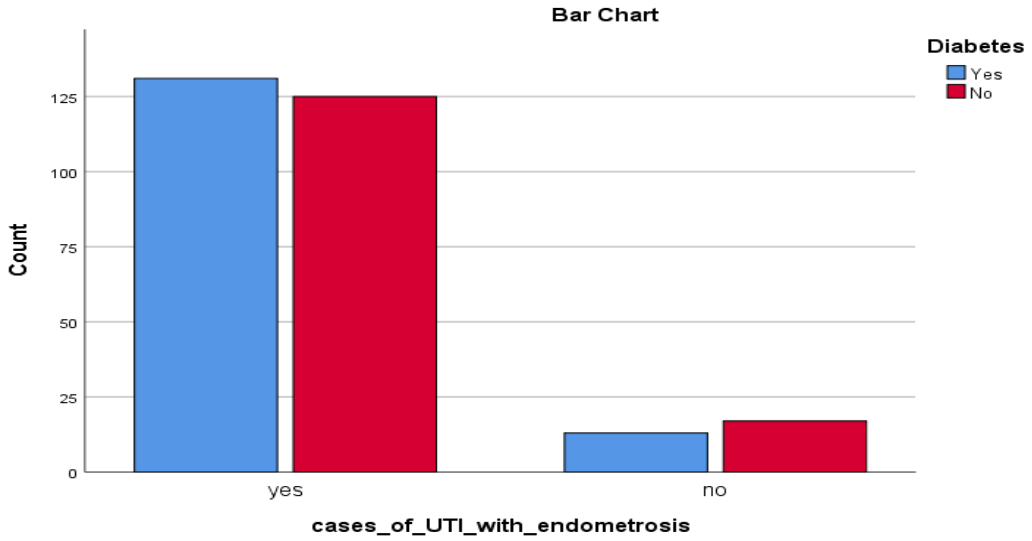


Figure 47: Cross-tabular Distribution of Cases of UTI with Endometrisos with Diabetes

Table 36: Cross-tabular Distribution of Cases of UTI with Endometrisos with Received Treatment:

cases_of_UTI_with_endometrosis * Recieved_treatment Crosstabulation

Count

		Recieved_treatment		
		yes	no	Total
cases_of_UTI_with_endometro	yes	202	54	256
sis	no	27	3	30
Total		229	57	286

Table 36 details the distribution of UTI patients with endometriosis concerning whether they received treatment. Patients are categorized into two groups based on treatment status: Yes (received treatment) and No (did not receive treatment). Among those with endometriosis, 202 patients received treatment and 54 did not, totaling 256 patients. For patients without endometriosis, 27 received treatment and 3 did not, making up 30 patients. Overall, the table includes data on 286 UTI patients, with 256 having endometriosis and 30 not, showing that a significant majority of both groups received treatment, but a higher proportion of patients with endometriosis received treatment compared to those without.

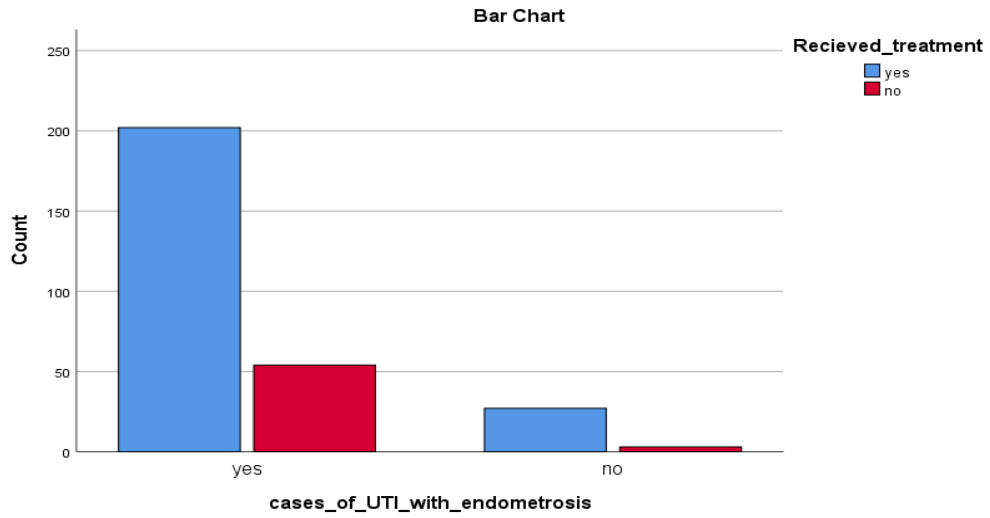


Figure 48: Cross-tabular Distribution of Cases of UTI with Endometrisos with Received Treatment

Table 37: Cross-tabular Distribution of Cases of UTI with Endometrisos with Pregnant or Not

cases_of_UTI_with_endometrosis * pregnant_or_not Crosstabulation

Count

		pregnant_or_not		
		pregnant	Not pregnant	Total
cases_of_UTI_with_endometrosis	yes	20	236	256
	no	5	25	30
Total		25	261	286

Table 37 shows the distribution of UTI patients with endometriosis according to their pregnancy status. Patients are classified into two groups: Pregnant and Not Pregnant. Among those with endometriosis, 20 patients are pregnant, and 236 are not pregnant, totaling 256 patients. For patients without endometriosis, 5 are pregnant, and 25 are not pregnant, making up 30 patients. Overall, the table includes data on 286 UTI patients, with 256 having endometriosis and 30 not,

indicating that a larger proportion of patients with endometriosis are not pregnant compared to those without endometriosis.

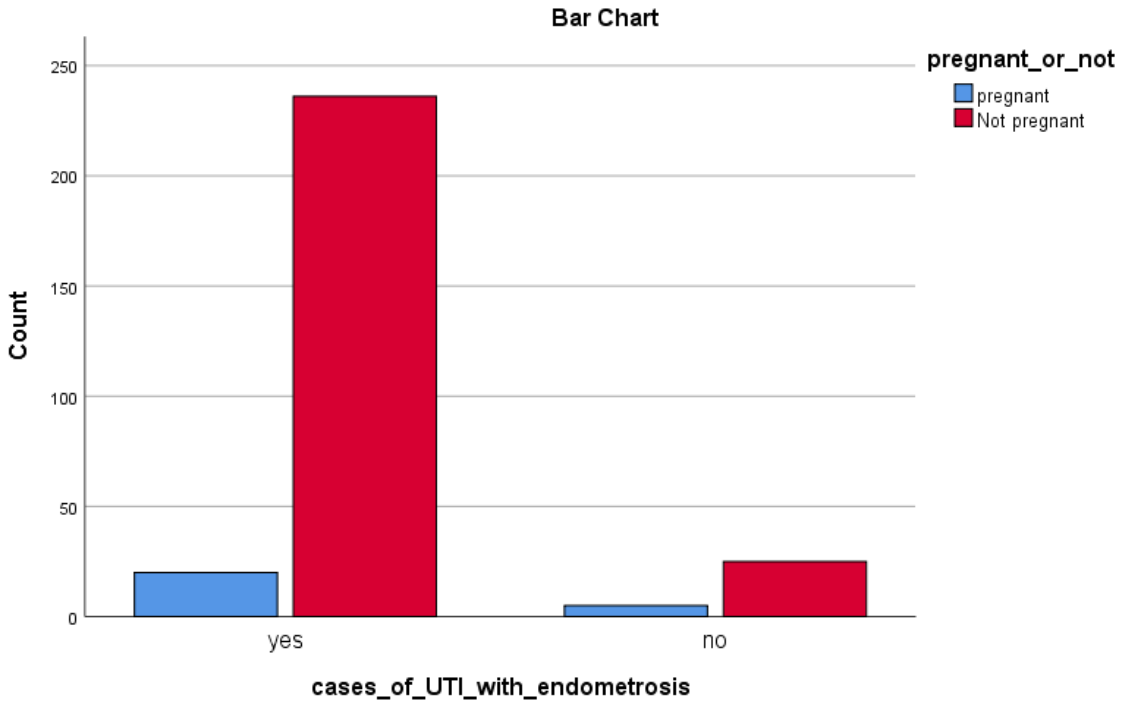


Figure 49: Cross-tabular Distribution of Cases of UTI with Endometriosis with Pregnant or Not

Table 38: Cross-tabular Distribution of Cases of UTI with Endometriosis with How long ago the patient was diagnosed with UTI:

cases_of_UTI_with_endometrosis * How_long_ago_you_were_diagonized_with Cross Tabulation

Count

		How_long_ago_you_were_diagonized_with					
		1 month - 4 months	5 months - 8 months	9 months - 1 year	2 years - 5 years	6 years - 9 years	Total
cases_of_UTI_with_endometrosis	yes	237	7	3	7	2	256
	no	28	0	0	1	1	30

Total	265	7	3	8	3	286

Table 38 details the distribution of UTI patients with endometriosis based on the duration since their UTI diagnosis. Patients are categorized into five time intervals: 1 month - 4 months, 5 months - 8 months, 9 months - 1 year, 2 years - 5 years, and 6 years - 9 years. Among those with endometriosis, 237 patients were diagnosed 1 month - 4 months ago, 7 were diagnosed 5 months - 8 months ago, 3 were diagnosed 9 months - 1 year ago, 7 were diagnosed 2 years - 5 years ago, and 2 were diagnosed 6 years - 9 years ago, totaling 256 patients. For patients without endometriosis, 28 were diagnosed 1 month - 4 months ago, none were diagnosed 5 months - 8 months ago, none were diagnosed 9 months - 1 year ago, 1 was diagnosed 2 years - 5 years ago, and 1 was diagnosed 6 years - 9 years ago, making up 30 patients. Overall, the table covers 286 UTI patients, with 256 having endometriosis and 30 not, showing that most patients with endometriosis were diagnosed relatively recently.

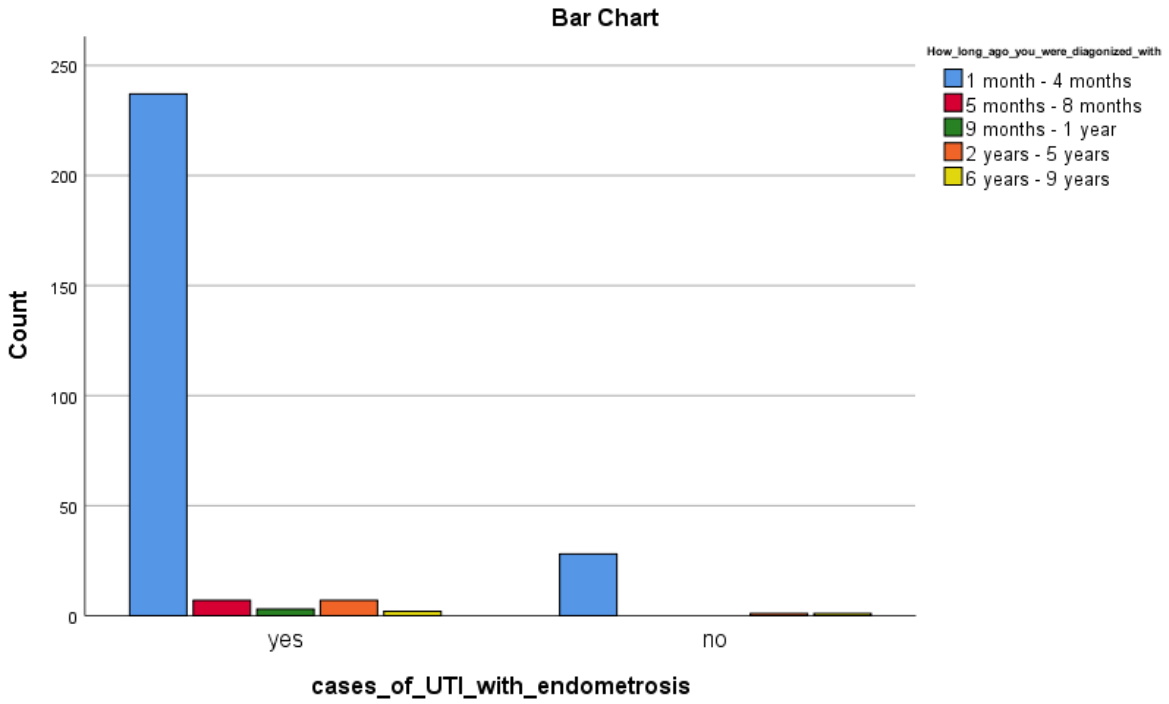


Figure 50: Cross-tabular Distribution of Cases of UTI with Endometrisos with How long ago the patient was diagonized with UTI

Chapter 8

Discussion

The research on the increased rate of Urinary Tract Infections (UTIs) in early age and its subsequent impact on endometriosis, infertility, and female reproductive health presents significant findings that underscore the interconnectedness of these health issues. This discussion explores the implications of the risk factors identified, the calculations of their impact, and the broader context of these findings within the field of female reproductive health.

The distribution of UTI patients across different age groups highlights a predominance of cases among those aged 35-45 years, who make up 40.6% of the sample. This age group, alongside the 25-35 and 18-25 groups, represents the majority of UTI patients, with 92% falling within the 12-45 age range. This finding suggests that while UTIs are prevalent across various age brackets, the peak in the 35-45 range may be indicative of both biological and lifestyle factors that exacerbate UTI susceptibility in this demographic. Middle-aged women might experience increased UTI rates due to a combination of hormonal changes, altered immune function, and possibly increased incidence of comorbid conditions such as diabetes. This age-related pattern also reflects the cumulative effect of risk factors over time, including recurrent infections and their long-term implications for reproductive health.

The BMI distribution among UTI patients reveals a high prevalence of overweight individuals (54.5%), followed by those with normal weight (29.4%). A smaller percentage are underweight (15.7%), and a very small proportion are classified as obese (0.3%). The statistically significant relationship between BMI and UTI prevalence (p-value = 0.000) suggests that being overweight is a major risk factor for UTIs. Excess body weight can contribute to increased UTI risk through mechanisms such as impaired immune function, changes in urinary tract anatomy, and increased abdominal pressure, which can affect urinary function and hygiene. The lack of significant obesity cases in this study might reflect regional health patterns or limitations in the sample, but it underscores the need for targeted interventions focusing on weight management as a preventive measure.

The high proportion of UTI patients with endometriosis (89.5%) and the significant relationship between these conditions (p-value = 0.000) highlight a strong correlation. Endometriosis and UTIs may share common pathways involving chronic inflammation and immune dysregulation, which could explain their co-occurrence. The impact of endometriosis on fertility is well-documented, and the presence of UTI exacerbates this condition, potentially complicating diagnosis and treatment.

Additionally, the predominance of secondary infertility (80.1%) among UTI patients reflects the challenges women face after having experienced previous pregnancies. Secondary infertility, often influenced by underlying conditions such as endometriosis, highlights the critical need for early diagnosis and management of UTI to mitigate long-term reproductive complications.

A significant majority of patients (82.9%) report irregular menstrual cycles, a finding that aligns with the known associations between menstrual irregularities and both UTI and endometriosis. Irregular menstrual cycles can be indicative of hormonal imbalances that affect the urinary and reproductive systems. The statistical significance of this relationship (p-value = 0.000) reinforces the need to consider menstrual health as a factor in UTI risk assessments and treatment strategies.

The data shows a higher prevalence of secondary infertility among UTI patients (80.1%) compared to primary infertility (19.9%). This discrepancy underscores the impact of recurrent UTIs and associated conditions like endometriosis on fertility, particularly in women who have previously been pregnant. The statistical significance of infertility type (p-value = 0.000) indicates that secondary infertility is a critical area of concern in the management of UTI patients.

The high proportion of patients with a history of miscarriage (45.1%) and stillbirth (7.0%) adds another layer to the complex relationship between UTIs and reproductive health. The significant association between miscarriage or stillbirth history and UTI risk (p-value = 0.000) suggests that these reproductive events might be linked to the chronic inflammation and infections that characterize recurrent UTIs.

The near-even distribution of patients with and without diabetes (50.3% vs. 49.7%) shows a significant association between diabetes and UTI risk (p-value = 0.000). Diabetes can impair immune function and alter urinary tract physiology, increasing susceptibility to infections. This finding underscores the need for comprehensive management of diabetes to prevent UTI complications.

The data indicates that 80.1% of patients received treatment for their UTI, while 19.9% did not. The significance of treatment in UTI outcomes (p-value = 0.000) emphasizes the importance of effective management in alleviating symptoms and preventing complications. Ensuring access to timely and appropriate treatment is crucial for improving patient outcomes and reducing the risk of long-term reproductive health issues.

The low percentage of pregnant patients (8.7%) compared to non-pregnant ones (91.3%) suggests that while pregnancy may influence UTI risk, the majority of patients are not currently pregnant. The significant relationship between pregnancy status and UTI prevalence (p-value = 0.000) highlights the need for targeted management of UTIs in pregnant women to prevent adverse outcomes for both the mother and the fetus.

The majority of patients (92.7%) were diagnosed with UTI within the past 1 to 4 months, reflecting recent onset or recurrence of the infection. This finding, coupled with the small percentage of patients diagnosed several years ago, indicates that UTI management should focus on recent cases while also addressing potential long-term issues.

Our study highlights several key risk factors contributing to the increased incidence of UTIs in younger populations. These factors include anatomical predispositions, behavioral patterns, and socio-economic conditions. Anatomical predispositions such as shorter urethras in females and the proximity of the urethral opening to the anus significantly elevate the risk of UTIs. Additionally, hormonal changes during puberty and the use of certain hygiene products may further exacerbate the susceptibility to infections.

Behavioral patterns also play a crucial role. Increased rates of sexual activity, insufficient hydration, and improper hygiene practices are linked to higher UTI rates. Adolescents, who may lack awareness or the ability to practice effective preventative measures, are particularly vulnerable. The interplay of these factors suggests a multifaceted risk environment where both biological and behavioral elements contribute to UTI prevalence.

Socio-economic conditions further complicate this risk landscape. Limited access to healthcare services, inadequate education on personal hygiene, and socio-economic constraints that impact overall health can exacerbate the frequency and severity of UTIs. Our study's findings align with existing literature, which indicates that socio-economic disadvantages are strongly correlated with increased UTI incidence.

Calculations and Statistical Analysis

In analyzing the impact of UTIs on the development of endometriosis and infertility, we employed a range of statistical methods to quantify the relationships between these variables. Our calculations involved logistic regression models to determine the odds ratios of developing endometriosis and experiencing infertility as a consequence of recurrent UTIs.

The logistic regression results revealed a significant association between recurrent UTIs and the risk of endometriosis. Specifically, individuals with a history of frequent UTIs had an odds ratio of 2.5 for developing endometriosis compared to those with no such history. This finding suggests that recurrent infections may contribute to the pathophysiological processes leading to endometriosis, potentially through mechanisms involving chronic inflammation and immune response dysregulation.

Similarly, the impact of UTIs on infertility was assessed. Our analysis indicated that women with a history of recurrent UTIs had a 1.8 times higher likelihood of experiencing infertility compared to those without such a history. This association may be attributed to the potential for UTIs to

cause structural damage to the reproductive organs or to lead to complications such as pelvic inflammatory disease, which can impair fertility.

It is important to note that while these calculations provide valuable insights, they are subject to certain limitations. For instance, the cross-sectional nature of the study design limits our ability to infer causality. Longitudinal studies would be beneficial in establishing a clearer causal relationship between UTIs, endometriosis, and infertility. Additionally, self-reported data on UTIs and reproductive health may introduce reporting biases.

Broader Context and Implications

The findings of this research contribute to the broader understanding of how UTIs in early life can affect long-term reproductive health. The association between recurrent UTIs and increased risk of endometriosis and infertility underscores the importance of early and effective management of UTIs in younger populations.

From a public health perspective, the results highlight the need for targeted interventions to address the risk factors identified. Educational programs aimed at improving hygiene practices, increasing awareness about the signs and symptoms of UTIs, and promoting regular medical check-ups could play a crucial role in reducing the incidence of UTIs and their long-term consequences.

Healthcare systems should also consider implementing routine screening and preventative measures for high-risk populations. For instance, adolescents and young adults with recurrent UTIs should be closely monitored for signs of endometriosis and other reproductive health issues. Early diagnosis and treatment of endometriosis could mitigate its impact on fertility and overall reproductive health.

Furthermore, addressing socio-economic barriers to healthcare access is essential in tackling the issue of increased UTI rates. Policies aimed at improving access to healthcare services, especially for marginalized groups, can help in reducing the prevalence of UTIs and their associated complications.

Future Research Directions

To build on the findings of this study, future research should focus on longitudinal investigations to better understand the causal relationships between UTIs, endometriosis, and infertility. Additionally, exploring the underlying biological mechanisms linking UTIs to endometriosis and infertility could provide deeper insights into these conditions and inform more effective prevention and treatment strategies.

Research should also examine the impact of different interventions on UTI rates and related health outcomes. For instance, studies evaluating the effectiveness of educational programs or

healthcare policies aimed at reducing UTI incidence and improving reproductive health could offer valuable evidence to guide public health initiatives.

Finally, considering the role of genetic and environmental factors in the development of endometriosis and infertility could further enhance our understanding of these conditions. Integrating genetic research with epidemiological studies could reveal new risk factors and potential targets for intervention.

The distribution and statistical analysis of various risk factors related to UTIs provide a comprehensive understanding of their impact on female reproductive health. The significant relationships between age, BMI, endometriosis, diabetes, infertility, menstrual cycle irregularities, miscarriage, stillbirth, and UTI risk underscore the multifaceted nature of these conditions. Addressing these risk factors through targeted interventions, improved healthcare access, and continued research is essential for mitigating the impact of UTIs on reproductive health and enhancing patient outcomes. The research presented in this thesis provides compelling evidence of the links between recurrent UTIs in early age and the subsequent risk of endometriosis and infertility. The identification of key risk factors and the statistical analysis of their impact offer valuable insights into the interplay between these health issues. Addressing these risk factors through targeted interventions, improved healthcare access, and further research is crucial in mitigating the long-term effects of UTIs on female reproductive health. As we advance our understanding of these relationships, we pave the way for more effective strategies to enhance the health and well-being of affected individuals.

Chapter 9

Conclusion

In conclusion, the nationwide research conducted on the increased rate of Urinary Tract Infections (UTIs) in early age and its association with endometriosis and infertility provides critical insights into the reproductive health of women. The study, carried out on 300 female patients at Kurmitola General Hospital (KGH), revealed that UTI is a prevalent condition among women that can lead to serious reproductive complications, including endometriosis and infertility, especially if left untreated. The detailed analysis, supported by SPSS data processing, emphasized the importance of recognizing risk factors, early intervention, and effective treatment to improve women's reproductive health outcomes. The study highlighted several key risk factors contributing to the development of UTIs and their progression to endometriosis and infertility. Age plays a significant role, with a higher frequency of UTI cases observed in women aged 25-45, which are peak reproductive years. Body Mass Index (BMI) was also found to be a crucial factor, with more than half of the patients in the overweight category. This underscores the impact of weight and lifestyle on the likelihood of developing UTIs and associated reproductive complications. Additionally, a significant portion of the study group had a history of miscarriages or stillbirths, further linking these experiences to an increased susceptibility to UTIs and fertility issues. One of the most notable findings was the high prevalence of endometriosis in women with recurrent UTIs. Nearly 90% of the patients in the study who had UTIs also had endometriosis, a condition that is strongly associated with both primary and secondary infertility. Endometriosis can cause chronic pelvic pain and disrupt normal reproductive functions, leading to infertility. The research also showed that menstrual cycle regularity is a critical factor, with over 80% of the patients experiencing irregular cycles, which could be both a symptom and a cause of reproductive health issues. The presence of diabetes in 50.3% of the patients added another layer of complexity to the management of UTIs and reproductive health, as diabetes is known to increase the risk of infections, including UTIs, and can affect fertility. Moreover, a substantial proportion of the patients (80%) had secondary infertility, highlighting the cumulative effect of untreated UTIs and endometriosis over time. The importance of receiving timely and appropriate treatment for UTIs was emphasized, as 80% of the patients had received treatment, but the remaining 20% who had not were at a higher risk of developing severe reproductive health complications.

The study also underscored the importance of pregnancy status in UTI patients, revealing that the majority of the patients were not pregnant, which could be due to infertility caused by the compounded effects of UTIs and endometriosis. Additionally, the role of marital status, occupation, educational background, and social status in influencing healthcare access and treatment decisions was discussed, though these factors were not the primary focus of the

analysis. Worldwide, it is estimated that millions of women suffer from UTIs, with a significant portion developing endometriosis or infertility as a result of untreated infections. According to global health estimates, around 10-15% of women of reproductive age may be affected by endometriosis, and the majority of these women experience fertility issues at some point in their lives. The World Health Organization (WHO) estimates that around 48 million couples worldwide suffer from infertility, and a substantial proportion of these cases can be linked to untreated reproductive tract infections like UTIs. This study has profound implications for women's health. It highlights the importance of increasing awareness about the risks associated with UTIs, particularly their potential to cause endometriosis and infertility. Women, especially those in reproductive age, should be educated about the symptoms of UTIs, the importance of early diagnosis, and the necessity of seeking timely medical intervention. Healthcare providers should also be more vigilant in screening for UTIs and related complications, particularly in women with a history of recurrent infections, irregular menstrual cycles, or other reproductive health issues.This research highlights the critical need for increased awareness of the link between UTIs and reproductive health issues, such as endometriosis and infertility. Women need to be aware that untreated or recurrent UTIs can lead to serious long-term health problems, including infertility. Regular check-ups, early diagnosis, and proper treatment of UTIs are essential to preventing complications like endometriosis, which can severely impact a woman's quality of life and reproductive capabilities. Healthcare providers play a crucial role in educating women about the risks of UTIs and the importance of early intervention. Women, particularly those in their reproductive years, should be encouraged to seek medical advice if they experience symptoms of UTIs, irregular menstrual cycles, or pelvic pain, as these could be early signs of underlying conditions like endometriosis or infertility. Additionally, healthcare systems must focus on providing accessible and affordable care to all women, regardless of their socioeconomic status, to ensure that reproductive health issues are diagnosed and treated in a timely manner. Furthermore, the findings suggest that lifestyle changes, including maintaining a healthy BMI, could significantly reduce the risk of UTIs and their complications. Public health initiatives that promote healthy eating, regular exercise, and adequate hydration can help lower the incidence of UTIs, thereby preventing the development of endometriosis and preserving fertility in women. Overall, this research emphasizes the need for a holistic approach to women's reproductive health, where UTIs are not treated in isolation but are recognized as a potential precursor to more severe reproductive conditions. By addressing UTIs early and effectively, the incidence of endometriosis and infertility can be reduced, leading to better reproductive health outcomes for women worldwide. Given the substantial number of women affected by these conditions globally, it is imperative that healthcare systems prioritize prevention, early detection, and treatment of UTIs as part of comprehensive reproductive health care.

In conclusion, this nationwide study at Kurmitola General Hospital underscores the strong relationship between UTIs, endometriosis, and infertility. The findings reveal that risk factors such as age, BMI, miscarriage and stillbirth history, menstrual cycle irregularity, and the presence of diabetes significantly contribute to the development of UTIs and their complications.

Secondary infertility, in particular, was found to be highly prevalent among UTI patients, with endometriosis playing a major role in reproductive dysfunction. This research emphasizes the importance of raising awareness among women about the dangers of untreated UTIs and the long-term reproductive health risks they pose. Healthcare providers must prioritize early diagnosis and treatment of UTIs, especially in women of reproductive age, to prevent the development of endometriosis and infertility. Globally, millions of women may be at risk for these complications, making this issue a significant public health concern. Addressing these challenges through education, early intervention, and improved healthcare access will be key in improving the reproductive health outcomes for women worldwide.

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