“Infertility of women in Focus: Risk factors and predictive Outcome among Women diagnosed with PCOS of Bangladesh”

Submitted By

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A thesis submitted to the Department of Mathematics and Natural Sciences in partial fulfillment of the requirements for the degree of Bachelor of Science in Biotechnology

Mathematics and Natural sciences

Brac University

December, 2023

Declaration

It is thus declared that:

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2. The thesis does not include any previously published or third-party written content, unless properly cited through complete and correct referencing

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Abstract

Polycystic ovary syndrome (PCOS) is a common endocrine disorder in women, and it is the main cause of infertility in women of reproductive age due to anovulation. It affects women during their reproductive years and one might not have regular periods or perhaps experience lengthy menstrual cycles. Also, women suffering from PCOS have a hormone called androgen present in excess, many small sacs of fluid develop along the ovary's outer edge, cysts exist, and eggs that grow inside the little cysts that are fluid-filled (called follicles). Infertility is a worldwide health concern that affects millions of people of reproductive age. Despite widespread awareness, infertility issues like PCOS is still regarded as a health issue in many impoverished countries, including Bangladesh. To add, this study aims to determine the risk factors that affect infertility in both male and females and also finds out the effective treatments among the current ones. This investigation was conducted at two tertiary Hospitals. A total of 70 patients were enrolled in the research. Out of the 70 participants, 63 women tested positive for PCOS. Most of the patients were of age 20-25 by 57.1%, followed by age 26-30 and 31-35 by 31.7% and 7.9% respectively, and it was found that only 3.2% were the ages of 36-40. Most women who were PCOS patients and infertile were in their early 20s. Among the PCOS patients, 57.1% had irregular cycles, followed by 20.6 who had infrequent cycles, 15.9% were Oligomenorrhoea and only 6.3% had regular cycles. In case of hormone, 85.7% patients had normal levels of S. Testosterone whereas 14.3% had high S. Testosterone. To add, 54% had normal S. Prolactin whereas 46% had high S. Prolactin levels, 71.4% were normal, 25.4% suffered from Hypothyroidism and 3.2% from Hyperthyroidism. This study also looks into the various symptoms and issues that people with PCOS face. In developing countries such as ours, most cases of this disease are treated with only an ovarian cyst examination and a blood test. Even though PCOS is a common hormonal condition, it must be addressed because it can lead to serious complications such as type 2 diabetes and high blood pressure.

Keywords: PCOS, Oligomenorrhoea, Hypothyroidism, Hyperthyroidism and cysts .

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Dedication

"This work is dedicated to my parents, siblings, friends and my beloved Jack."

Tshering Choden

December, 2023.

"This work is dedicated to my parents, sister and friends for their support."

Fahmida Chowdhury

December. 2023

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Tshering Choden and Fahmida Chowdhury

December, 2023

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PCOS: Polycystic Ovarian Syndrome

FSH: Follicle-stimulating hormone

LH: Luteinizing hormone

DFAB: Designated female at birth

DMAB: Designated male at birth

FT4: free thyroxine

TSH: thyroid stimulating hormone

PID: Pelvic inflammatory disease

POF: Primary or Premature ovarian failure

IVF: in vitro fertilization

Chapter 1 Introduction

Reproduction is a defining characteristic that sets living organisms apart from non-living entities. Reproduction is the biological mechanism by which a parent organism generates children that inherit their genetic or biological characteristics. Reproduction is the paramount factor on our planet that guarantees the perpetuation of species. Reproduction can be classified into two distinct sorts. Reproduction can occur in two ways: asexual reproduction and sexual reproduction. Humans, as constituents of the animal realm, engage in sexual reproduction. Sexual reproduction necessitates the involvement of two parents. This is a reproductive process in which two individuals of different sexes merge their genetic information to produce unique offspring. Genetic information, often known as hereditary data, is retained on chromosomes located within the nucleus of specialized sex cells called gametes. The male gamete is referred to as sperm, whereas the female gamete is referred to as either egg or ovum. The fusion of these two gametes occurs during sexual reproduction, resulting in the formation of a zygote that ultimately gives rise to an embryo. Fertilization takes place within the fallopian tubes. The fallopian tube serves as the conduit from the ovaries to the uterus.

The female reproductive system is an intricate and intricate part of the female anatomy. Adherence to appropriate precautions can help prevent infections, injuries, and several other issues, including certain chronic conditions. Reproductive health pertains to an individual's overall well-being in regards to reproduction during all phases of life. It is a component of sexual and reproductive rights.

Reproductive health, as defined by the World Health Organisation (WHO), encompasses the overall physical, mental, and social well-being related to the reproductive system and its functions. It goes beyond the mere absence of illness or weakness (World Health Organisation, June 1946)."Properly maintaining female reproductive organs is crucial for preventing a range of unpleasant and uncomfortable reproductive disorders, as well as the transmission of sexually transmitted diseases." Ensuring the normal functioning of one's reproductive system is crucial for maintaining a healthy sexual life. Likewise, it is crucial for the growth and well-being of children. The majority of the world's 1.3 million female deaths each year are attributed to women's reproductive health difficulties.

According to a report, the condition of infertility impacts 15% of couples (Brugo-Olmedo et al.2001). The treatment for female infertility commences with a comprehensive evaluation of the patient's medical background, followed by a thorough examination of the physical, gynecological, and endocrine aspects. The cause of infertility will be investigated by many procedures including assessment of ovarian function and reserve, examination for uterine abnormalities, and evaluation of tubal permeability. Polycystic ovary syndrome (PCOS) is a common gynecological and endocrine disorder that impacts 7 to 15% of women in

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their reproductive years. It is a significant contributor to infertility (Collee et al., 2021). Various therapies, including behavioral, pharmacological, and surgical approaches, have been studied to enhance the fertility of women with PCOS. Implementing lifestyle modifications, such as ceasing smoking, engaging in regular physical activity, and achieving weight loss when necessary, is of utmost importance. If there are no other specific causes of infertility in men or women, clomiphene citrate is the initial choice for medical therapy of infertility in women with PCOS. Metformin should not be only utilized for infertility when there is no underlying metabolic dysfunction, and a promising new medicine called myo inositol is emerging. When conventional medical treatment proves ineffective, surgical interventions targeting the enhancement of ovulation and pregnancy rates serve as an alternate option. Ovarian drilling, performed through laparoscopy or transvaginal hydrolaparoscopy, is being utilized as a therapy for infertility. In the treatment of PCOS, in vitro maturation and fertilization are employed as a final resort.

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Chapter 2 Female Reproductive System

2.1 Introduction

The human body is composed of various organ systems. Every organ system possesses intricate structural organization and regulatory processes that give rise to intricate, temporary, sporadic, and non-linear behavior. The human body is a complex system where several organ systems interact through feedback mechanisms across diverse spatial and temporal scales to optimize and coordinate their functions. The interplay between organ systems is crucial for the maintenance of well-being and the generation of different physiological conditions, including wakefulness and sleep, as well as different stages of sleep such as light and deep sleep. Furthermore, it is also responsible for the states of consciousness and unconsciousness. An interference or cessation of organ communication can result in dysfunctions in specific systems or a collapse of the entire organism, such as fever, hypertension, pneumonia, coma, and multi-organ failure.

There are 11 types of organ systems in the human body. They are:

1. Integumentary system:

The integumentary system is the outer layer of the body. It consists of skin, hair, nails, and glands. These organs and structures are the first line of defense against bacteria and help to protect against injuries and sunlight. It works with other systems in our body to keep it in balance.

Functions:

1. Offers a safeguarding shield against mechanical, thermal, and physical harm as well as hazardous substances.
2. Mitigates the detrimental impact of UV radiation.
3. Serves as a tactile receptor and thermoreceptor.
4. Retains moisture effectively.
5. Assists in maintaining optimal temperature.
6. An immunological organ designed to identify and respond to infections and other similar conditions.

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2. Skeletal system:

The human skeletal system functions as the internal framework of the body. This structure comprises numerous distinct bones and cartilages. In addition, there are fibrous connective tissue bands, ligaments, and tendons that are closely associated with various elements of the skeleton. The musculoskeletal system is an alternative term for this system. The skeletal system comprises seven components: the skull, hyoid bone, spine, thorax, shoulder, upper limb, and hip.

Functions:

· The skeletal system works as a support structure for our body.

· It gives the body its shape, allows movement, makes blood cells, provides protection for organs, and stores minerals.

3. Muscular system:

The muscular system consists of specialized cells known as muscle fibers. The primary purpose of it is contractility. Muscles that are connected to bones or internal organs and blood vessels are accountable for facilitating movement. Virtually all bodily movement is a consequence of muscle contraction.

Functions: ·

1. Muscles enable voluntary movement, speech, and mastication.
2. The autonomic nerve system controls vital physiological processes such as cardiac rhythm, breathing, and digestion.

4. Endocrine system:

Glands and organs secrete hormones into the bloodstream, allowing them to be transported to various tissues and organs in the body. The endocrine system regulates various vital processes in the body, such as growth, metabolism, and reproduction, through the secretion of hormones. Endocrine hormones regulate mood, growth, development, and organ function. This system

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controls the secretion of each hormone. The primary glands responsible for hormone production are:

1. The hypothalamus, situated in the brain, regulates our endocrine system.
2. Pituitary gland: This little gland is approximately the size of a pea.
3. The thyroid is a gland located at the anterior of the neck that has a form resembling that of a butterfly.

5. Cardiovascular system:

The cardiovascular system, also known as the blood circulation system, transports nutrition and oxygen to every cell in the body. The cardiovascular system comprises the heart and the network of blood arteries that traverse the entire body. Arteries transport blood away from the heart, whereas veins return it to the heart. Functions:

1. Facilitates the transportation of oxygen and elimination of carbon dioxide.
2. Supplies cells with essential nutrients.
3. Transports metabolic waste to excretory organs for elimination.
4. Enhances the body's immune system to defend against diseases and infections.

6. Lymphatic system:

The lymphatic system functions as the body's waste disposal system. It regulates the fluid balance in bodily tissues by eliminating any fluid that escapes from blood vessels. The components of this system encompass the bone marrow, spleen, thymus, lymph nodes, and lymphatic veins, which are a complex network of slender tubes responsible for transporting lymph and fluid blood cells. Lymphatic vessels, similar to blood vessels, extensively spread across all bodily tissues, playing a crucial role in facilitating the efficient operation of our overall and targeted immune system. The lymphatic system performs several essential functions, including safeguarding the body against pathogens, regulating fluid balance, facilitating the absorption of lipids from the digestive tract, and eliminating cellular waste.

7. Respiratory system:

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The respiratory system comprises a network of organs which is complex and tissues that facilitate the process of respiration. The components of this system encompass the respiratory airways, pulmonary organs, and circulatory blood vessels. The muscles responsible for the functioning of our lungs are integral components of the respiratory system. The components collaborate to facilitate the distribution of oxygen throughout the organism and eliminate waste gases, such as carbon dioxide.The lungs serve as the principal component of the system of respiration. Additional respiratory organs encompass the nose, trachea, and the muscles of respiration such as the intercostal and diaphragm muscles. This system performs several roles such as facilitating the exchange of gases, maintaining acid-base balance, enabling phonation, defending against pulmonary threats, regulating metabolism, and managing bioactive substances.

8. Digestive system:

The digestive system refers to the organs responsible for the absorption, breakdown, and utilization of food and fluids by the body for energy, development, and tissue repair. Excretory byproducts that are not metabolically useful are eliminated from the body via defecation. The digestive system comprises vital organs responsible for the breakdown and processing of food and fluids. The anatomical structures encompassed in this list are the oral cavity, pharynx, esophagus, stomach, small intestine, large intestine, rectum, and anus. The digestive system comprises the salivary glands, liver, gallbladder, and pancreas, which generate digestive juices and enzymes to facilitate the digestion of food and liquids. This system is alternatively referred to as the gastrointestinal system. The digestive system performs mechanical processing, digestion, ingestion of food, secretion of water, acids, enzymes, buffers, salt, and removal of waste materials.

9. Urinary system:

The urinary system functions as a filtration mechanism, eliminating toxins and waste from our body via urine. It employs a network of tubes and channels to facilitate the passage of this waste.

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These tubes are interconnected with our circulatory and gastrointestinal systems. The urinary system facilitates the healthy functioning of our body. The urinary system comprises the bladder, urethra, kidneys, and uretus. They collaborate to filter, retain, and eliminate liquid waste from our bodies. The primary role of this system is to purify the blood and produce urine as a byproduct of waste elimination. The primary function of the renal system is to excrete waste products from the body, maintain blood volume and pressure, manage levels of electrolytes and metabolites, and control blood ph.

10. Nervous system:

The nervous system comprises the cerebral cortex, spinal cord, and an intricate network of neural pathways. This system facilitates bidirectional communication between the brain and the body. The brain governs all physiological processes of the body. The spinal cord spans from the brain to the posterior region of the body. The human body is innervated by a complex network of threadlike nerves that extend to every organ and region. The neural network facilitates the transmission of signals from the brain to other regions of the body. The nervous system comprises the central nervous system and the peripheral nervous system: The central nervous system comprises the brain and spinal cord, whereas the peripheral nervous system consists of the nerves that extend throughout the body.

Functions:

1. Regulate the internal milieu of the organism to ensure 'homeostasis' is maintained.
2. Spinal cord reflex programming.
3. Cognition and acquisition of knowledge.
4. Conscious regulation of bodily motion.

11. Reproductive system:

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The final system is the reproductive system, which holds significant significance in human existence. The human reproductive system comprises the tissues, glands, and organs that facilitate the body's production and maintenance of offspring. There exist two distinct categories of reproductive systems. The male reproductive system and the female reproductive system are two distinct systems.

The male reproductive system comprises a collection of organs that constitute both the male reproductive and urinary systems. These organs carry out the following functions within the body:

1. They generate, sustain, and convey spermatozoa (male gametes) and seminal fluid (protective liquid surrounding spermatozoa).

2. They deposit sperm into the female reproductive system.

3. They synthesize and release androgens

Hormones have a crucial role in regulating the entire male reproductive system. These substances are capable of inducing or controlling the functioning of cells or organs. The primary hormones responsible for the functioning of the male reproductive system are follicle-stimulating hormone (FSH), luteinizing hormone (LH), and testosterone.

The pituitary gland produces follicle-stimulating hormone (FSH) and luteinizing hormone (LH). The structure is situated at the cranial base and is accountable for numerous physiological processes in the organism. Follicle-stimulating hormone (FSH) is required for the process of sperm formation, also known as spermatogenesis. Luteinizing hormone (LH) promotes the synthesis of testosterone, an essential hormone for the ongoing progression of spermatogenesis. Testosterone plays a crucial role in the development of masculine attributes, such as muscular growth and strength, distribution of body fat, bone density, and sexual desire.

The female reproductive system is situated within the pelvic cavity, which is positioned in the lower region of the abdominal cavity. This system is a fascinating yet intricate subject. Proliferation can closely collaborate with the body's other systems. The female reproductive system comprises the internal and external sexual organs that facilitate the generation of new

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children. The female reproductive system in humans is underdeveloped at birth and undergoes maturation during adolescence in order to generate gametes and facilitate childbirth. The reproductive system comprises internal sex organs such as ovaries, fallopian tubes, uterus, vagina, and adrenal glands, as well as external sex organs including ovaries, genital tract, external genitalia, female sexual response, and hormone control. The female reproductive system performs various activities, including

1. the production of gametes known as eggs during the reproductive cycle.
2. Secretes sex hormones, including progesterone and estrogen, to regulate the reproductive cycle.
3. Creates an optimal setting for the process of fertilization.
4. Facilitates the initial growth of embryos, hence bolstering the duration of pregnancy.
5. Embryogenesis happens following fertilization, resulting in the development of a fetus.
6. Assists in the process of giving birth and labor.
7. Facilitates breastfeeding for the infant following delivery.

2.2 Development of the female reproductive system:

After fertilization of the egg, this system develops along with the development of primordial gonads one month after conception. Moreover, the urinary system constantly matures. The outward gender is not determined during the first eight weeks of an embryo's development within the uterus; however, the chromosomes must be analyzed during this phase for the determination of the gender and this phase is known as the "indifferent stage"(Gilbert, 2000).

In this phase, the fetal gonads and external genitalia begin to develop. "Biopotential" refers to the tissues that have the capacity of the identical group of cells in both male and female embryos differentiate into either male or female gonads.Likewise, as all the fertilized eggs naturally develop into females without the presence of any chemical stimulation, "females" are regarded as "Fundamental" sex (Gilbert, 2000). There are two types of chromosomes (package of genes) called the sex chromosome which helps in determining the genetic sex of the baby such as either X or Y. Also, the female baby has two X chromosomes(XX) whereas the male baby has one X and one Y chromosome(XY). Similarly, in men, the Y chromosome contains the gene that helps in initiating the series of events (also known as the SRY gene) that leads to the male sex organ's

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development. As females don't have Y chromosomes they lack the SRY gene and its absence results in feminine phenotype. The primitive ovary is produced from cortical cords by the epithelium of the gonads due to the absence of the SRY gene. In contrast, the presence of the SRY gene attracts other genes which initiate the development of testis. When the Leydig cells detect the testis nearby, they emit testosterone, which causes some bipotential tissues to transform into male reproductive organs. Bipotential cells do not mature into male testes in the absence of testosterone, but rather into female clitoris (Gilbert, 2000).

Both male and female embryos are identical as both have three fundamental protuberances that act the external genitalia and duct systems serve to connect the undifferentiated gonads to the external environment. throughout the embryonic stage of development. Each forming embryo contains four ducts, the fate of which has a significant influence on the biological development of men and women. The internal reproductive organs such as the uterus, uterine tubes, and a portion of the vagina in females, and the epididymis, ductus deferens, and seminal vesicles in males, originate from one of two primitive duct systems during embryonic development.
In the absence of testosterone and anti-Mullerian hormone, the Wolffian duct will degrade and the female duct, also known as the paramesonephric or Müllerian duct (also known as Female duct), will form (Admin, 2022). This suggests that the embryo in development will be a female. These ducts are divided into the Cranial, Horizontal, and Caudal portions. The Cranial and Horizontal portion develops into the Fallopian tubes. The caudal region is where the uterus, upper vaginal third, and cervix all grow. The lower two-thirds of the vagina was made up of sinovaginal bulbs, which originated from the pelvic portion of the urogenital sinus (Admin, 2022).

Moreover, the estrogens in the fetus regulate the growth of the female external genitalia. The genital tubercle only lengthens slightly to become the clitoris. The urethral folds and genital swellings do not link the development of the labia minora and labia majora. Since the urogenital groove is left open, the urethra and vaginal opening can pass through it and act as a vestibule.

Although they are there in their correct anatomical positions at birth, sexually functional adult organs are not yet functioning (Gilbert, 2000). All reproductive organs grow regularly and

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consistently up until the start of adolescence. Puberty begins with an increase in sex gland activity and the subsequent development of secondary sexual traits. At puberty, women's external genitalia become larger and begin to menstruate, which signals the start of the uterus' periodic activity. Fat is stored and mammary glands expand, giving the body the classic female contour. The hair follicles in the armpit and pubis develop thicker and more quickly.

2.3 Anatomy of the Female Reproductive System in Brief

The reproductive system of females can be categorized into three subsystems depending on its principal tasks. The three categories are primary and secondary sex organs, and secondary sex organ features. The female reproductive system consists of gonads, reproductive ducts, and external genitalia. The gonad, commonly referred to as the major sex organ, is the primary gland responsible for producing reproductive cells, known as gametes. The term used to refer to the female gonads is ovaries. The reproductive ducts comprise the fallopian tubes, uterus, and vagina. The reproductive canals, mammary glands and external genitalia comprise the secondary sex organs. Female secondary sexual features encompass the presence of body hair, a broad pelvis, and the distribution of fat in areas such as the breasts, mons pubis, belly, and hips.

The reproductive system of female is essentially composed of two distinct components. One set of genitalia is located inside, while the other set is located externally.

2.3.1 Internal Genitals

Internal genitalia includes- ovary, fallopian tube, uterus and vagina.

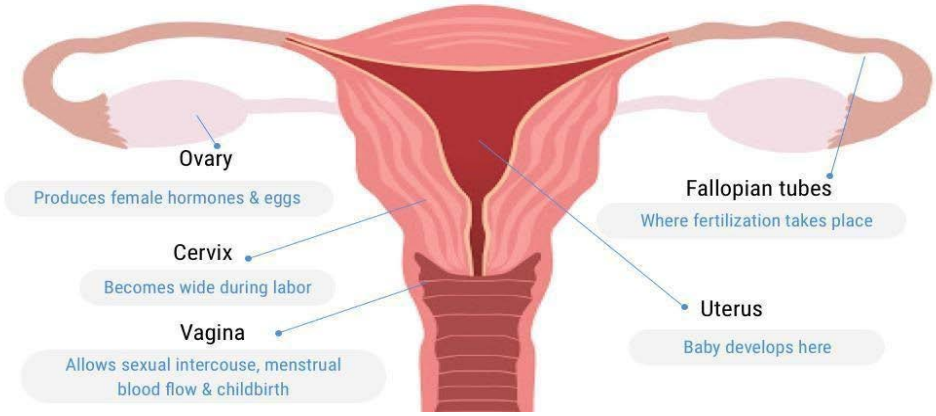

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Figure 1: Diagram of Female Reproductive System (Internal genitalia)

Ovary:

The ovaries are bilateral ovoid female gonads situated on each side of the uterus within the pelvic cavity. The dimensions of each ovary are 4 cm in length, 2 cm in width, and 1 cm in thickness, with a weight ranging from 2 to 5 grams. The ovaries serve as the principal reproductive organ responsible for the production of the egg, also known as the ovum. The endocrine system is linked to the reproductive system via the ovaries, which are part of the reproductive system. The ovary consists of four main components: the surface, tunica albuginea, cortex, and medulla. The surface is composed of Simple cuboidal epithelium, which is also referred to as the germinal epithelium. The Tunica albuginea, a connective tissue layer, provides a foundation for the germinal epithelium. The cortex of the ovary contains stroma, which is composed of connective tissue and contains ovarian follicles that house oocytes. The bone marrow is composed of loose connective tissue through which a substantial amount of blood circulates. Visible blood vessels are observed entering the hilum of the ovary.

The ovary performs various functions:

1. Production of gametes: The ovaries are responsible for the cyclical maturation and discharge of the ovum or female gametes during the process of ovulation. The developing egg undergoes maturation and transforms into follicles that are packed with fluid. A single egg is released singularly. Simultaneous maturation of several cells is also possible.
2. The ovaries release many hormones, such as estrogen, testosterone, progesterone, and inhibin, which play a role in the development of secondary sexual characteristics and the maintenance of reproductive activity in the ovaries.

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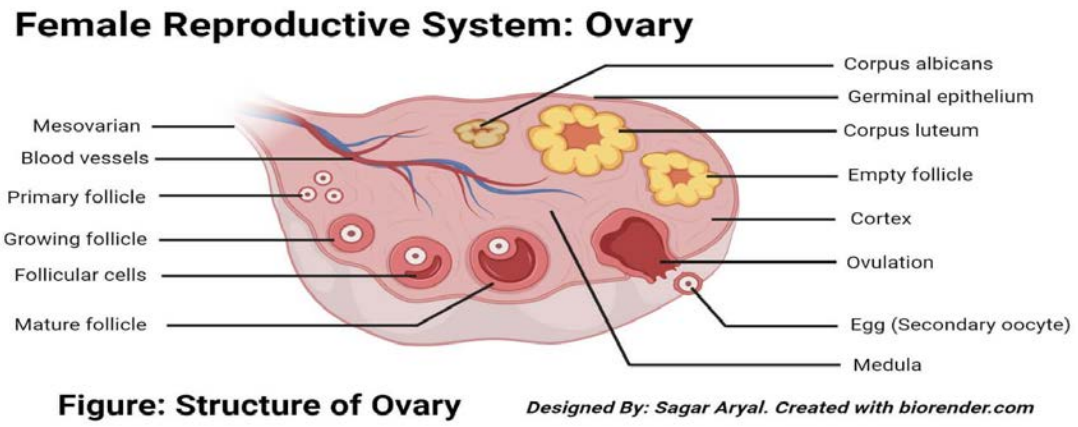

Figure 2: Diagram of Ovary

Fallopian tube (Uterine tubes):

The fallopian tubes, often referred to as oviducts, are responsible for the monthly transportation of eggs from the ovary to the uterus in the female reproductive system. After fertilization, this transport the fertilized egg to the uterus, where it implants. The length of each fallopian tube ranges from 10 to 13 cm, with a diameter of 1 to 2 cm. The tubes extend sideways from the upper part of the uterus. It is comprised of four distinct components:

1. The infundibulum is a conical structure that leads into the peritoneum of the abdominal ostia. The presence of connected fimbriae, which are finger-like extensions of mucosa, can be observed. The fimbriae extend beyond the ovaries, with the longest fimbriae, known as ovarian fimbriae, connecting to the tip of the ovum.
2. The ampulla is the most elongated segment of the tubes, measuring 5 cm in length. The structure possesses a slender boundary with a mildly undulating exterior, and the process of fertilization occurs within this cavity.
3. The isthmus is the narrowest segment of the fallopian tube that extends in the direction of the uterus.
4. The intramural (interstitial) segment that traverses the myometrium of the uterus.
5. The canal is encompassed by a mucosa layer that is intricately folded into papillae. The inner layer consists of a straightforward columnar epithelium including cells equipped

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with minute hair-like features known as cilia. The pin cells, located amidst the hair cells, release a fluid that nourishes sperm, eggs, and zygotes

The primary role of these tubes is to facilitate the transport of eggs from the ovaries to the uterus and to provide a suitable environment for fertilization to occur. The primary function of the fallopian tubes is to allow the transportation of the egg from the ovary to the uterus. This mode of transportation is facilitated by the peristaltic motion of the muscles and the synchronized movement of the ciliated cells.

During fertilization, the sperm traverse the tube to reach the egg, and typically, fertilization occurs in the ampulla. Following fertilization, the zygote receives nourishment from secretions produced by the fallopian tubes.

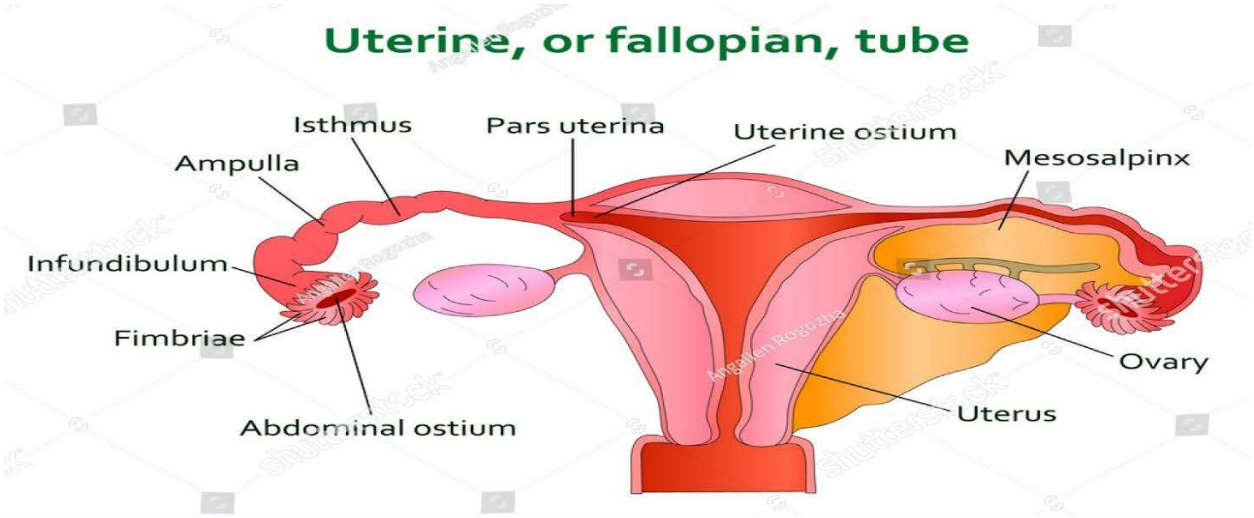

Figure 3: Diagram of Fallopian tube

Uterus:

The uterus is a pear-shaped, muscular, hollow organ located in the female reproductive system. It is narrow both in the front and back. It is situated between the urinary bladder and rectum. The uterus in an adult woman typically has a weight of around 30-40 grams and dimensions of approximately 7.5cm in length, 5cm in width, and walls that are 2.5cm thick.

The uterine wall is composed of three layers: the perimetrium, myometrium, and endometrium. The perimetrium is the outermost layer of the uterus that folds forward to create the vesicouterine pouch. Subsequently, it extends from the uterus to the rectum, creating the rectouterine pouch. The myometrium is the middle layer of the uterine wall, consisting of smooth muscles, connective tissue, blood arteries, and nerves. It is also the thickest layer. The endometrium is the deepest layer of the uterus, consisting of columnar epithelium that contains many tubular glands that secrete mucus. The endometrium is further subdivided into layers, and the upper layer thickens during the initial phase of the menstrual cycle. The basal layer is located within the myometrium. Menstruation results in the shedding of the superficial layer of the endometrium, while the basal layer remains intact.

From an external perspective, the uterus is anatomically partitioned into three segments: the fundus, body, and cervix. The cervix is located inferior to the isthmus. An isthmus is a narrow passage located in the center of the uterus. The fundus is located superior to the entry sites of the fallopian tubes. The fundus refers to the spherical, superior portion of the uterus. The uterine corpus is situated between the isthmus and the fundus.

Uterus Functions:

1. The primary function of the uterus is to create an optimal and supportive environment for the growth and development of a fetus.
2. The ovum is nourished by uterine secretions both before and after implantation in the uterine wall, as well as after fertilization. The proliferating cluster of cells is sustained by endometrial cells.
3. The uterus undergoes cyclical shedding, known as the menstrual cycle, at the onset of puberty in women. This secretion facilitates the preparation of the uterus for the purpose of nourishing and safeguarding a fertilized egg.

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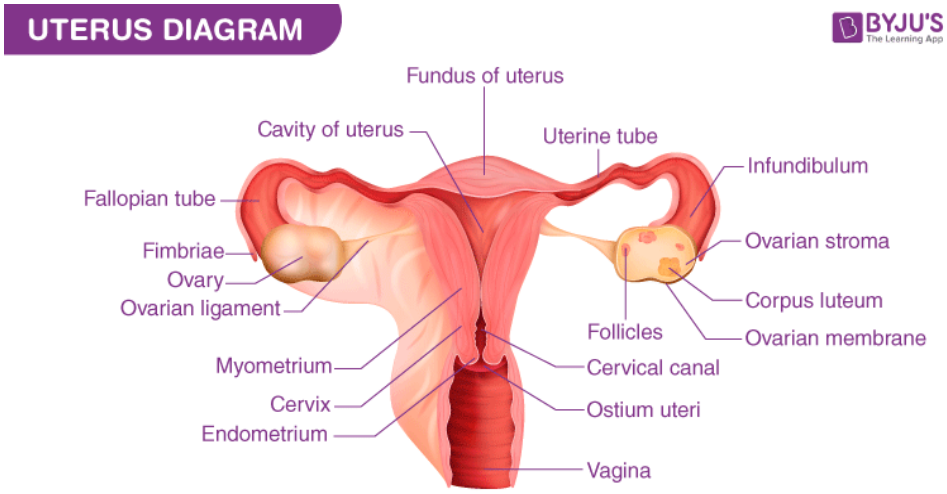

Figure 4: Diagram of uterus

Vagina:

The vagina is a fibromuscular tube lined with stratified squamous epithelium that connects the internal and external organs of the female reproductive system. The vagina is bent upwards at a 45° angle, with the bladder at the front and the rectum and anus at the back. The vagina is surrounded by three layers, the outer layer of areolar tissue, a middle layer of smooth muscle, and the inner layer of stratified squamous epithelium forming ridges or rugae. The vagina has no secretory cells; however, the surface is kept moist by cervical secretions. Between puberty and menopause, Lactobacillus acidophilus is abundant in the vagina. This organism secretes lactic acid, which keeps the pH of the vagina between 4.9 and 3.7. This acidity inhibits the growth of other microorganisms that can enter the vagina through the perineum.

Function of Vagina:

1. The vagina is the receptor for the penis during coitus or sexual reproduction.
2. Vagina also provides an elastic passage for the baby during childbirth.

2.3.2 External Genitals

The external genitalia include the mons pubis, vulva, labia majora, labia minora, clitoris, the urinary tract, hymen, the bladder, vestibule, vestibular glands, and vestibular bulbs.

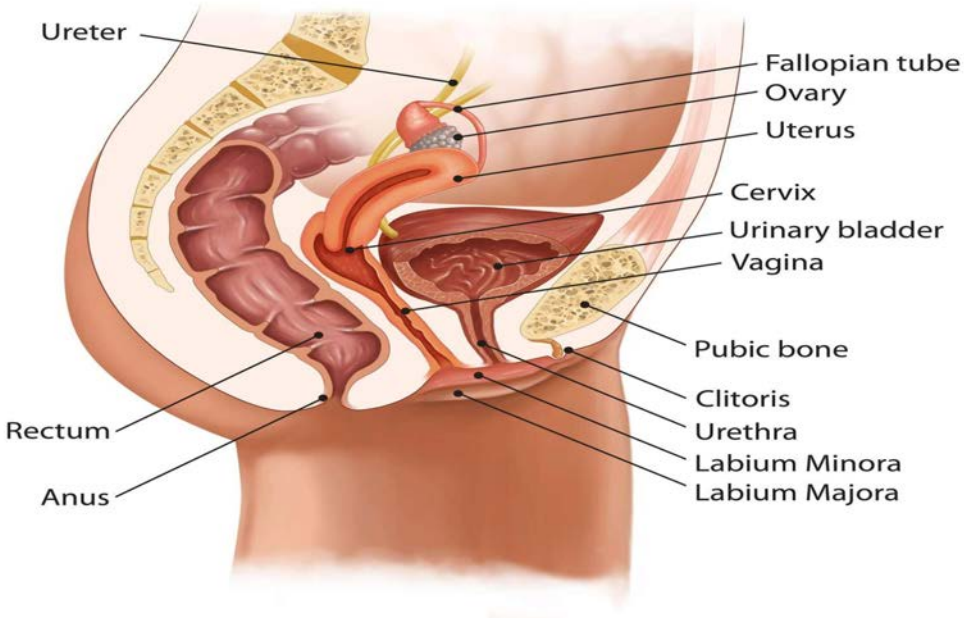

Figure 5: Diagram of Female Reproductive System (External genitalia)

Vulva:

The vulva, also known as the pudendum, refers to the external genital organs of the reproductive system of female. These structures are visible in the perineal area and are situated near the opening of the vagina, known as the genital orifice. The term "vulva" originated from a Latin word that denotes a covering. The vulva consists of the mons pubis, labia majora, labia minora, clitoris, urethra, hymen, perineum, vestibule, vestibular glands, and vestibular bulbs. The outer reproductive organs, known as the vulva, are protected by a layer of keratinized stratified squamous epithelium. Vulva development primarily occurs throughout the foetal and pubertal stages. Functions:

1. The vulva safeguards the entrance of the uterus or womb, and subsequently shields the internal reproductive tract from infection, utilizing the labia majora (big lips) and labia minora (small lips) as a pair of doors.

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2. It facilitates the process of urine or micturition by dilating the urethra.
3. The vulva possesses a network of nerves that serve as sensory tissue, enabling it to respond to various stimuli such as pain, touch,temperature and pressure. This heightened sensitivity contributes to the enhancement of sexual intercourse between males and females, ultimately leading to the initiation of fertilization, pregnancy, labor, and childbirth.
4. The pudendum aids in the maintenance of optimal vaginal health by facilitating the elimination of vulvovaginal fluid.

Mons Pubis:

The term Mons Pubis, often referred to as Mons Veneris, originates from the Latin phrase "Mound of Venus," which pertains to the Roman Goddess of love. The described anatomical structure is a layer of fatty tissue located above the pubic bone. Post-pubertal hair growth in a triangle arrangement is observable on the Mons Pubis. Functions:

1. The Mons Pubis or Mons Veneris serves to safeguard the vulva and pubic bone from harm during sexual activity.
2. Additionally, it secretes pheromones that enhance sexual appeal.

Labia majora:

The term "labia" refers to lips, while "majora" suggests bigger size. Therefore, the labia majora are the larger or outside lips, consisting of two thick fleshy folds of skin composed of connective tissue, adipose tissue, smooth muscle, sebaceous glands, and sweat glands. The labia majora extends from the mons pubis and continues to the perineum, encompassing the vulva. The dimensions and distribution of the labia majora might exhibit variability. Furthermore, the external skin color can differ as it predominantly corresponds to the individual's skin color. The

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inside layer of the skin exhibits a range of hues, ranging from pink to light brown. Its primary functions include:

1. The primary role of the labia majora is to safeguard the surrounding components of the vulva and the vaginal aperture.

Labia minora:

The labia minora, also referred to as the nymphaea, are the smaller or minor or inner lips of the vulva. The labia minora are two tiny folds of skin located within the labia majora. The folds consist of mucous membrane, connective tissue, and sebaceous glands, originating from the clitoris and extending downwards. The labia minora can vary in size, ranging from very little to a maximum length of 2 inches. The labia minora exhibit individual variation in coloration. The labia minora include blood vessels that experience heightened blood flow during sexual desire. This causes the nymphae to enlarge and become more sensitive to touch and pressure. Functions: 1. The primary function of the labia minora is to provide coverage for the openings of both the urethra and vagina.

Clitoris:

The clitoris is commonly described as a little penis, without a urethra. The clitoris is a small, pea-sized mound located at the apex of the labia minora. It is composed of erectile corpora cavernosa tissue and is rich in nerve endings. The presence of nerves renders it highly sensitive and causes it to become erect during sexual desire. The size of the clitoris varies across women, with the average length often measuring 2 cm and the diameter at 0.5 cm. The clitoris is covered by a fold of skin called the prepuce, which is similar to the foreskin of the penis. Functions:

1. The clitoris is responsive to sexual stimulation and contributes to the experience of pleasure.

Urethra:

The urethra is a component of the urinary system, with its opening orifice, known as the meatus, located on the vulva. Therefore, the urethra can be considered as part of the vulva. The urethra is a conduit that facilitates the expulsion of urine from the bladder to the urethral meatus. The

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urethra is composed of membranous connective tissue, whereas the lining of the urethral opening is made up of transitional epithelium with stratified squamous epithelium. The urethra is positioned superior to the vaginal opening. The dimensions of the female urethra typically vary between 3.5 and 5 cm, whereas the size of the urethral entrance is approximately 2.5 cm. Functions: 1. The primary role of the urethra is to expel pee.

Hymen:

The hymen is a delicate mucous membrane that separates the urethral sinus from the vaginal lumen. The hymen is a membrane located at the entrance of the vagina that partially covers the vaginal opening. Hymens vary in terms of their types and sizes, enabling unrestricted passage of menstrual blood. The semilunar hymen is the most commonly observed type of hymen in young females. There is a prevalent misconception that a hymen that is intact ensures a woman's virginity. However, the hymen can be torn as a result of engaging in sports activities, experiencing an injury, or using tampons. Functions: 1. The hymen facilitates the expulsion of menstrual blood from the vagina, while also providing protection from pathogens and external entities.

Perineum:

The perineum is commonly referred to as the lower region between the anus and the genitals in the United Kingdom. It is the anatomical region located between the vulva and the anus. The perineum is a rhombus-shaped region located between the symphysis (pubic arch) and the coccyx (tailbone). It consists of connective tissue, dermis, muscular tissue, and adipose tissue. The perineum is anatomically separated into two distinct regions: the anterior urogenital triangle and the posterior anal triangle. This encompasses the pelvic floor and houses the vulva as well as three orifices: the urethral orifice, vaginal orifice, and anus. It serves as a connection between the urinary, reproductive and digestive systems, providing support for their muscles and functions.The functions of the perineum are:

1. Attaches to the muscle located on the pelvic floor.
2. Urination
3. Bowel movement

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4. Sexual intercourse
5. Delivery of a baby

Vestibule:

The vestibule is a triangular region located between the labia minora, housing the vaginal aperture and the urethra. The vestibule is located within the labia minora and consists of six openings, including the urethral orifice, vaginal orifice, and the entrances of two greater vestibular glands and two lesser vestibular glands. Hart's lines are the boundaries that exist between the vestibule and labia minora. Hart's lines demarcate the boundary between the vulva vestibule and the labia minora. Functions: 1. Houses the urethral, vaginal, and greater and lesser vestibular gland orifices.

Vestibular glands:

This refer to the glands that enter into the vulva vestibule. There exist two distinct categories of vestibular glands. The glands in concern are known as the greater vestibular glands and the minor vestibular glands.

Greater vestibular glands:

This gland often referred to as Bartholin's Glands, are a pair of glands that are similar to the bulbourethral glands seen in males. The glands, which are comparable in size to a pea, are situated on either side of the vaginal entrance and discharge into the vaginal vestibule.

Functions: These glands produce a fluid that contains wax and pheromones. This material helps to keep the vaginal canal and vulva moist and lubricated during sexual stimulation.

Lesser vestibular Glands:

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Known as Skene's Glands, they are comparable to the prostate glands found in males, as both glands arise from the same embryonic tissue. The Skene's glands are bilateral glands located next to the urethra. Functions:

1. The glands excrete a viscous material called mucus, which provides lubrication to the entrance of the urethra.
2. Protects against urinary tract infection.

Vestibular Bulbs:

Two masses made of corpus spongiosum tissue, a type of erectile tissue, make up the vestibular bulbs. The inferior part of the clitoris is the source of the vestibular bulbs, which project towards the vagina and urethra. Anatomically, the urethra and vagina separate and enclose the bulbs. Anatomical structures called vestibular bulbs resemble the bulb seen in the male penis.

Functions: 1. The vestibular bulbs, unlike the clitoris, elicit a pleasurable sensation during sexual stimulation.

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Chapter 3 Menstrual Hygiene

According to UNFPA, “the process in which the uterus sheds blood and tissue through the vagina is called menstruation and this is a natural and healthy process for girls and women of reproductive age”. The female population of the world, which makes up 26% of the total population, is about 52% of reproductive age. Monthly menstruation affects 1.8 billion people globally, according to UNICEF. Every day, more than 300 million women throughout the world have their periods. But in the majority of the world, it is still taboo and rarely broached. Thus, a variety of societal and cultural expectations and customs make it much harder to practice excellent menstrual hygiene. According to the World Bank, 500 million people lack regular access to sanitary facilities or period products (*Globally to Locally, Period Poverty Affects Millions*, 2023).

Access to menstrual hygiene services is crucial for the independence and health of women and girls around the world. The Global Monthly Collective Organization’s Terminology Action Group states that "Menstrual health is a state of total physical, mental, and social well-being and not only the absence of disease or infirmity, about the menstrual cycle”, (Hennegan et al,2021).
Menstrual hygiene management (MHM) refers to the provision of knowledge, tools, and privacy necessary for women and girls to maintain their personal cleanliness and health during menstruation (Budhathoki et al., 2018).
Menstrual hygiene encompasses a range of practices, such as replacing one's sanitary towel every 4-6 hours, thoroughly washing one's hands, refraining from douching, correctly disposing of used napkins, and using just one method of cleanliness at a time. Girls and women necessitate reliable and easily accessible water, sanitation, and hygiene (WASH) facilities, along with inexpensive and suitable menstrual hygiene products. They also need to be equipped with knowledge of the most effective methods and provided with a supportive atmosphere to manage menstruation discreetly and without feeling ashamed. According to the International Monetary Fund (Ahmed et al., 2023), the absence of WASH, or water, sanitation, and hygiene, facilities, especially in public settings such as educational institutions, workplaces, or health clinics, poses a significant obstacle that women and girls must surmount. The correct disposal of spent menstrual products and the practice of thorough hand washing may be a substantial challenge for women and girls. It limits their ability to move and act, negatively impacts their social

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involvement and academic achievements, and compromises their safety, exacerbating their existing anxiety levels.Women must maintain proper menstrual hygiene since it might cause infections in the urinary tract or reproductive system, which could ultimately result in infertility or complications during childbirth. Infections like reproductive tract infections (RTI), yeast infections, hepatitis B, and even cysts can be transferred or formed when women don't wash their hands after changing their menstrual products. It was found that using the same sanitary pads for more than 4 hours and not maintaining hygiene would cause cysts in the ovaries.

According to the Indian Express (2023), a study was conducted where ten different pad brands were examined and 12 different phthalates were discovered as evidence and VOCs (used in sanitary pads for fragrance) in each sample and the highest concentration of phthalates observed in the test sanitary pads was 19460 g/kg of DIDP in one of the tested organic pads. Phthalates have been related to some health problems, such as endocrine disruption, impacts on the heart and reproductive systems, diabetes, some malignancies, and congenital defects, this is dangerous. "The majority of these additives are used to increase the pad's elasticity however, they are risky because they can result in issues like PCOS, endometriosis, hypothyroidism, etc. and they have the power to alter how the body produces hormones. Phthalates are not attached to the product they are put to; they leak away and as the tissues of the vagina are more permeable, these substances are absorbed into the body at a faster rate," Dr. Mehrotra (Online, 2022).

Even though menstruation is common in Bangladesh, only 6% of schools provide MHM instruction. According to the results of the 2018 National Hygiene Survey, just 36% of teenagers and 30% of adult women were aware of menstruation before their first period or menarche. Additionally, more than a third of Bangladeshi girls claimed that menstrual issues forced them to skip class. In a survey of adolescent girls in rural Bangladesh, 69% either used filthy clothes or had no protection at all during their periods (*National Hygiene Survey 2018 | WaterAid Bangladesh*, n.d.-b). According to a study by IRC and BRAC, it is challenging to enhance menstrual hygiene facilities in Bangladeshi schools because only around 24% of them fulfill the minimum standards for wash facilities. There is typically one toilet for every 187 pupils, and over two-thirds of those restrooms are inadequately equipped with water and soap (Roundtables, 2015).

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Chapter 4 Infertility

4.1 Introduction

Infertility is a global health issue that impacts a significant number of individuals throughout their reproductive years. Infertility is a medical disorder affecting the male or female reproductive system, which is characterized as the incapacity to conceive a child despite regularly engaging in unsecured sexual activity for a duration of at least twelve months.. The consequences can include significant distress, social disapproval, and economic challenges, which can have adverse effects on individuals' mental and psychosocial well. Infertility is commonly defined as the incapacity to achieve pregnancy (conception) after engaging in unprotected sexual intercourse for a duration of one year or longer. Due to the gradual decrease in women's fertility as they age, certain healthcare professionals assess and address the reproductive health of women who are 35 years old or older after a period of 6 months of engaging in unprotected sexual intercourse. The fertility of women gradually declines as they age, particularly in their mid-30s, and significantly decreases after the age of 37.

The International Classification of Diseases by the World Health Organization provides details on the main and contributing factors of infertility in males and females. Primary infertility refers to the complete inability to conceive, while secondary infertility refers to the inability to conceive following a previous successful conception. WHO research indicates that infertility has a significant impact on a substantial number of individuals throughout their lives. Approximately 17.5% of the global adult population, or about one in every six individuals, experiences infertility. This underscores the urgent requirement to offer affordable and excellent reproductive treatment to those who require it. The most recent research indicates that the occurrence of infertility exhibits minimal variation across different regions. The rates for high-income, middle-income, and low-income countries are similar, suggesting that this is a significant global health issue. The lifetime prevalence rate was 17.8% in high-income nations and 16.5% in low- and middle-income countries.

4.2 Etiology of male infertility:

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Approximately 14% of couples experience infertility, indicating their inability to conceive a child despite engaging in regular, unprotected sexual intercourse for a duration of one year or longer. Male infertility may contribute to the infertility of approximately 50% of these couples. Male infertility can arise from factors such as reduced sperm production, impaired sperm function, or obstacles in sperm transportation. Male infertility can arise from various causes, including illnesses, injuries, chronic health conditions, lifestyle choices, and other contributing factors.

4.3 Etiology of female infertility:

Ovulatory disorder is the main factor behind female infertility, impacting forty percent of women that are unable to achieve pregnancy. Ovarian or gynecological diseases, such as primary ovarian insufficiency or polycystic ovary syndrome, can also lead to infertility. Ovulatory abnormalities are the main cause of female infertility. Age, hormone imbalances, weight, chemical or radiation exposure, and cigarette smoking are among factors that might affect fertility. Ovulation disorders often contribute to infertility, as they involve difficulties in the regular release of an egg from the ovaries. Certain obstacles may impede the complete release of an egg, while others may hinder its release in certain cycles but not in others. PCOS might result in ovulation difficulties. Common causes of infertility in women are irregular ovulation, blocked fallopian tubes, and uterine anomalies such as fibroids and endometriosis. Surgery, hormone therapy, and IVF are all viable treatment options. As per the World Infertility Survey, the infertility rate among couples in Bangladesh stands at 4%, with 15% of this being attributed to women aged 45 to 49 who are approaching the end of their reproductive years.

4.4 The following are some prevalent issues related to infertility:

1. Endometriosis: Endometriosis is a medical disorder characterized by the presence of tissue similar to the lining of the uterus growing outside of the uterus. It can result in substantial pelvic discomfort and complicate the process of pregnancy. This often commences with an individual's initial occurrence of menstruation and continues until menopause. Extraneous growth of

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endometrial tissue beyond the uterus might eventually result in the formation of cysts, adhesions, and scar tissue. This can lead to persistent (chronic) pain, especially during menstruation. A significant number of individuals with endometriosis experience challenges in achieving pregnancy.

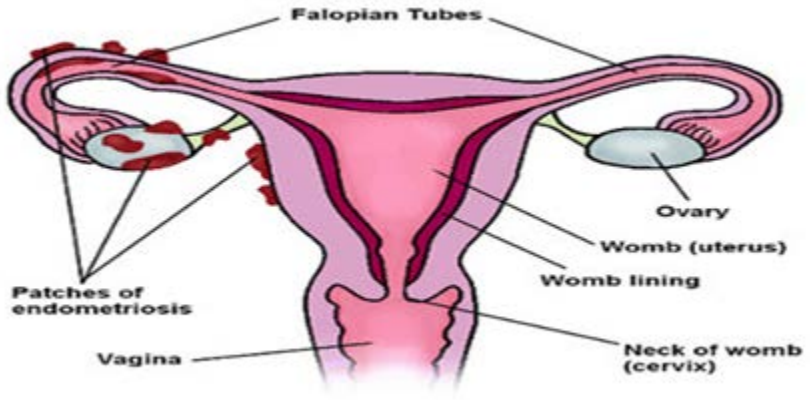

Figure 6: Endometriosis

The current understanding is that endometriosis is caused by:

1. Retrograde menstruation is the process in which menstrual blood, together with endometrial cells, reverses its flow through the fallopian tubes and enters the pelvic cavity while blood is simultaneously exiting the body through the cervix and vagina. Endometrial-like cells can be transported beyond the uterus by retrograde menstruation, where they have the potential to adhere and grow.

2. Cellular metaplasia refers to the phenomenon in which cells undergo a transformation from one state to another. Extraneous cells undergo a transformation into cells resembling the endometrium and commence rapid multiplication.

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3. The disease can be initiated by stem cells and disseminated throughout the body via blood and lymphatic vessels.

Endometriosis Symptoms:

1. Pain is particularly prominent during menstruation, sexual intercourse, and urination or defecation.

2. Persistent pelvic discomfort.

3. Certain individuals may encounter excessive hemorrhaging during or amidst menstrual cycles.

4. Challenges conceiving.

5. Experiencing abdominal distention or feelings of queasiness.

6. Exhaustion

7. Presence of anxiety or despair.

Endometriosis entails significant social, public health, and economic ramifications. The presence of intense pain, tremendous fatigue, profound grief, overwhelming anxiety, and the inability to conceive may potentially diminish one's overall quality of life.

2.Uterine fibroids:

Uterine fibroids are benign growths that often develop in the uterus throughout a woman's reproductive years. Uterine fibroids, medically referred to as leiomyomas or myomas, do not pose an increased risk of uterine cancer and typically do not progress into a malignant condition. These are neoplasms that originate in the uterus of a female. If a fibroid tumor is not causing any discomfort, excessive bleeding, or rapid expansion, it may not necessitate removal.

Uterine fibroids, also known as leiomyomas, are the most prevalent form of tumor in women. Uterine fibroids are neoplastic growths that arise from the myometrium, which is the smooth

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muscle tissue of the uterus. Fibroids are noncancerous growths composed of disordered smooth muscle cells surrounded by a large amount of extracellular matrix. Within a living organism, the cells undergo a gradual increase in number. The development of the extracellular matrix also plays a substantial role in the expansion of tumors. Uterine fibroids are almost always benign. These lesions interfere with the usual operation of the uterus, causing symptoms such as excessive uterine bleeding, anemia, problems with embryo implantation, repeated pregnancy loss, premature delivery, labor that is obstructed, pelvic unease, urinary incontinence, and occasionally resembling or imitating malignant tumors. By the time they reached the age of 50, approximately 70 percent of Caucasian women and more than 80% of African American women would have encountered at least one fibroid. Severe symptoms occur in between fifteen and thirty percent of these women. Upon diagnosis, black women exhibit significantly larger fibroids in their uterus in comparison to white women. Individuals with this condition are identified at an earlier stage of life, exhibit more intense symptoms, and endure a prolonged period of continuous growth. Typical indications of fibroids in the uterus may include:

1. Profuse vaginal hemorrhage. Experiencing excessive or prolonged menstrual bleeding is a frequently observed symptom.

2. Pelvic discomfort and pain.

3. Urinary problems.

4. Lumbar pain.

5. Sensation of pressure in the rectum.

6. Sensations of discomfort or pain experienced during sexual intercourse.

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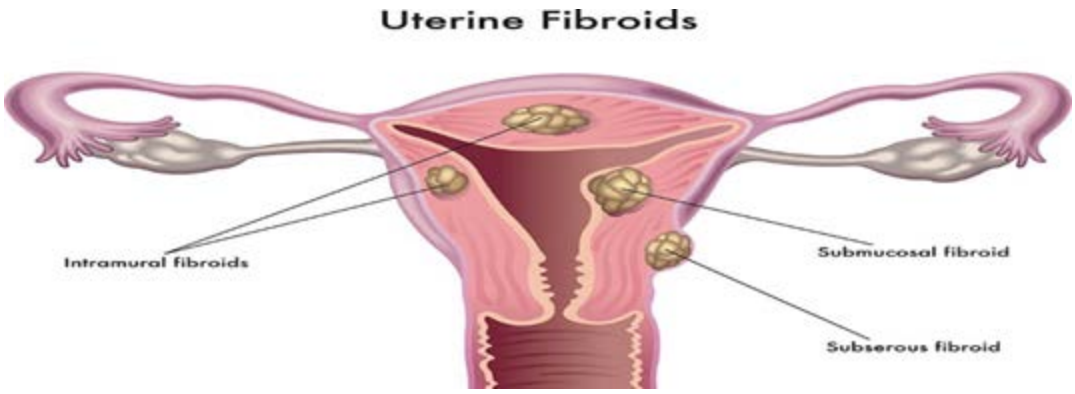

Figure 7: Uterine Fibroids

Fibroids, irrespective of their size or location, can exert paracrine molecular influences on the adjacent endometrium, resulting in significant uterine hemorrhage or impaired implantation.

1. Dysfunctions related to cervical mucus:

While abnormal cervical mucus might hinder the passage of sperm into the uterus, it is never the main factor contributing to infertility. Cervical mucus issues seldom contribute significantly to infertility, but they may be a factor in women with a cervical infection or scarring on the cervix (cervical stenosis). Hormonal imbalance and irregular ovulation are the primary causes of unfriendly cervical mucus. The presence of thick cervical mucus can impair sperm motility. It may also be attributable to the bad effects of medication.

2.Early onset ovarian dysfunction:

Premature ovarian failure (POF), also known as primary menopause, is a condition in which the ovaries cease to function properly before the age of 40. During this occurrence, the ovaries cease the production of the hormone estrogen and the regular release of eggs. This condition, usually referred to as early ovarian failure, commonly leads to infertility. This is a heterogeneous condition that impacts around 1-2% of women under the age of 40 and 0.1% of women under the age of 30 (Coulam et al., 1986). POF is characterized by decreased levels of gonadal hormones (estrogens and inhibin's) and increased levels of gonadotropins (LH and FSH) (hypogonadotropic amenorrhea). Premature ovarian failure can be attributed to iatrogenic

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factors, including chemotherapy, radiation therapy, and surgery, as well as autoimmune disorders, X-chromosome abnormalities, and autosomal genetic issues, all of which can result in permanent damage to the ovaries. The etiology of POF remains mostly elusive, with only a limited cohort of individuals discovered in scientific investigations (Woad et al., 2006). Women diagnosed with Premature Ovarian Failure (POF) exhibit menopausal symptoms that are similar to those encountered during natural menopause, including hot flushes, nocturnal sweats, and vaginal dryness (Woad et al., 2006). The occurrence of POF is linked to a decline in fertility, mostly caused by either the absence of follicles or the failure of existing follicles to respond to stimulation (Nelson, 2009).

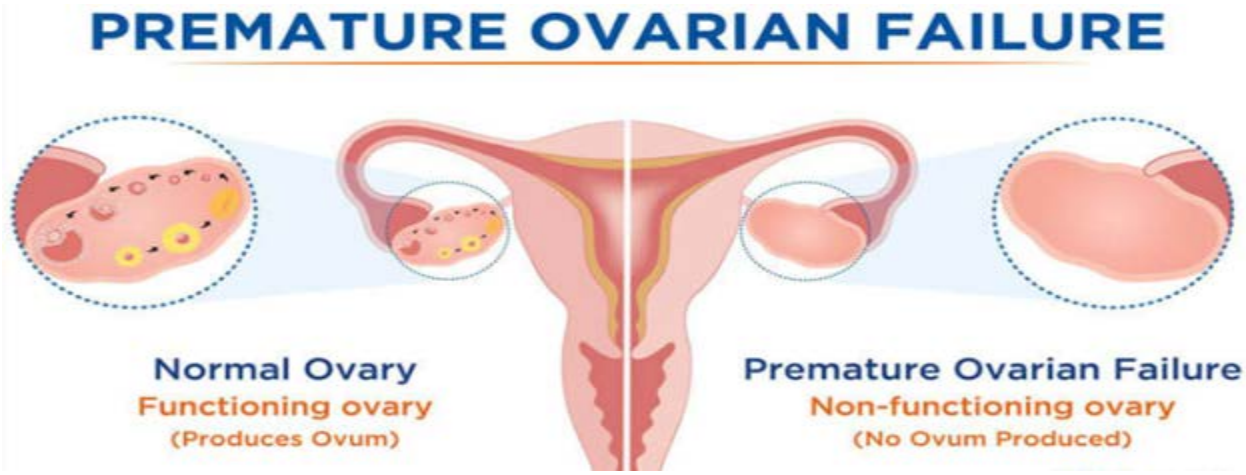

Figure 8: Premature ovarian failure (POF)

Moreover, an extended duration of low estrogen exposure heightens the likelihood of developing osteoporosis. Treatment is associated with managing menopausal symptoms, reducing the risk of osteoporosis, and addressing fertility decline. Like many health issues, there is often a hereditary basis that can either induce the condition in particular individuals or make them more likely to have it later in life (Shelling, 2009). Considering the hereditary nature of POF, it is evident that multiple genetic disorders may contribute to or be associated with the onset of POF.

Pelvic inflammatory disease (PID): This is an infection that affects the reproductive organs of female. Pelvic inflammatory disease is an inflammatory condition of the upper female reproductive system (including the endometrium, fallopian tubes, ovaries, and pelvic peritoneum) that is caused by an infection. It can manifest in several ways. Endometritis is an

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intermediary phase in the development of a disease that advances from the vagina or cervix to the higher reproductive system. Pelvic inflammatory disease is a significant cause for worry as it can result in enduring reproductive dysfunction, including infertility, ectopic pregnancy, and chronic pelvic pain. After the introduction of laparoscopy in the 1960s, research on pelvic inflammatory disease expanded significantly during the following decades (1970s, 1980s, and 1990s). This led to significant advancements in understanding the microbial origins of the disease, its connection to reproductive impairment, and the establishment of standardized antimicrobial treatment.

Endometritis is an intermediary phase in the development of a disease that advances from the vagina or cervix to the higher reproductive system. Pelvic inflammatory illness is characterized by pelvic discomfort accompanied by inflammation of the lower genital tract. Women with this condition often experience mild symptoms and signs. A significant number of women undergo clinically asymptomatic infection that spreads to the upper genital canal, leading to subclinical pelvic inflammatory disease.

10% of women with PID will experience infertility. Pelvic inflammatory disease (PID) can cause damage to the fallopian tubes. Scar tissue formation can obstruct the fallopian tubes, impeding the fertilization of an egg. Pelvic inflammatory disease (PID) scarring can hinder the migration of a fertilized egg to the uterus, leading to the occurrence of an ectopic pregnancy.

Figure 9: Pelvic inflammatory diseases

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1.Sterilization: It refers to the condition of being unable to conceive, which is known as sterility. Female sterilization prevents the passage of egg cells through the fallopian tubes, which are the connecting pathways between the ovaries and the uterus. This implies that the ova and spermatozoa of a female individual are unable to unite, resulting in the prevention of fertilization. The ovaries will undergo regular ovulation, but the eggs will be naturally reabsorbed by the woman's body.

PCOS, or Polycystic Ovarian Syndrome, is the most prevalent yet manageable endocrine illness in women, among several reproductive issues. In individuals with polycystic ovary syndrome (PCOS), there is a disturbance in the hormonal equilibrium that interferes with the development and release of oocytes (eggs) from the ovaries, leading to disrupted ovulation. Polycystic ovarian syndrome (PCOS) is a medical condition that impacts 10% of women in their reproductive years. Women diagnosed with Polycystic Ovary Syndrome (PCOS) have disruptions in their hormonal equilibrium and metabolic functions, which can have an impact on their overall well-being and physical attractiveness. PCOS poses a risk to women of all racial and cultural backgrounds. The chance of developing PCOS may be elevated in those who are overweight or have a family history of PCOS, namely if their mother, sister, or aunt has been diagnosed with the condition.

Chapter 5 About the Disease

5.1 PCOS

Polycystic ovarian syndrome (PCOS) is a hormonal and metabolic disorder that specifically impacts women in their reproductive years (World Health Organization: WHO & World Health Organization: WHO, 2023b). Women in their reproductive years may be affected by this condition, resulting in irregular or prolonged menstrual cycles. Additionally, women afflicted with Polycystic Ovary Syndrome (PCOS) experience an overabundance of the hormone androgen, resulting in the formation of several small fluid-filled sacs around the outer periphery of the ovary. These sacs, known as cysts, contain developing eggs referred to as follicles. PCOS, as reported by the Office of Women's Health, impacts around 5% to 10% of women aged 15 to 44 who are biologically capable of becoming pregnant. Typically, a woman becomes aware of her Polycystic Ovary Syndrome (PCOS) when she encounters difficulties conceiving and seeks medical advice during her twenties or thirties. Nevertheless, it can manifest at any stage after puberty and can impact women of all ethnic and cultural origins. The etiology of PCOS remains elusive or unacknowledged. Additionally, there is evidence indicating that the combination of obesity and having a mother, sister, or aunt with PCOS can heighten the likelihood of acquiring the disorder. The exact etiology of PCOS remains elusive. Most experts concur that multiple factor, including genetics, play a role:

1. **Elevated levels of androgens**: Despite the fact that women naturally produce low levels of androgens, these hormones are sometimes colloquially referred to as "man hormones." Androgens control the development of masculine traits such as male pattern baldness. Women with PCOS exhibit elevated levels of androgens compared to the typical amount. Elevated androgen levels in women can hinder ovulation, resulting in the absence of egg production during each menstrual cycle. Additionally, this hormonal imbalance can lead to the development of acne and excessive hair growth, which are both indicative of PCOS.
2. **Elevated insulin levels**: Insulin, a hormone, controls the conversion of food into energy. Insulin resistance refers to the condition when the body's cells fail to respond appropriately to insulin. As a consequence, your insulin levels exceed the normal range. Women diagnosed with polycystic ovary syndrome (PCOS) have an increased likelihood of experiencing insulin resistance, especially if they are overweight or obese, have

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unhealthy dietary patterns, engage in insufficient physical activity, or have a familial predisposition to diabetes, often type 2 diabetes. Insulin resistance may ultimately lead to the development of type 2 diabetes.

Research has established links between Polycystic Ovary Syndrome (PCOS) and various medical conditions, notably Diabetes. A study revealed that over 50% of women with polycystic ovary syndrome (PCOS) develop either diabetes or prediabetes (glucose intolerance) prior to reaching 40 years of age. Additional disorders associated with PCOS include:

1. **Hypertension**. Women with a diagnosis of PCOS have a higher likelihood of developing hypertension compared to women of the same age who do not have PCOS.
2. **Elevated levels of harmful cholesterol**. Women diagnosed with polycystic ovary syndrome (PCOS) generally exhibit decreased levels of high-density lipoprotein (HDL) cholesterol, which is considered beneficial, and increased levels of low-density lipoprotein (LDL) cholesterol, which is considered harmful.
3. **Obstructive sleep apnea**. This refers to the phase of sleep disturbance characterized by frequent and brief episodes of cessation of breathing. PCOS patients frequently experience obesity and overweight, conditions that might result in the development of sleep apnea. Sleep apnea elevates your susceptibility to diabetes and heart disease.
4. **Depressive and anxious feelings.** Prevalent in women with Polycystic Ovary Syndrome (PCOS).
5. **Endometrial carcinoma.** Women with PCOS are at a higher risk of developing this condition due to factors such as ovulation problems, obesity, insulin resistance, and diabetes affecting the lining of the uterus or womb.

5.2 Symptoms

The symptoms of PCOS often manifest during the onset of the initial menstrual cycle. Occasionally, there is a delay in the onset of symptoms following a prolonged period of time with regular menstruation. A PCOS diagnosis is given when an individual displays at least two of the several symptoms associated with PCOS. The symptoms are as follows, according to the World Health Organization (WHO) in 2023:

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1. Irregular menstruation: Polycystic ovary syndrome (PCOS) is often marked by irregular or infrequent menstrual cycles. It is also common to experience periods that are longer than the typical duration. An individual afflicted with Polycystic Ovary Syndrome (PCOS) may encounter a menstrual cycle occurring less frequently than nine times per year, with intervals exceeding 35 days. Additionally, individuals may encounter challenges in the process of conceiving.

Hyperandrogenism: Elevated levels of androgens can lead to an overgrowth of body and facial hair. Hirsutism is the appropriate word for this condition. Occasional instances of male-pattern baldness and severe acne may also arise. Ovarian polycysts. It is possible that your ovaries are enlarged. Follicles containing undeveloped eggs can potentially develop along the periphery of the ovary. The ovaries may exhibit impaired functionality. Obese persons generally encounter more pronounced signs and symptoms of PCOS.

1. Presence of acne lesions over the facial area, chest, and upper back.
2. Scalp hair that is becoming sparse or falling out; a condition known as male-pattern baldness.
3. Increased body mass or challenges in achieving weight loss.
4. Hyperpigmentation of the skin, namely in the areas where the neck folds, in the groin region, and beneath the breasts.
5. Skin tags are tiny, redundant flaps of skin that commonly occur in the armpits or neck region.

5.3 Risk Factors of PCOS:

Risk factors of PCOS are factors that could increase the risk of developing PCOS. Some of the risk factors are obesity/overweight, sedentary lifestyle, age, and family history of PCOS.

1) Obesity: A body mass index (BMI) of more than 25 is regarded as overweight, and over 30 is considered obese, according to WHO (n.d). This abnormal or excessive fat accumulation poses a health risk. Additionally, there is a clear association between obesity and PCOS, which implies that PCOS patients who are obese may gain weight due to hormonal changes in their bodies. In our body, the chemical messengers that regulate the processes are hormones and obesity cause changes in these hormones. These hormones encourage abnormal metabolism and the

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accumulation of body fat. The endocrine system is a system of glands that secretes hormones into our bloodstream. In addition, it helps our body to cope with different events and stresses by working with the nervous system and immune system. Some of these hormones are insulin and sex hormones.

I) Insulin: This pancreatic hormone promotes the uptake of glucose (sugar) from the blood in tissues like muscles, the liver, and fat. It is involved in the regulation of carbs and the metabolism of fat. Moreover, it helps in maintaining the glucose level in the blood in turn maintaining homeostasis. In an obese person, these insulin signals are lost and therefore lead to uncontrolled glucose levels in the tissues. The outcome of these hormonal changes leads to type II diabetes and PCOS in women. Female infertility is frequently caused by insulin resistance, especially in overweight individuals. Often, treating insulin resistance can help a woman become pregnant, though occasionally more reproductive therapies are required (Morris, 2021).

Because of its link to insulin resistance and diseases like polycystic ovarian syndrome (PCOS), insulin indirectly impacts female fertility. i) Insulin Resistance: The pancreas must produce more insulin to keep blood glucose levels within normal range when body cells grow immune to the effects of insulin. Increased insulin levels can affect the metabolism and other hormones. ii) Androgen Excess: An increase in androgens, or male hormones, is frequently linked to insulin resistance. The usual balance of reproductive hormones in women can be upset by elevated androgen levels, which can impact ovarian function. iii) Effect on Ovulation: A disruption in the regular ovulatory cycle is frequently observed in disorders such as PCOS, which are marked by insulin resistance. Menstrual abnormalities and problems with fertility might result from irregular or absent ovulation.

iv) Hyperinsulinemia: The ovaries may create more androgens when there is a persistently high insulin level, known as hyperinsulinemia. This further reduces fertility by interfering with egg maturation and causing ovarian cysts to form. v) Disruption of Menstrual Cycles: Hormonal imbalances brought on by insulin resistance may cause irregular menstrual cycles. There is less possibility of conception in the absence of regular ovulation. iv) Reduced Endometrial Receptivity Insulin resistance may affect the uterine endometrial lining, reducing its

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receptiveness to a fertilized egg. This may lessen the chance of a fruitful implantation and conception. The link between insulin, hormones, and fertility is complex and varies from person to person, and not all women with insulin resistance have problems becoming pregnant.

II) Sex hormones: Sex hormones, such as estrogen and androgens, play a role in determining the order of distribution of body fat. Estrogens, which are produced by the ovaries, serve to stimulate ovulation during every period and in women who have not yet reached menopause. Men and postmenopausal women have limited estrogen production in their testes or ovaries. The majority of their estrogen is synthesized in their body fat. Nevertheless, the quantity of estrogen generated in their adipose tissue is significantly reduced compared to the levels produced in ovaries of premenopausal individuals. In contrast, the testicles of young men generate androgens at higher concentrations; however, these levels decline as the man ages. Age-related alterations in sex hormone production contribute to shifts in fatty tissue distribution in both males and females. Increased body weight results in decreased estrogen levels, leading to an unpredictable menstrual cycle.

a. Androgen:

Androgens are reproductive and growth hormones synthesized in both male and female organisms. Androgens are commonly perceived as male hormones by certain individuals. However, the female body inherently synthesizes minimal quantities of androgens as well. For instance- the hormone testosterone. Ovarian hyperandrogenism is a medical disorder that involves excessive synthesis of testosterone by the ovaries. This results in the manifestation of masculine traits in a female individual. Androgens originating from different regions of the body can induce the development of masculine traits in females. The ovaries and adrenal glands in healthy women contribute approximately 40% to 50% of the total testosterone production in the body. Tumors of the ovaries and polycystic ovarian syndrome (PCOS) can both produce too much androgen production. Excessive androgen production caused by adrenal gland tumors can result in the development of masculine physical traits in females.

Polycystic ovary syndrome (PCOS) is the predominant diagnosis related to infertility, characterized by elevated levels of androgens. It is a prevalent factor contributing to

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infertility. The condition is distinguished by erratic menstrual periods, heightened testosterone levels (and/or excessive hair or acne), and ovaries containing numerous tiny follicles that exhibit a "string of pearls" visual pattern. Women exhibiting masculine physical characteristics, such as abundant body hair, a deepened voice, or an enlarged clitoris, may indicate elevated testosterone levels. Both an excess and a shortage of androgens can lead to female infertility. Optimal follicle growth and avoidance of apoptosis in granulosa cells require a precise balance of androgens. However, an excessive number of androgens primarily affects theca cells, leading to follicular arrest and anovulation.

b. LH:

Luteinizing hormone (LH) is an endogenous substance that initiates crucial physiological mechanisms within our reproductive system. Luteinizing hormone (LH) stimulates ovulation and facilitates the synthesis of hormones necessary for sustaining pregnancy. It enhances physiological functions in our body that are crucial for sexual well-being, growth, and procreation. The pituitary gland, a small anatomical component of our brain, releases luteinizing hormone (LH). Luteinizing hormone (LH) induces modifications in our gonads, specifically the ovaries or testes, which facilitate the proper functioning of our reproductive system. The pituitary gland releases two crucial hormones, follicle-stimulating hormone (FSH) and luteinizing hormone (LH), which collaborate to control functions in the human reproductive system. Hormones serve as chemical messengers that stimulate our sex organs (ovaries or testes) to initiate the necessary procedures for maintaining our reproductive well-being. In individuals designated female at birth (DFAB), LH is only secreted during the latter phase of the menstrual cycle. After an initial surge triggers the release of an egg (ovulation), LH is consistently secreted for a duration of two weeks. This enhances the production of progesterone in the ovaries. In individuals designated male at birth (DMAB), the pituitary gland releases luteinizing hormone (LH) steadily and testosterone is created at a consistent rate. Luteinizing hormone (LH) induces modifications in our ovaries that sustain our menstrual cycle and facilitate pregnancy. Luteinizing hormone (LH) induces these physiological alterations in

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individuals assigned female at birth (DFAB), encompassing cisgender women, certain transgender men, and nonbinary individuals with vaginas.

The release of a mature egg from the ovary occurs due to an increase in LH levels during the second week of each menstrual cycle. An elevated LH level at this point indicates that the patient is currently at the most fertile phase of her menstrual cycle, increasing the likelihood of conception. Luteinizing hormone (LH) stimulates the formation of the corpus luteum in the ovary, which in turn increases the production of progesterone between the third and fourth week of the menstrual cycle. With advancing age and the onset of menopause, individuals experience an elevation in their LH levels concomitant with a decline in estrogen and progesterone levels. It also plays a crucial part in the process of sexual development and functioning. Luteinizing hormone (LH) regulates the menstrual cycle in females. Additionally, it stimulates the ovary to release an egg. This process is commonly referred to as ovulation. Luteinizing hormone (LH) levels see a rapid increase immediately prior to ovulation.

Imbalances in LH levels, whether excessive or insufficient, can lead to a range of issues such as infertility (the inability to conceive) and monthly irregularities in women. Typically, in women with good health, the LH to FSH ratio falls between the range of 1 to 2. In women with polycystic ovary disorder, this ratio becomes inverted, potentially reaching values as high as 2 or 3.

c. Progesterone:

Progesterone is primarily recognized as the hormone responsible for pregnancy in females. Its major role is to support pregnancy by preparing the lining of the uterus, reducing contractions of the uterine muscles to facilitate implantation, encouraging the development of the fetus, and preventing lactation throughout pregnancy. Elevated progesterone levels can indicate the presence of a molar pregnancy, characterized by an unusual proliferation of uterine tissue. The condition arises from a fertilized egg that possesses significant genetic abnormalities, rendering it incapable of developing into a viable fetus. The proliferation has the potential to develop into malignancy and necessitates excision.

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Progesterone plays a crucial role in sustaining a pregnancy by increasing the thickness of the uterine lining. An enlarged endometrium facilitates the development of a fertilized ovum into an embryo, and subsequently into a fetus.

The levels of it continue to increase during pregnancy. Elevated progesterone levels inhibit ovulation during pregnancy. Additionally, it inhibits uterine contractions, preventing premature labor. Progesterone facilitates the preparation of the breasts for the act of breastfeeding. Insufficient levels of progesterone can hinder conception and increase the likelihood of miscarriage due to the crucial role progesterone plays in sustaining the initial phases of pregnancy. An optimal progesterone level for fertility is required, ranging from 0.1 to 0.7 ng/mL during the follicular stage of the menstrual cycle. The concentration ranges from 2 to 25 nanograms per milliliter during the luteal phase of the menstrual cycle. The concentration ranges from 10 to 44 nanograms per milliliter during the initial three months of pregnancy. The concentration of 19.5 to 82.5 nanograms per milliliter during the second trimester of pregnancy.

d. FT4:

The FT4 or free T4 test is used to quantify the concentration of unbound thyroxine in the bloodstream. A complimentary T 4 assay is employed to assess the thyroid gland's functionality. T4 is one of the two hormones secreted by the thyroid, which is a gland shaped like a butterfly located in the neck. There are two variations of T 4. A portion of the T 4 in the human bloodstream is bound to proteins, whereas another portion circulates freely, without being bound to proteins. Testing for free T 4 is more precise than testing for bound T 4. The T 4 test detects the concentration of unbound T 4 in the body. Triiodothyronine, sometimes known as T 3, is another hormone produced by the thyroid gland. T4 is converted to T3, which then becomes biologically active and exerts its effects on the body's tissues. These hormones play a crucial role in controlling our body's metabolism. They become active in response to thyroid stimulating hormone (TSH), which is secreted by the pituitary gland in the brain.

Thyroid hormones have a crucial role in regulating the metabolism and growth of ovarian, uterine, and placental tissues, which are essential for the proper functioning of the female reproductive system. There are two distinct thyroid-related conditions: hyperthyroidism, characterized by an excessively active thyroid, and hypothyroidism,

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characterized by an insufficiently active thyroid. Hypo- and hyperthyroidism can lead to reduced fertility or the inability to conceive in women. During the initial trimester of pregnancy, the developing fetus is dependent on the mother for the provision of thyroid hormones. Thyroid hormones have a crucial role in the correct development of the brain and growth of the fetus. The presence of hypothyroidism in the mother can result in enduring consequences for the fetus. Hypothyroidism can cause irreparable damage to the fetus by depriving it of maternal thyroid hormone. Preliminary research indicated that offspring of women with hypothyroidism during pregnancy exhibited diminished intelligence quotient (IQ) and reduced psychomotor abilities.

Hyperthyroidism can result in increased levels of the protein SHBG and the hormone prolactin, which can inhibit the release of eggs from the ovaries. These conditions can result in the inability to conceive, and other complications connected to reproduction, such as miscarriage, irregular menstrual cycles, and preeclampsia. An individual with hyperthyroidism has the ability to conceive a child. Nevertheless, the presence of hyperthyroidism can pose difficulties in achieving conception and decrease the likelihood of pregnancy. Irregular menstruation is a common symptom of hyperthyroidism. Hyperthyroidism can cause a reduction in sperm count in men, leading to infertility. After the ailment is remedied, it reverts back to its normal state.

Restoring thyroid hormone levels in women can help rectify menstruation or ovarian issues that may be causing infertility. A significant proportion of women develop thyroid dysfunction, with approximately 25% being affected at some point in their lives. This prevalence is roughly four times higher compared to men.

2) Sedentary lifestyle: A sedentary lifestyle or inactive lifestyle means a lifestyle with little to no exercise, poor nutrition, etc. Being inactive and having no proper nutrition leads to weight gain, metabolic imbalance, and diseases. There are several ways in which a sedentary lifestyle can contribute to infertility. Long-term inactivity contributes to obesity and weight increase, which in turn causes insulin resistance and hormonal imbalances that interfere with menstruation and ovulation, especially in women. Men's scrotal temperatures can rise as a result of less physical activity, which can impact sperm quality and production. Furthermore, sedentary lifestyles may affect reproductive health by compromising blood circulation to the pelvic organs.

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Additional disruptions to hormonal balance and menstrual cycles might come from psychological variables like elevated stress and anxiety, which are frequently linked to a sedentary lifestyle. A holistic approach to boosting fertility must address physical inactivity, as there may be linkages to lower success with assisted reproductive technologies. Sedentary behavior is also associated with unhealthy dietary habits and other lifestyle factors that increase the risk.

3. Aging:

The fertility of both men and women is influenced by their age. The age of a woman is the primary determinant influencing her likelihood of conceiving and giving birth to a healthy baby. From approximately the age of 30 onwards, a woman's fertility begins to gradually decrease, and by her mid-30s, this reduction accelerates. The likelihood of experiencing pregnancy problems grows with advancing maternal age. Women are inherently equipped with their entire lifetime supply of eggs at birth. The quality and quantity of her eggs decline as she ages. The age of a woman is the primary determinant of her fertility. Although maintaining good health increases the likelihood of conceiving and giving birth to a healthy baby, it does not supersede the impact of age on a woman's fertility. A woman in her early to mid-20s has a monthly probability of 25–30% of conceiving a child. The fall in fertility often initiates a gradual decrease when a woman reaches her early 30s, and accelerates around the age of 35. At the age of 40, the probability of conceiving in a given monthly cycle is approximately 5%. There is a widespread misunderstanding that IVF treatment may effectively counteract the impact of age on fertility. The success rate of IVF is also influenced by a woman's age. In Australia, the probability of a successful live delivery resulting from a single complete IVF cycle, which includes all fresh and frozen-thawed embryo transfers after one ovarian stimulation, is approximately: a. 43% for women between the ages of 30 and 34 b. 31% for women between the ages of 35 and 39 c. 11% for women between the ages of 40 and 44.

The probability of older women conceiving a child is enhanced when they opt for the use of eggs donated by younger women. The likelihood of experiencing pregnancy difficulties also rises with advancing age. The likelihood of experiencing a miscarriage and the occurrence of genetic abnormalities in the fetus escalate after reaching the age of 35. Older women are more prone to experiencing complications during pregnancy, such as gestational diabetes, placenta previa (when the placenta partially or fully covers the cervix, increasing the chance of detachment),

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cesarean delivery, and stillbirth, compared to younger women. Endometriosis and polycystic ovarian syndrome (PCOS) are potential factors that can impact a woman's fertility. The egg count diminishes with advancing age. Furthermore, the eggs that are still present are more prone to possessing aberrant chromosomes. With increasing age, the probability of having acquired health disorders that can impact fertility, such as uterine fibroids and endometriosis, also increases. During the reproductive years, an ovum is released from the ovaries and travels to the uterus on a monthly basis. Pregnancy occurs when fertilization takes place, resulting in the fusion of an egg and sperm within the uterus. A woman's ovarian reserve, which refers to the quality and quantity of her eggs, gradually diminishes over time. However, this decline becomes more pronounced around the age of 37, making it increasingly challenging for her to conceive. After reaching post menopause, the hormonal changes in the body prevent the ovaries from releasing any further eggs, which means the women have reached a stage where conception through natural means is no longer possible.

Menopause is the irreversible cessation of menstruation that occurs without any medical intervention. The procedure is incremental and occurs in three distinct stages:

a. Perimenopause: This is often known as the "menopause transition," refers to the period of time that occurs eight to 10 years before menopause. During this phase, the ovaries gradually decrease their production of estrogen. The onset typically occurs throughout one's forties. Perimenopause is the transitional phase that occurs until menopause, which is the stage when the ovaries cease to release eggs. During the final one to two years of perimenopause, there is a rapid decline in estrogen levels. During this phase, a significant number of individuals may have symptoms associated with menopause. However, it is important to note that you will continue to experience menstrual periods and remain susceptible to pregnancy during this period.
b. Menopause: Menopause refers to the cessation of menstrual cycles. At this point, your ovaries have ceased the release of eggs and significantly reduced the production of estrogen. Menopause is diagnosed by a healthcare provider when there has been a continuous absence of menstrual periods for 12 consecutive months.
c. Post menopause: This refers to the period of time following the cessation of menstruation for a full year, or for the remainder of one's life after menopause. At this point, menopausal symptoms, such as hot flashes, may improve. Nevertheless, certain

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individuals persistently encounter menopausal symptoms for a duration of ten years or more subsequent to the menopause transition. Due to decreased estrogen levels, individuals in the postmenopausal phase face an elevated susceptibility to several health issues, including osteoporosis and heart disease.

Estrogen reaches its highest levels in the days preceding ovulation. Simultaneously, estrogen reduces the viscosity of cervical mucus, a liquid that sperm must navigate in order to reach and fertilize an egg. These alterations generated by estrogen facilitate conception following sexual intercourse.

4. Environmental effect:

Environmental factors refer to external elements that have the potential to influence our well-being. These factors encompass elements such as atmospheric pollution, water pollution, exposure to harmful substances, and even personal choices like dietary habits and physical activity. Environmental influences exert a dual impact on human health, encompassing both beneficial and detrimental impacts. These elements are subject to influence from various determinants, such as geographical location, climatic conditions, as well as social and economic issues. Environmental variables can exert a direct influence on fertility by disrupting the reproductive process. Exposure to chemicals and pollution can harm reproductive systems and disturb hormone levels, leading to increased difficulty in achieving conception. For instance, the presence of lead and other heavy metals can result in abnormalities in sperm, whereas exposure to pesticides and other chemicals can interfere with ovulation and hinder fertility in women. Environmental variables might also indirectly impact fertility by heightening the susceptibility to health issues that may hinder conception.

There are many environmental factors that can impact fertility, including:

- Air pollution: Air pollution has been associated with several reproductive issues, such as reduced sperm count and quality, as well as an elevated likelihood of infertility and miscarriage. Specific air pollutants have the potential to interfere with hormonal balance, hence impeding women's ability to conceive. A study revealed a positive correlation between residing in regions with elevated air pollution levels and increased challenges in conceiving as well as a higher likelihood of experiencing miscarriages among women. A further investigation revealed a correlation between exposure to air pollution and a reduction in ovarian egg count, alongside an elevation in the quantity of defective eggs.

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- Water contamination: Water contamination can adversely affect fertility by disrupting hormone levels and producing reproductive issues due to exposure to substances such as lead, mercury, and arsenic. Heavy metal exposure in women can interfere with hormone function, leading to potential impacts on fertility and pregnancy. Additionally, it can result in fetal developmental issues, resulting in congenital abnormalities or other complexities.
- Pesticides: The act of being exposed to pesticides has been associated with a heightened likelihood of experiencing infertility, as well as other reproductive issues such as miscarriage and birth abnormalities.
- Radiation: High quantities of radiation can cause harm to reproductive organs and negatively impact fertility. Exposure to deleterious radiation, such as that employed in cancer therapy, can impair reproductive organs and impact fertility.
- Lifestyle factors, such as food, exercise, and smoking, can also exert an influence on fertility. Inadequate nutrition and insufficient physical activity can contribute to the development of obesity, which is a significant risk factor for infertility. Smoking has been associated with reduced fertility in both males and females. Prolonged stress can detrimentally affect reproductive well-being, leading to disturbances in the menstrual cycle, impaired ovulation, and diminished sperm count and motility. Excessive alcohol use can impair fertility in both males and females. Pregnant women are also at an elevated risk of experiencing birth abnormalities. Smoking has been associated with reduced fertility in both males and females. Elimination of smoking can enhance your likelihood of achieving conception.

To summarize, environmental influences can exert a substantial influence on fertility. To enhance your likelihood of conceiving and experiencing a healthy pregnancy, it is advisable to minimize your contact with toxins and pollutants, uphold a healthy lifestyle, and undergo testing if you suspect exposure to environmental variables.

6. Sleeping:

Disrupted sleep habits disrupt the natural release of melatonin and can negatively affect reproductive health. High amounts of melatonin are linked to delayed puberty and reduced ovulation, while low levels of melatonin are connected with early puberty. Hormone production

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is the primary aspect of fertility that can be influenced by sleep. Sleep deprivation disrupts hormone production, leading to an imbalance where certain hormones are overproduced while others are underproduced, negatively impacting fertility. Leptin, a hormone, establishes a connection between sleep and fertility in women. Leptin is synthesized in women when they consistently have sufficient sleep. Insufficient sleep can disrupt the menstrual cycle in women due to the impact of the hormone Leptin, which plays a direct role in ovulation.

Sleep governs the secretion of cortisol, a corticosteroid hormone synthesized by the adrenal glands.It is generally known as the hormone associated with stress. Cortisol is essential for regulating many hormones in the body. Estrogen and progesterone contribute to the maintenance of reproductive system health. Insufficient sleep results in elevated cortisol levels upon awakening. This can disturb the delicate balance between estrogen and progesterone. It can induce hypothyroidism, leading to a deceleration of metabolic processes. Sleep plays a crucial role in regulating metabolism, which refers to the series of chemical events in the body that transform food into energy.

7. Hereditary:

Polycystic ovary syndrome (PCOS) can be hereditary. The presence of PCOS in close family members, such as mother, sister, or aunt, often elevates the likelihood of having the condition. There is a possibility of a genetic connection to PCOS, although the particular genes related to the disorder have not been found yet. Approximately 20%–40% of those diagnosed with PCOS have a family member who is also affected, typically a mother or sister. According to the Genetics Home Reference, although Polycystic Ovary Syndrome (PCOS) does not follow a distinct genetic pattern, there is evidence of a familial connection. Approximately 20%–40% of individuals with PCOS have a family member, typically a mother or sister, who is also affected.

8. Irregular menstruation:

Individuals afflicted with polycystic ovarian syndrome (PCOS) may experience irregular or nonexistent menstrual cycles as a result of hormonal imbalances. Irregular menstrual cycles can indicate infertility in individuals with polycystic ovary syndrome (PCOS). Each month, a follicle undergoes maturation and is then expelled by the ovaries in order to facilitate fertilization. However, this is not true in the context of PCOS. Ovulatory infertility can result from the absence of ovulation. Polycystic ovary syndrome is the primary cause of infertility related to the absence of ovulation. PCOS leads to elevated androgen levels, such as testosterone, and

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increased amounts of luteinizing hormone, which aids in ovulation and conception. Elevated amounts of circulating androgens, such as testosterone, disrupt the menstrual cycle and hinder the process of ovulation. Due to the hormonal imbalance associated with Polycystic Ovary Syndrome (PCOS), the follicle fails to undergo maturation or release. Instead of undergoing release, the follicle (often misidentified as a cyst) remains within the ovaries, making it visible on an ultrasound. In the absence of ovulation and the accompanying hormonal processes, the uterus lacks the necessary stimulation to undergo the shedding of its lining, resulting in the absence of a regular menstrual period. In cases of Polycystic Ovary Syndrome (PCOS), the ovaries may exhibit excessive production of androgen hormones. Excessive levels of androgen disrupt the process of ovulation. Consequently, eggs do not undergo typical development and are not discharged from the follicles in which they mature. Hirsutism and acne can also be caused by an excess of androgen.

5.4 Diagnosis:

The precise diagnosis of polycystic ovarian syndrome (PCOS) lacks a single test. The doctor begins by talking about the symptoms, prescription drugs, and any other illnesses. Also, the doctor might inquire about any changes in weight and menstrual cycles. During a physical examination, signs of acne, insulin resistance, and excessive hair growth are looked for. The recommended tests are:

1) Pelvic exam: The doctor examines reproductive organs during a pelvic exam to look for lumps, growths, or other abnormalities.
2) Blood examinations: Blood tests can be used to quantify hormone levels. This testing can help exclude potential factors such as irregular periods or excessive androgen levels that mimic the symptoms of PCOS. You may undergo additional blood tests, such as overnight cholesterol and triglyceride assessments. A tolerance test for glucose can be used to quantify the body's response to sugar (glucose).
3) Ultrasonic: An ultrasound can be used to assess the visual characteristics of the ovaries and measure the depth of the lining of the uterus. Additionally, the vagina serves as the entry point for inserting a transducer, which bears a resemblance to a wand. The transducer emits sound waves which are then transformed into visual representations on the computer's screen.

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In the event that PCOS is diagnosed, the physician suggests additional tests to look for complications (Polycystic Ovary Syndrome (PCOS) - Diagnosis and Treatment - Mayo Clinic, 2022). These examinations may consist of:

1) Frequent monitoring of triglyceride and cholesterol levels, blood pressure, and glucose tolerance
2) screening for anxiety and depression
3) obstructive sleep apnea screening

5.5 Treatment:

One of the main goals of PCOS treatment is managing your concerns. Among these could be obesity, hirsutism, acne, or infertility. Medication or dietary adjustments may be part of a specific treatment plan.

i) Changes in lifestyle: A low-calorie diet along with moderate exercise may be suggested by the healthcare provider as a weight loss strategy. The patient might feel better even if one loses just a small amount of weight 5% of the body weight, for example. Reducing weight can aid in infertility and potentially boost the efficacy of PCOS medications prescribed by the doctor. Together, a patient and a registered dietitian can choose the most effective weight-loss strategy.
ii) Medications: To help one manage their menstrual cycle, your physician may suggest:

1) Combination birth control pills: Combination estrogen and progestin pills control estrogen levels and reduce testosterone production. Hormone regulation can treat acne, excessive hair growth, irregular bleeding, and reduce one's risk of endometrial cancer.
2) Progestin Therapy: In addition to regulating periods, taking progestin for 10 to 14 days every 1 to 2 months can help prevent endometrial cancer. Progesterone treatment won't increase androgen levels or stop conception. If one also wants to avoid getting pregnant, the progestin-only mini pill or the progestin-containing intrauterine device is a better option.

In order to facilitate ovulation and enable conception, the physician may suggest (Polycystic Ovary Syndrome (PCOS) - Diagnosis and Treatment - Mayo Clinic, 2022):

1) Cromoglypene: This is taken as an oral contraceptive pill in the early stages of the menstrual cycle.

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2) Femara, or letrozole. The ovaries may be stimulated by this breast cancer treatment.
3) Metformin. This oral medication for type 2 diabetes reduces insulin levels and enhances insulin resistance. The doctor may advise adding metformin to help one ovulate if clomiphene isn't successful in getting one pregnant. Metformin can help with weight loss and slow the onset of type 2 diabetes in people with prediabetes.
4) Gonadotropins. The administration of these hormone drugs is by injection.

In order to alleviate acne or lessen excessive hair growth, the physician may suggest (Polycystic Ovary Syndrome (PCOS) - Diagnosis and Treatment - Mayo Clinic, 2022):

1) birth control pill: These medications lessen the production of testosterone, which can result in acne and excessive hair growth.
2) Salicylic acid (Aldactone): This drug prevents acne and overgrowth of hair on the skin, two effects of androgen. Effective birth control is required while taking Spiro lactone since it can result in birth defects. If someone is pregnant or intends to become pregnant, this medication is not advised.
3) Eflornithine, or Vaniqa: Face hair growth may be slowed by using this cream.
4) hair elimination: There are two ways to remove hair: electrolysis and laser hair removal. A tiny needle is placed into each hair follicle during electrolysis. Electric current pulses out from the needle. The follicle is first damaged by the current, then destroyed. A focused light beam is used in a medical procedure called laser hair removal to remove unwanted hair. It is possible that one will require several electrolysis or laser hair removal treatments. Other options include shaving, plucking, or using creams that dissolve unwanted hair. However, these are transient, and when the hair grows back, it might get thicker.
5) Acne treatments: Medication, such as tablets and topical gels or creams, may help reduce acne.

5.6 Complications:

Historically, the primary emphasis of polycystic ovarian syndrome (PCOS) has been on the regulation of the menstrual cycle and a woman's reproductive capacity. Nevertheless, PCOS is a multifaceted condition that can affect numerous organ systems. Insufficient management of PCOS can result in severe and enduring consequences, including endometrial cancer, heart

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disease, diabetes, and metabolic syndrome. Women diagnosed with Polycystic Ovary Syndrome (PCOS) have a higher likelihood of developing specific and significant health complications. These conditions encompass type 2 diabetes, hypertension, cardiovascular issues, and uterine cancer. Women diagnosed with Polycystic Ovary Syndrome (PCOS) frequently experience fertility issues.

Endometrial Cancer: Women with Polycystic Ovary Syndrome (PCOS) have a slightly elevated risk of getting endometrial cancer compared to women without PCOS. A woman's risk increases when her menstrual cycles become more irregular and less frequent. Throughout a typical menstrual cycle, the endometrium is subjected to hormones, such as estrogen, that stimulate the growth and thickening of the lining. In cases of PCOS, where ovulation does not take place, the endometrium does not shed as usual. Consequently, it is subjected to significantly elevated levels of estrogen, resulting in an abnormally thick growth of the endometrium. This is the factor that enhances the likelihood of the initiation of cancer cell proliferation.

Cardiovascular Disease: The presence of PCOS in women elevates the likelihood of developing hypertension and heart disease. This is a result of the elevated insulin levels that are linked to PCOS and are recognized to raise the likelihood of excessive triglycerides, inflammatory markers, blood pressure, and atherosclerosis. These circumstances can elevate your susceptibility to a heart attack and stroke.

Diabetes: Women with PCOS commonly experience insulin resistance, which indicates that their bodies have a reduced ability to utilize glucose effectively, leading to elevated glucose levels and increased insulin production. Prolonged elevation of blood glucose levels can result in the development of diabetes. A study conducted in 2012 and published in the journal Diabetes tracked 255 women with polycystic ovary syndrome (PCOS) for a period of 10 years. The study found that 39.3% of these women had type 2 diabetes, whereas only 5.8% of women in the general population developed the same condition.

Metabolic Syndrome: This is often known as Syndrome X, is a collection of risk factors that frequently coexist and elevate the likelihood of developing cardiovascular disease. The prevailing metabolic alterations linked to this syndrome encompass the subsequent:

a. Elevated abdominal mass.

b. Elevated triglyceride levels.

c. Reduced levels of high-density lipoprotein (HDL), commonly known as good cholesterol.

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d. Hypertension

e. Elevated fasting blood glucose levels.

Women with PCOS have an approximately 33% probability of developing metabolic syndrome, which is associated with obesity and insulin resistance.

5.7 Prevention:

There are no known preventive measures for Polycystic Ovary Syndrome (PCOS). However, one can exert control over it by effectively controlling symptoms, leading to significant enhancements in both health and quality of life. This may encompass pharmaceuticals targeting acne and hair growth, fertility interventions, and weight reduction achieved by a nourishing diet and regular physical activity. Untreated PCOS can elevate the likelihood of developing hypertension, hyperlipidemia, and insulin resistance, so augmenting the risk of heart disease and diabetes. Considering the absence of a cure for PCOS, physicians address each symptom individually. The treatment received by each woman will vary based on the specific symptoms that are most bothersome and the individual goals of treatment.

5.8 Epidemiology:

PCOS is a complex genetic disorder that is heterogeneous and multifactorial (Fatema et al, n.d). Approximately 5% of women suffered from PCOS or polycystic ovary syndrome while they were in their reproductive age, and PCOS is a common condition characterized by hyperandrogenism and anovulation as clinical features (Solomon, 1999). According to certain research, PCOS may raise the risk for a number of illnesses, such as type 2 diabetes, dyslipidemia, hypertension, cardiovascular disease, diabetes and hypertension linked to pregnancy, and certain cancers. 3.7% of young women (18–25 years old) had PCOS, and most of them were thin. Due to the higher prevalence of pre-hypertension and abnormal waist-hip ratio, these women were already at a high risk of developing metabolic syndrome at this young age.

A study involving 16,700 infertile women in Bangladesh revealed that 31.7% of these women had PCOS (Fatema et al, n.d). Similar to Pakistan and Bangladesh, PCOS affects a significant portion of Nepal's female population. In Nepal, PCOS affects 5–10% of the population overall. This spurt of percentage in PCOS patients in Bangladesh and around the world in general gives a broad idea of how infertility and PCOS is increasing among the women. Incidence of PCOS among women of reproductive age increased globally in 2017 to 82.44 (64.65–100.24) cases per 100,000 people.

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Moreover, since people have begun to visit hospitals and check what could be the reason they aren't conceiving or having irregular menstrual cycles, this might be the reason many cases of infertility due to PCOS are unwinding. To add, there might be more women suffering from PCOS and have no idea about it since it's symptoms mostly comprises of Hormonal imbalance, growth of facial hair or body hair, weight gain, messed sleeping schedule, impaired blood sugar level or Diabetes mellitus, thyroid problem and etc.

The only way to control PCOS is by lessening the symptoms and losing weight by eating a healthy diet and exercising more. These factors facilitate ovulation, lower blood glucose levels, and improve the way your body uses insulin. ovulation-inducing medications. Also, medications can facilitate the ovaries' regular egg release. Although there's no cure for PCOS however, treatment of PCOS is available and there are infertility experts who help patients diagnosed with PCOS to become pregnant via various treatments such as lifestyle changes, medication, and also IVF (in vitro fertilization).

In a nutshell, the epidemiology of PCOS has been increasing in Bangladesh as well as around the world as people are being more open to learning or treating PCOS. Moreover, it has become one of the most common problems among Bangladeshi women. Nevertheless, there are treatments to help lessen the symptoms and allow the women with PCOS to go with their daily lives and even start a family of their own.

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Chapter 6: Literature Review

6.1 Introduction:

The objective of this review of the literature is to provide the necessary context and structure for the study papers pertaining to the subject of my inquiry. Polycystic ovarian syndrome is a widespread condition that impacts women worldwide. An irregular cycle of menstruation is the main cause that contributes to this illness. Furthermore, the subsequent scholarly publications function as secondary sources and provide suggestions for the employed research methodologies. Furthermore, these sources played a role in enhancing data collection procedures, identifying appropriate focus groups, and formulating well-designed questionnaire queries. In addition, the research papers deepened my comprehension of the topic area of my thesis.Here is a concise overview of a research paper:

6.2 Association of PCOS with other factors:

The study titled "Sleep Habits of Women with Infertility" was conducted by Esther Eisenberg et.al. The objective of this study was to assess sleeping patterns in infertile women with polycystic ovary syndrome (PCOS) in comparison to women with unidentified infertility (UI), and to identify factors that contribute to disrupted sleep.

The study sample consisted of 739 women diagnosed with Polycystic Ovary Syndrome (PCOS) and 864 women diagnosed with infertility and Urinary Incontinence (UI). These women completed a sleep questionnaire at the beginning of the study and participated in simultaneous randomized controlled trials conducted by the NICHD's Collaborative Reproductive Medicine Network. Both trials involved women between the ages of 18 and 40. The diagnosis of PCOS in women was made using the modified Rotterdam Criteria, which necessitated the existence of ongoing anovulation and both excess testosterone (clinical or biochemical) or the observation of polycystic ovaries using ultrasound. Exclusion of additional causes of PCOS was performed. Furthermore, it was required that at least one fallopian tube exhibit tubal patency, and the male partner must possess a sperm count of no less than 14 million sperm per milliliter. Women experiencing urine incontinence (UI) exhibited regular ovulatory menstrual cycles and underwent a comprehensive evaluation to exclude any potential reproductive problems. It was determined that at least one of their fallopian tubes was unobstructed, and their male partner had a minimum approximately 5 million specimens in their semen. Both trials involved couples who had been unable to get pregnant for a minimum period of 1 year.

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Participants for both research were selected via several channels, including local medical facilities affiliated with each academic institution, such as television and newspaper advertisements, as well as online platforms. Eligibility of participants was determined through a succinct telephone interview conducted according to a standardized approach across all sites. Participating couples who fulfilled the specified requirements underwent an official screening visit, at which they gave written consent after being fully informed, and also filled out survey questionnaires. Both studies recruited individuals from an identical clinical population source by simultaneously selecting the identical clinical sites using similar approaches. This method resulted in the formation of simultaneous, well defined cohorts of women who are unable to conceive and have Polycystic Ovary Syndrome and women who experience Urinary Incontinence (UI), which accurately reflect their respective populations across the United States.

The results of the investigation showed that women with PCOS had a greater occurrence of sleep duration below six hours (6.1% vs 2.7%; $P < .001$), regular snore (37.8% vs 19.0%; $P < .001$), and clinical sleepiness (12.0% vs 8.6%; $P < .026$) in comparison with women with UI. After considering variables that could affect the results, it was determined that there is a significant connection ($P = .010$) between polycystic ovary syndrome (PCOS), high fasting insulin, and the clinical signs of a sleep apnea with obstructive (OSA) diagnosis. Furthermore, the study revealed a strong association between regular snoring and PCOS, high insulin levels ($P = .003$), waist circumference greater than 88 centimeter ($P = .003$), and current cigarettes smoked ($P = .012$). The study revealed a strong correlation between the depressive disorder rating ($P < .001$) and the diagnosis of PCOS ($P = .002$) in relation to felt daytime tiredness. No significant link was observed between a shorter duration of sleep and the development of clinical signs of OSA (Obstructive Sleep Apnea) in relation to conception and live birth rates. The experiment's findings indicate that infertile women with PCOS are more susceptible to reporting sleep troubles in comparison to those with UI.

Indicators of diabetes are associated with a previous diagnosis of sleep apnea with obstruction (OSA), persistent snoring, and a restricted duration of sleep. The presence of clinical symptoms of OSA or a short duration of sleep does not affect one's reaction to fertility treatment.

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Chapter 7: Methodology

7.1 Introduction

The research methodology involves the systematic techniques used to gather data, analyze it, and derive findings related to the subject under investigation. A research technique is a crucial element in the study's plan. The creation and establishment of a systematic approach is a crucial stage in attaining the objectives of a research effort. Using an effective and dependable research methodology assures that conclusions are grounded in sound scientific principles. Furthermore, the detailed aspects of the strategy enable researchers to maintain focus, leading to a more streamlined and manageable process overall. The researcher's methodology explains the cognitive processes and systematic approaches that resulted in the study's conclusions.

7.2 Aim of the study:

General objective:

To find out the infertility outcome of women.

Specific objectives:

1. To find out the infertility outcome of women and also men.
2. To find out the risk factors contributing to infertility in women and men.
3. To predict the outcome of how specific risk factors impact infertility.
4. To find out if the current treatments are effective for infertile women.
5. To find out the relationship between socio-demographic variables and infertility outcome of the respondents.

7.3 Research Methodology:

A cross-sectional study is observational research that evaluates both the exposure and the outcome at a single moment in time within a sample group. In a cross-sectional investigation, information is gathered from a substantial number of individuals at a particular moment and location. Cross-sectional studies are distinguished by their non-interventional nature, as they collect data without actively seeking to modify any of the measurable variables.

7.4 Ethical statement:

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Participants and/or legal guardians are given verbal permission for them to take part in the investigation (in this instance of children). The participants were given extensive information regarding the study's methodology and its objectives. The identity of the respondents were also concealed.

7.5 Area of study and participants:

The investigation was conducted at two tertiary hospitals. The research was conducted from December 15, 2022 to October 20, 2023. Prior to beginning any data collection, the relevant authorities were consulted and provided authorization. We were granted access to patient records and given permission to communicate with attending physicians and other hospital staff. The investigation included a total of 70 patients. The survey primarily consisted of patients who received medical care at the institution. The age of the patients varied from the stage before reaching sexual maturity to the period long beyond the cessation of menstruation. The inclusion of participants from various socioeconomic backgrounds and educational levels enhances the study's comprehensiveness.

In order to be eligible for the study, the patient must belong to the demographic of married individuals who are actively attempting to conceive. Individuals affected with infertility seeking treatment at these medical facilities.

7.6 Questionnaire:

A questionnaire was devised to gather data, encompassing age, marital status, economic and social background, academic achievement, menstruation cycle, symptoms, issues, and risk factors of the participants.Their lifestyle data was unattainable due to individuals' reluctance to divulge personal information. The doctor's assistant completed the questionnaire form.

7.7 Statistical Analysis:

All the collected data were coded, input into the computer and analyzed by SPSS software programme 27 version. Frequency, percentage of all variables, mean and standard deviation of age of the respondents, income per month (taka), duration of seeking baby, marital history, time interval between marriage and first conception (in years) and BMI of respondents were calculated. Then the risk factors were assessed and the relationship between age of respondents

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and infertility outcome was analyzed by the test statistics. The relationship between some socio-demographic variables, biosocial factors, risk factors and infertility outcome of respondents were also statistically analyzed by the chi-square test. Moreover, to find out if the current treatments were effective, t test was conducted.

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Chapter 8 Results

After data was gathered, it was summarized and examined. Establishing the frequency of distinct traits among patients and comparing them across patients with varying circumstances and also, t-test was done to get to the depth of the study.

8.1 Distribution of patients' diagnosis.

8.1.1 Distribution of Patients' Disease Diagnosis.

Table 1: Frequency table distribution of patients' disease diagnosis.

	Frequency	Percent	Valid Percent	Cumulative Percent
PCOS	63	90.0	90.0	90.0
Normal	7	10.0	10.0	100.0
Total	70	100.0	100.0	

According to the data presented in Table 1, a cross-table analysis was conducted to examine the distribution of patient's disease diagnosis. The total number of participants was 70, with 63 women testing positive for PCOS, accounting for 90% of the total patients. Only 7 out of the 70 participants were found to be normal, representing 10% of the total. Therefore, the individuals who tested positive for the condition were chosen as the subjects for the study. The study excluded patients who tested negative for PCOS.

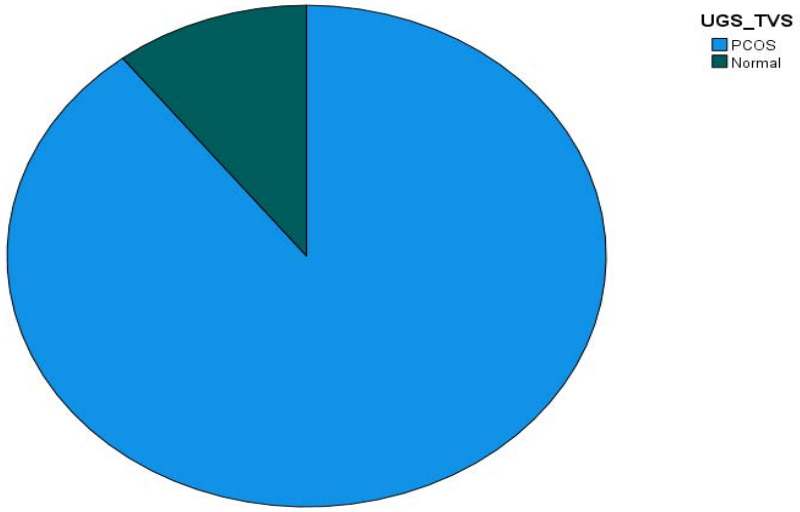

Figure 10: Distribution of Patient's Disease Diagnosis

8.1.2 Two sample T-test to check for association between infertile patient and their Husband.

H0 hypothesis: There does not exist correlation between the age of a patient and the age of their spouse.

H1 hypothesis: Exists a correlation between the age of the patient and the age of their spouse

Mean of patient: 25.9286 Mean of husband: 34.6286

SD of patient: 4.83442 SD of husband: 6.02452

The p-value is 1.389e-16 and the test statistic T is -9.4233, which falls outside the 95% acceptability range. Given that the p-value is less than the significance level α, we can conclude that the null hypothesis H0 is rejected.

The mean age of the population of PCOS patients is not equivalent to the mean age of the population of their husbands.

Put simply, the disparity between the average age of infertile patients and their husbands is substantial enough to have statistical significance.

Table 2: Frequency Table Distribution of Patient and their husband with mean difference.

	N	Mean	Std. Deviation		t	df
Age	70	25.9286	4.83442	Age	44.873	69
husband's age	70	34.6286	6.02452	husband's age	48.091	69

In the above table 2, we can see the cross-sectional analysis between the patient's age and their husband's. The total number of patients was 70 and the mean of their age is 25.9286. The mean of the husband's age was 34.628. And the mean difference of their age is (34.6286 - 25.9286) = 8.7 approximately. The standard deviation of the patient's age and husband's age is 4.83442 and 6.02452 respectively. The T value of the patient and husband's age is 44.837 and 48.091 respectively. The degree of freedom of the patient's and husband's age is the same which is 69.

8.2 Association of PCOS with Socio-Demographic Factor:

This study revealed a substantial prevalence of PCOS among individuals from different socio-demographic backgrounds, including relationship status, education level, economic position, place of residence, work, previous experience with abortion, and number of years in marriage.

8.2.1 Distribution of PCOS Patient Based on Age:

Table 3: Frequency Table Distribution of Age Among PCOS Patients

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20-25	36	57.1	57.1	57.1
	26-30	20	31.7	31.7	88.9
	31-35	5	7.9	7.9	96.8
	36-40	2	3.2	3.2	100.0
	Total	63	100.0	100.0	

As visible in Table 3, this table contains the age variation among PCOS patients. Out of the 63 patients, 36 patients age range between 20-25 have PCOS which is 57.1% out of 100. 31.7%

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patients aged between 26-30 have PCOS. 5 patients aged between 31-35 have PCOS which is 7.9 percent. and only 2 people out of 63, ages between 36-40 have PCOS which is only 3.2% of total. Most women who were PCOS patients and infertile were in their early 20s.

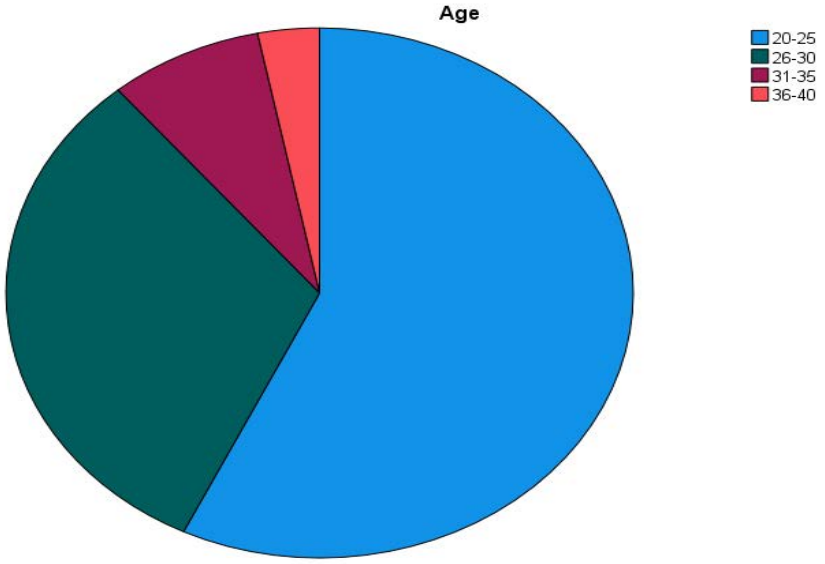

Figure 11: Distribution of Age among PCOS Patients

8.2.2 Distribution of PCOS Patient Based on Education:

Table 4: Frequency Table Distribution of Education Among PCOS Patients

Education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Class V	4	7.8	7.8	7.8
	Class VI-X	7	13.7	13.7	21.6
	Class XI-XII	18	35.3	35.3	56.9
	Graduate	19	37.3	37.3	94.1
	Postgraduate	3	5.9	5.9	100.0
	Total	51	100.0	100.0	

From Table 4, the Education distribution of PCOS patients were depicted where, 7.8% patients studied till class 5. 13.7% of patients studied between class 6 to 10. 35.3% studied till college. 37.3% of patients were graduates and only 5.9% of patients were postgraduates. So, the highest percentage of patients having PCOS were graduated.

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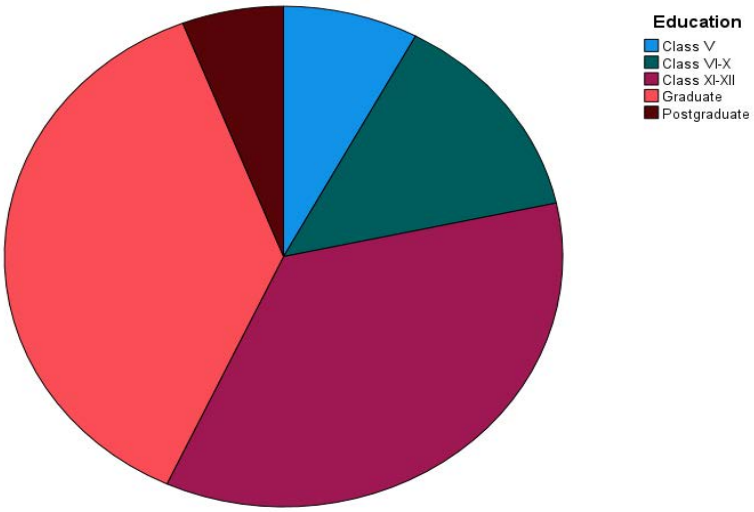


Figure 12: Distribution of Education Among PCOS Patients

8.2.3 Distribution of PCOS Patient Based on Occupation:

Table 5: Frequency Table Distribution of occupation Among PCOS Patients

Occupation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Housewife	47	74.6	74.6	74.6
	Service holder	14	22.2	22.2	96.8
	Student	2	3.2	3.2	100.0
	Total	63	100.0	100.0	

Table-5 contains distribution according to the Occupation of the PCOS patients, it was found that around 74.6% were housewives, followed by 22.2% being service holders and only 3.9 % were students. so, from the analysis we can see the maximum of the patients were housewives and minimum were students.

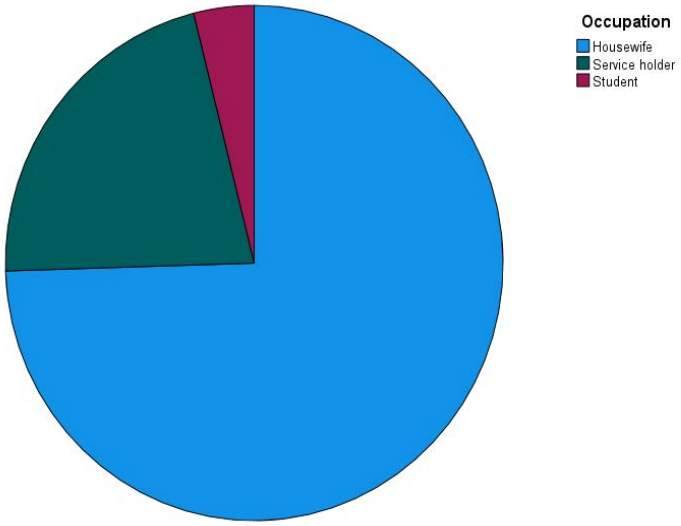


Figure 13: Distribution of Occupation Among PCOS Patients

8.2.4 Distribution of PCOS Patient Based on Marital status:

Table 6: Frequency Table Distribution of Marital status Among PCOS Patients

Marital_status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Married	63	100.0	100.0	100.0

As illustrated in Table 6, all the 63 diagnosed PCOS patients were married and trying to conceive.

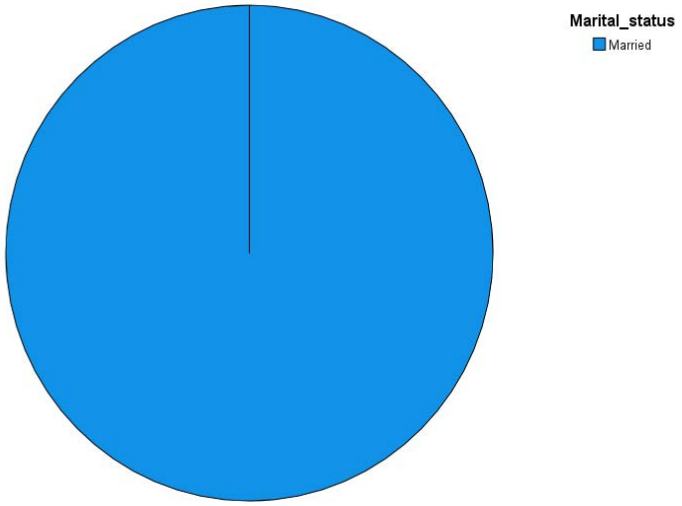


Figure 14: Distribution of Marital status Among PCOS Patients.

8.2.5 Distribution of PCOS Patient Based on Habitation:

Table 7: Frequency Table Distribution of Habitation Among PCOS Patients

Habituation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Urban	43	68.3	68.3	68.3
	Rural	20	31.7	31.7	100.0
	Total	63	100.0	100.0	

Table 7 contains distribution of habituation among PCOS patients. Out of the 63 patients 43 used to live in urban areas with a percentage of 68.3 out of 100. And 20 out 63 used to live in rural areas with a percentage of 31.7. So, from this analysis we see that the number of patients living in cities is the highest.

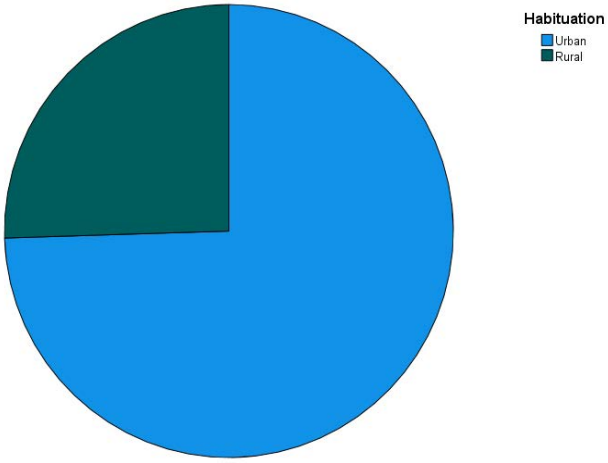


Figure 15: Distribution of Habitation Among PCOS Patients

8.2.6 Distribution of PCOS Patient Based on Economic Status:

Table 8: Frequency Table Distribution of Economic status Among PCOS Patients

Economic_status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-20,000 taka	20	31.7	31.7	31.7
	21,000 - 45,000taka	20	31.7	31.7	63.5
	46,000- 65,000 taka	13	20.6	20.6	84.1
	66,000 - 1lakh taka	10	15.9	15.9	100.0
	Total	63	100.0	100.0	

Table 8 is the distribution of economic status among PCOS patients. Here, 31.7 percent which is 20 patients out of 63 have monthly income less or equal to 20k. 20.6 percent which is 13 out of 63 people have a monthly income between 46k to 65k. 15.9 percent which is only 10 people out of 63 have a monthly income between 66k to 1 lakh. So, only 15.9 % people were economically more stable than others.

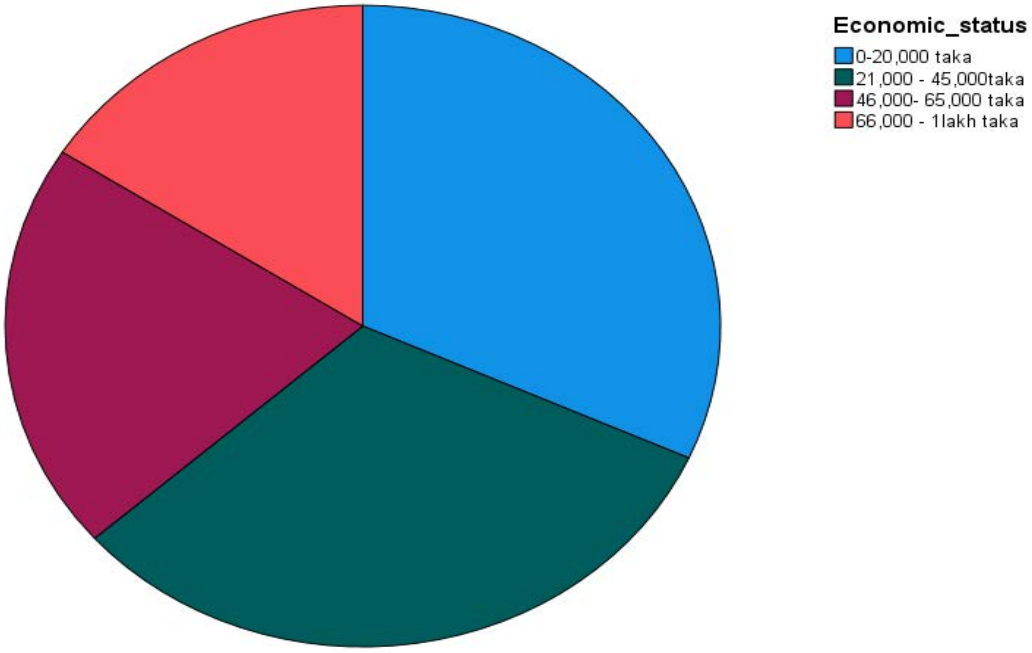


Figure 16: Distribution of Economic status among PCOS Patients.

8.2.7 Distribution of PCOS Patient Based on Abortion:

Table 9: Frequency Table Distribution of Abortion Among PCOS Patients

Statistics

		Abortion	Number_of_abortions
N	Valid	63	63
	Missing	0	0
Mode		2.0	3.00
Range		1.0	2.00
Minimum		1.0	1.00
Maximum		2.0	3.00

From table 9, we can see the distribution of abortion among the PCOS patients. Here, the mode of abortion is 2 and the number of abortions is 3. The range of abortion is 1 and the range of

abortion is 2. The minimum number of abortion and abortion is 1. and the maximum abortion is 2 and the maximum number of abortions is 3.

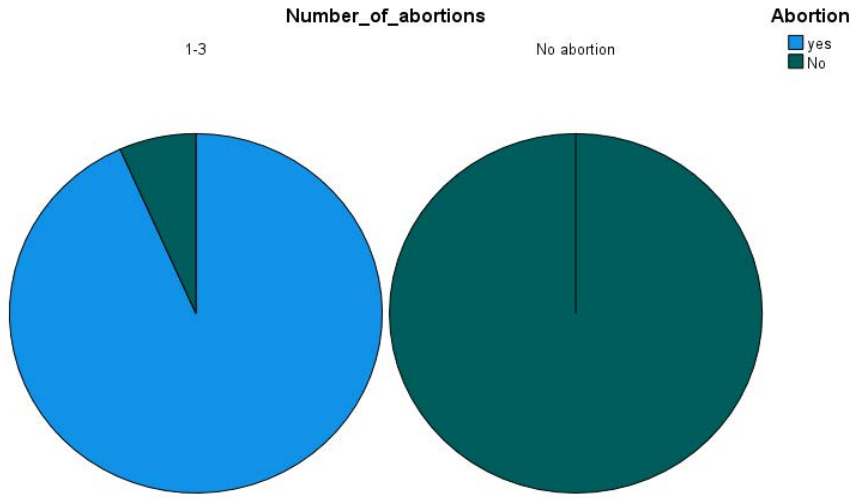


Figure 17: Distribution of Abortion Among PCOS Patients

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

Table 10: Frequency Table Distribution according to Socio-demographic variables.

Statistics

		Age	Education	Occupation	Marital_status	Habituation	Economic_status	Abortion
N	Valid	63	63	63	63	63	63	63
	Missing	0	0	0	0	0	0	0
Mode		22.00	3.00[a]	1.000	1.00	1.00	20000.00	2.0
Range		20.00	4.00	2.000	.00	1.00	142000.00	1.0
Minimum		20.00	1.00	1.000	1.00	1.00	8000.00	1.0
Maximum		40.00	5.00	3.000	1.00	2.00	150000.00	2.0

a. Multiple modes exist. The smallest value is shown

According to Table 10, it summarizes the distribution according to Socio-demographic variables such as age, education, occupation, habitation, etc. Moreover, for each socio-demographic factor, respective modes, range, maximum and minimum are given here.

8.4 Association of PCOS with Medical related history or problems:

8.4.1 Distribution of PCOS Patient Based on Menstrual cycle:

Table 11: Frequency Table Distribution of Menstrual cycle Among PCOS Patients

Menstrual_cycle

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Regular	4	6.3	6.3	6.3
	Irregular	36	57.1	57.1	63.5
	Infrequent	13	20.6	20.6	84.1
	Oligomenorrhoea	10	15.9	15.9	100.0
	Total	63	100.0	100.0	

Table 11 depicts the distribution of menstrual cycles among the PCOS patients and as we can see here, 57.1% patients out of 100 had irregular cycles, followed by 20.6% patients had infrequent cycles, 15.9% were Oligomenorrhoea and only 6.3% had regular cycles. so, here we can see that the percentage of patients having regular cycles is very low whereas the number of irregular cycles is the highest.

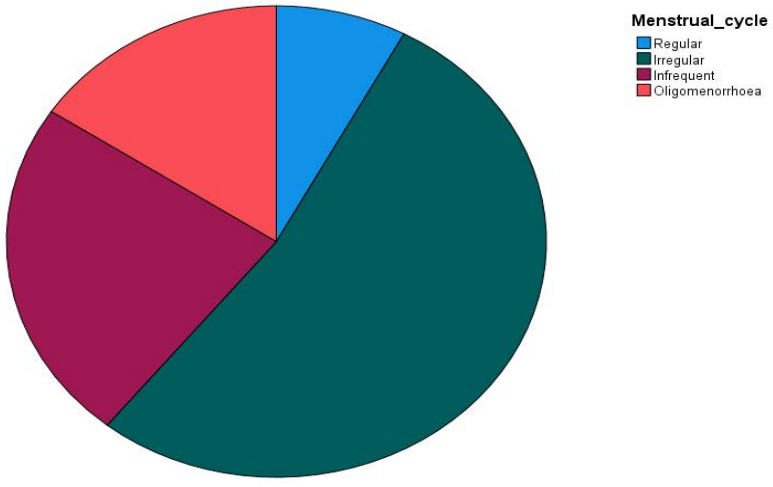


Figure 18: Distribution of Menstrual cycle among PCOS Patients.

8.4.2 Distribution of PCOS Patient Based on Medical and Surgical history:

Table 12 & 13: Frequency Table Distribution of Medical and Surgical History Among PCOS Patients.

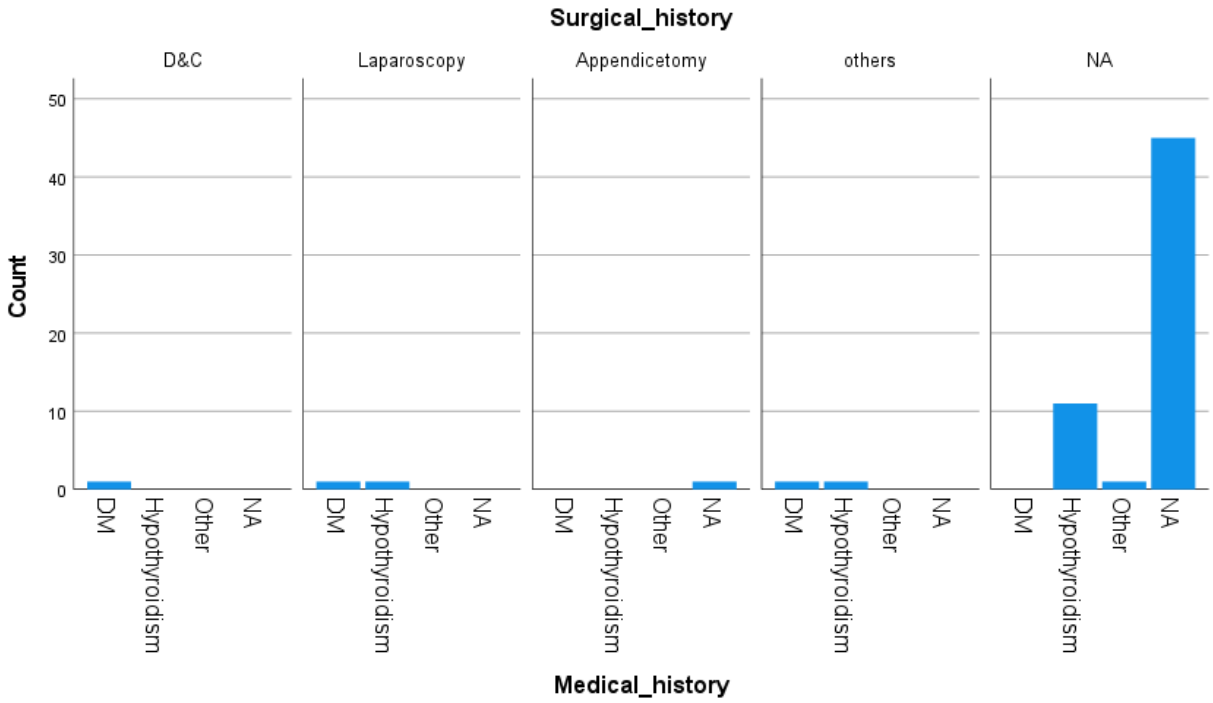
Table 12 and 13 illustrates that 73% PCOS patients did not have any medical history and 90.5% didn't have any surgical history whereas 20.6% had Hypothyroidism, 4.8% had Diabetes mellitus and 1.6% had other disease or did D&C and laparoscopy in the past. So, from the analysis we came to the conclusion that the number of PCOS patients who did not have any past medical or surgical history is the highest.

Medical_history

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DM	3	4.8	4.8	4.8
	Hypothyroidism	13	20.6	20.6	25.4
	Other	1	1.6	1.6	27.0
	NA	46	73.0	73.0	100.0
	Total	63	100.0	100.0	

Surgical_history

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	D&C	1	1.6	1.6	1.6
	Laparoscopy	2	3.2	3.2	4.8
	Appendicetomy	1	1.6	1.6	6.3
	others	2	3.2	3.2	9.5
	NA	57	90.5	90.5	100.0
	Total	63	100.0	100.0	



Graph 1: Distribution of Medical and surgical history Among PCOS Patients

8.4.3 Distribution of PCOS Patient Based on Tubal Patency Test:

Table 14: Frequency Table Distribution of Tubal Patency Test among PCOS Patients.

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Tubal_patency_Test_HSG_SHS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Tube patent(Right-Left)	18	28.6	28.6	28.6
	Tube Block(Right)	2	3.2	3.2	31.7
	Tube block(left)	3	4.8	4.8	36.5
	Tube Block(both)	4	6.3	6.3	42.9
	Not done	36	57.1	57.1	100.0
	Total	63	100.0	100.0	

According to Table 14, 57.1% of the patients didn't do the Tubal patency test and among those who did, 28.6% did Tube patent (Right-left), followed by 6.3% Tube Block (both) and lastly 3.2% of Tube block (right) and 4.8% Tube Block (left)

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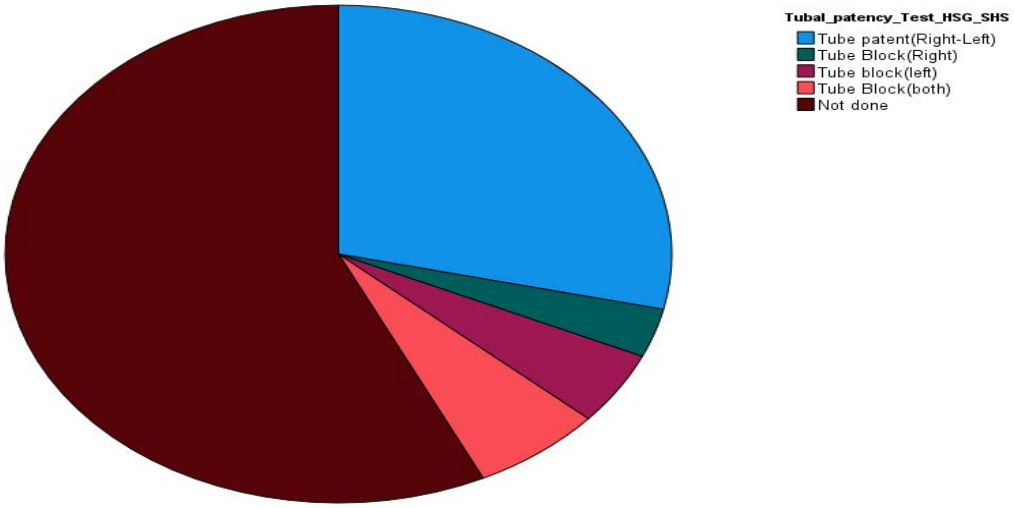

Figure 19: Distribution of Tubal Patency Test among PCOS Patients.

8.4.4 Distribution of PCOS Patient Based on Contraceptive history:

Table 15: Frequency Table Distribution of Contraceptive history Among PCOS Patients.

Contraceptive_history

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	OCP	17	27.0	27.0	27.0
	Implant	1	1.6	1.6	28.6
	Cu-T	1	1.6	1.6	30.2
	none	44	69.8	69.8	100.0
	Total	63	100.0	100.0	

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Table 15 displays the contraceptive history of the PCOS patients where 69.8% did not use or consume any whereas 27% had OCP and 1.6% had implant and 1.6% Cu-T.

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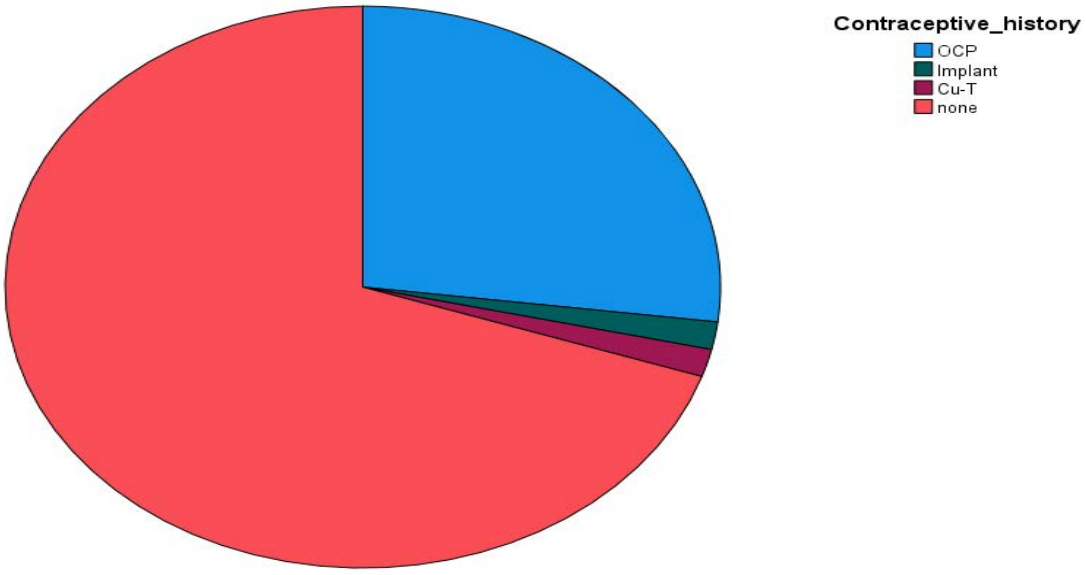


Figure 20: Distribution of Contraceptive history among PCOS Patients.

8.4.6 Distribution of PCOS Patient Based on infertility type:

Table 16: Frequency Table Distribution of infertility type Among PCOS Patients.

Type_of_infertility

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Primary	46	73.0	73.0	73.0
	Secondary	17	27.0	27.0	100.0
	Total	63	100.0	100.0	

From Table 16, 73% of the PCOS patients have primary infertility and 27% have secondary infertility. Here, the primary infertility among PCOS patients is the highest.

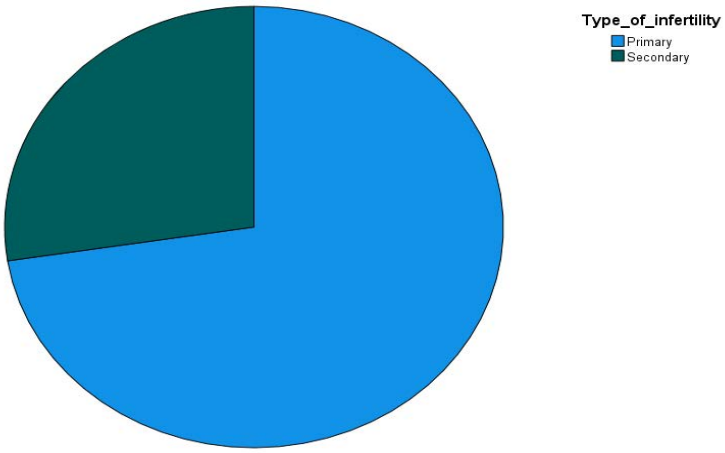


Figure 21: Distribution of types of infertility among PCOS Patients.

8.5 Distribution of PCOS according to the medical related problems or history.

Table 17: Frequency Table Distribution of Medical related problems or history among PCOS Patients.

	N	Minimum	Maximum	Sum	Mean	Std. Deviation
Menstrual_cycle	63	1.00	2.20	125.30	1.9889	.27007
Medical_history	63	2.00	8.00	433.00	6.8730	1.95508
Surgical_history	63	1.00	6.00	361.00	5.7302	.97064
Family_history_of_infertility	63	1.00	2.00	112.00	1.7778	.41908
Contraceptive_history	63	1.00	5.00	244.00	3.8730	1.78246
Husband_medical_history	63	1.00	10.00	598.00	9.4921	1.98277
Husband_Surgical_history	63	6.00	7.00	438.00	6.9524	.21467
Type_of_infertility	63	1.00	2.00	80.00	1.2698	.44744
Valid N (listwise)	63					

As shown in Table 17, all the medical related problems or history are summarized in the table giving a brief understanding of the mean, standard deviation and standard error mean of each factor all together.

8.6 Association of PCOS with Risk Factors:

8.6.1 Distribution of PCOS Patient Based on BMI (Body Mass Index):

Table 18: Frequency Table Distribution of BMI among PCOS Patients.

BMI

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Underweight(<18.5)	1	1.6	1.6	1.6
	Normal(18.5-24.9)	22	34.9	34.9	36.5
	Overweight(25-29.9)	32	50.8	50.8	87.3
	Obsese(30-39.9)	8	12.7	12.7	100.0
	Total	63	100.0	100.0	

According to Table 18, 50.8% of the PCOS patients were found to be Overweight whereas 34.9% were Normal followed by 12.7% being obese and only 1.6 percent underweight. From the analysis we can see that the highest number of people having PCOS were overweight.

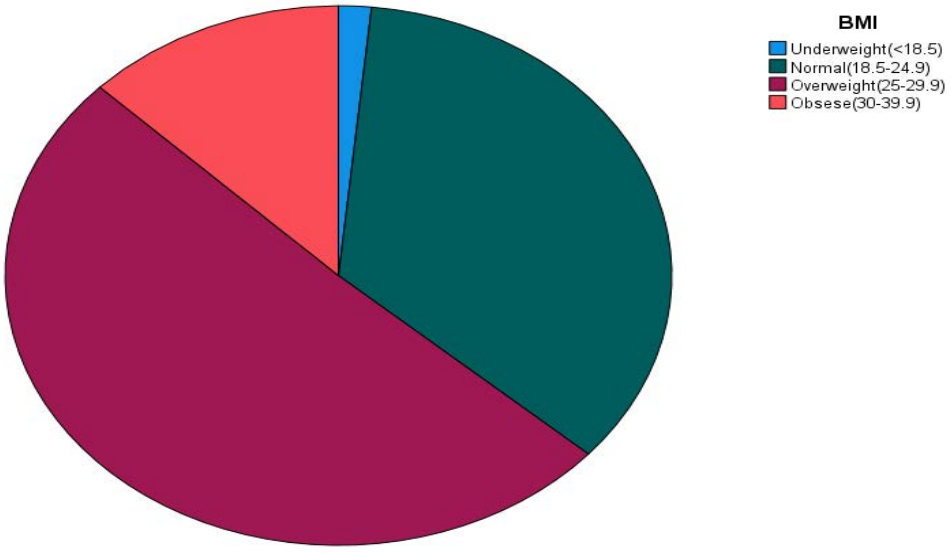


Figure 22: Distribution of BMI among PCOS Patients.

8.6.2 Distribution of PCOS Patient Based on Hirsutism and Acanthosis Nigricans:

Table 19 & 20: Frequency Table Distribution of Hirsutism and Acanthosis Nigricans among PCOS Patients.

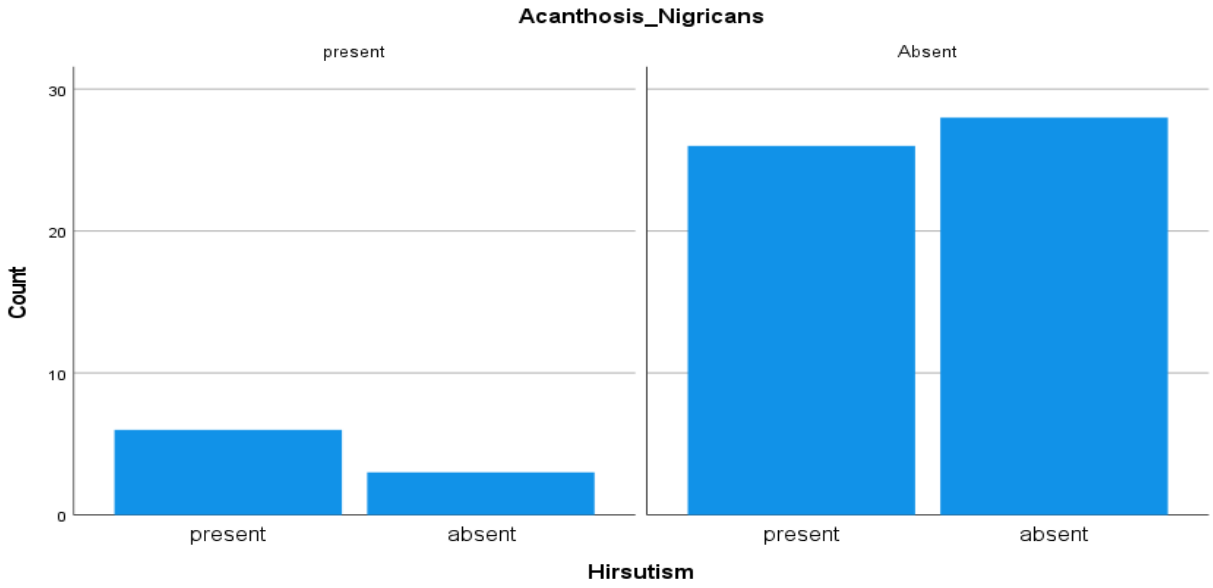
From the table 19 and 20, 49.2% had the absence of Hirsutism and 50.8% had its presence whereas, 85.7% had the absence of Acanthosis Nigricans and 14.3% had its presence.

Hirsutism

	Frequency	Percent	Valid Percent	Cumulative Percent
present	32	50.8	50.8	50.8
absent	31	49.2	49.2	100.0
Total	63	100.0	100.0	

Acanthosis_Nigricans

	Frequency	Percent	Valid Percent	Cumulative Percent
present	9	14.3	14.3	14.3
Absent	54	85.7	85.7	100.0
Total	63	100.0	100.0	



Graph 2. Distribution of Hirsutism and Acanthosis Nigricans among PCOS Patients.

8.6.3 Distribution of PCOS Patient Based on Blood sugar:

Table 21: Frequency Table Distribution of Blood sugar among PCOS Patients.

Table 21 depicts that 44.4% of the patients were Normal, followed by 49.2% having impaired blood glucose and 6.3% had Diabetes mellitus.

Blood_sugar

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Normal	28	44.4	44.4	44.4
	impaired blood glucose	31	49.2	49.2	93.7
	Diabetes mellitus	4	6.3	6.3	100.0
	Total	63	100.0	100.0	

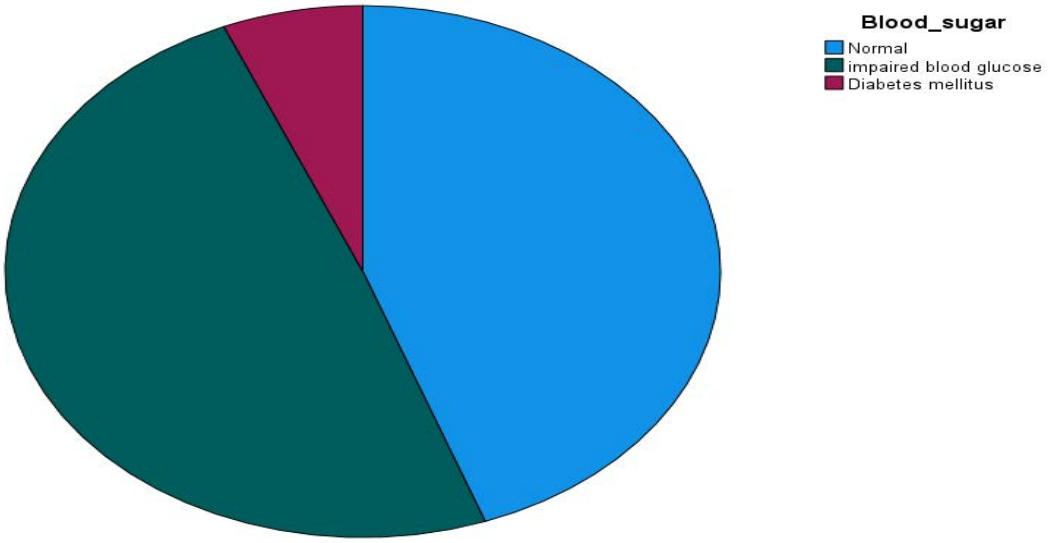


Figure 23: Distribution of Blood sugar among PCOS Patients.

8.6.4 Distribution of PCOS Patient Based on Family history of infertility:

Table 22: Frequency Table Distribution of Family history of infertility Among PCOS Patients.

77.8% Patients did not have any family history of infertility whereas the remaining 22.2% agreed that they have family history of infertility as shown in Table 22.

Family_history_of_infertility

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	14	22.2	22.2	22.2
	no	49	77.8	77.8	100.0
	Total	63	100.0	100.0	

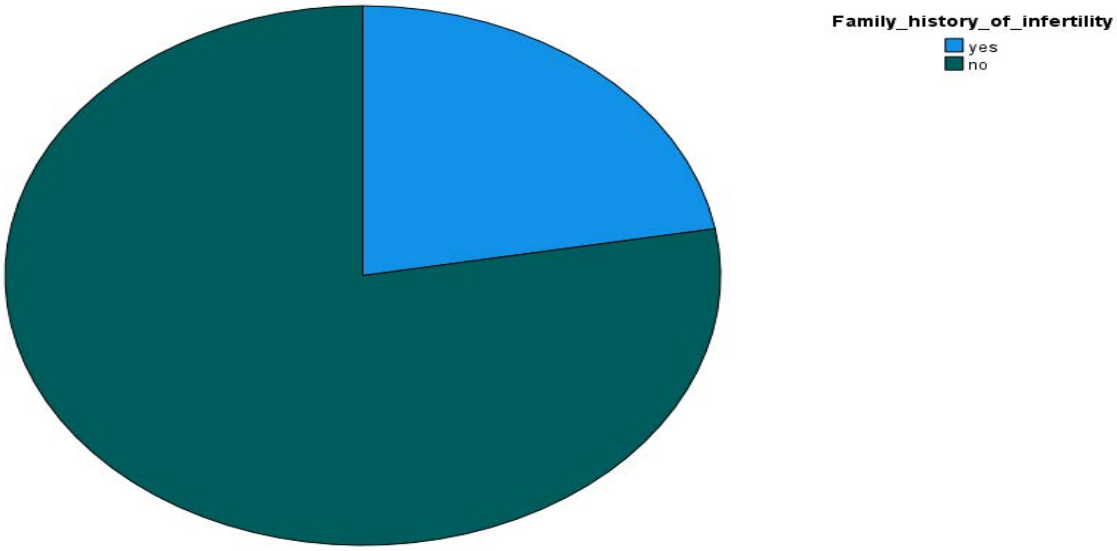


Figure 24: Distribution of Family history of infertility among PCOS Patients.

8.6.5 Distribution of PCOS Patient Based on Hormone Profile:

Table 23: Frequency Table Distribution of Hormone profile among PCOS Patients.

Table 23 illustrates that 66.7% of the PCOS patients had 2:1 Hormone profile, 19% were normal, 9.5% were >=3:1 and 4.8% was 1:1.

Hormonal_profile_LH_to_FSH_ratio

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1:1	3	4.8	4.8	4.8
	2:1	42	66.7	66.7	71.4
	>=3:1	6	9.5	9.5	81.0
	1:2 (Normal)	12	19.0	19.0	100.0
	Total	63	100.0	100.0	

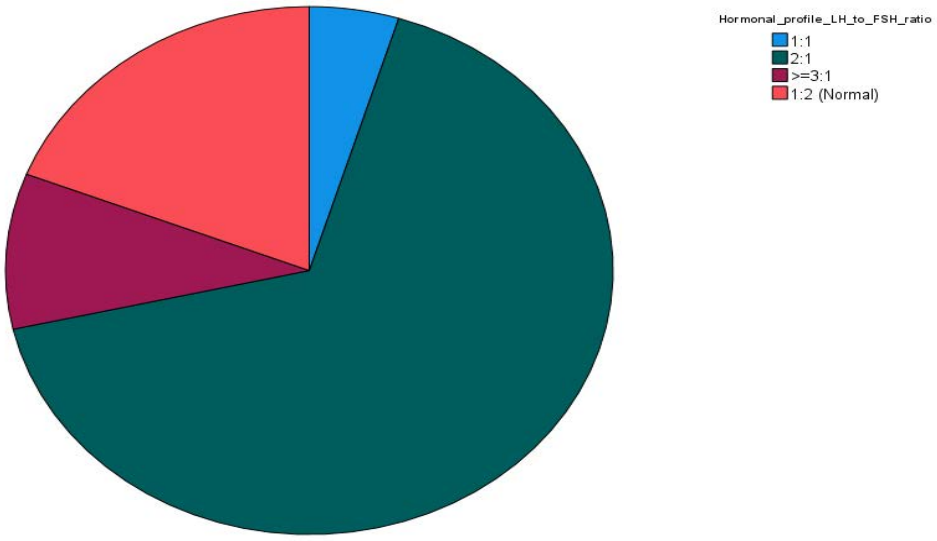


Figure 25: Distribution of Hormonal Profile among PCOS Patients.

8.6.6 Distribution of PCOS Patient Based on Thyroid hormone:

Table 24: Frequency Table Distribution of Thyroid Hormone among PCOS Patients.

According to the Thyroid hormone depicted by Table 24, 71.4% were normal, 25.4% suffered from Hypothyroidism and 3.2% from Hyperthyroidism.

Thyroid_hormone

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Normal	45	71.4	71.4	71.4
	Hypothyroidism	16	25.4	25.4	96.8
	Hyperthyroidism	2	3.2	3.2	100.0
	Total	63	100.0	100.0	

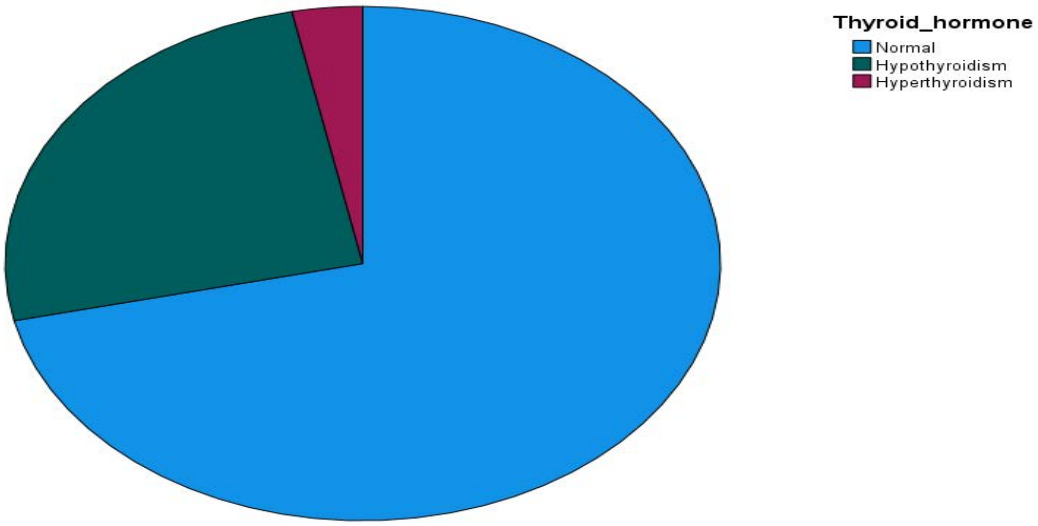


Figure 26: Distribution of Thyroid Hormonal among PCOS Patients.

8.6.7 Distribution of PCOS Patient Based on S. Testosterone and S. Prolactin:

Table 25 & 26: Frequency Table Distribution of S.Testosterone and S.Prolactin among PCOS Patients.

From Tables 25 & 26 below, 85.7% patients had normal levels of S. Testosterone whereas 14.3% had high S. Testosterone. To add, 54% had normal S. Prolactin whereas 46% had high S. Prolactin levels.

S.Testosterone

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Normal	54	85.7	85.7	85.7
	High	9	14.3	14.3	100.0
	Total	63	100.0	100.0	

S.Prolactin

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Normal	34	54.0	54.0	54.0
	High	29	46.0	46.0	100.0
	Total	63	100.0	100.0	

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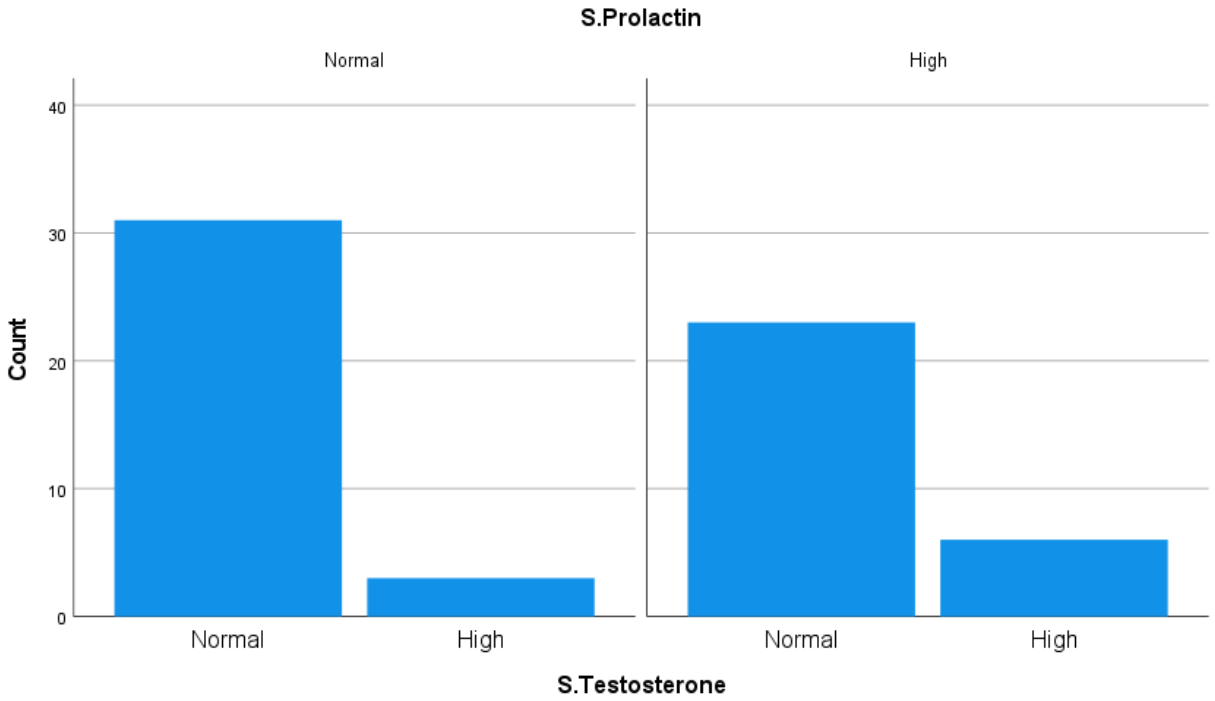

Graph 3: Distribution of S. Testosterone and S. Prolactin among PCOS Patients.

8.6.8 Distribution of PCOS Patient Based on Sleeping Pattern:

Table 27. Frequency distribution on Sleeping Pattern of PCOS patient.

sleeping

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 5 hours	25	39.7	39.7	39.7
	6-7 hours	26	41.3	41.3	81.0
	8-9 hours	9	14.3	14.3	95.2
	more than 10 hours	3	4.8	4.8	100.0
	Total	63	100.0	100.0	

According to Table 27, 39.7 percent of patients used to sleep for less than 5 hours. 41.3 percent of patients used to sleep for 6-7 hours. 14.3 percent of patients used to sleep for 8-9 hours. And lastly 4.8 percent of patients used to sleep for more than 10 hours. It is seen from the analysis that most patients of pos did not have proper sleep.

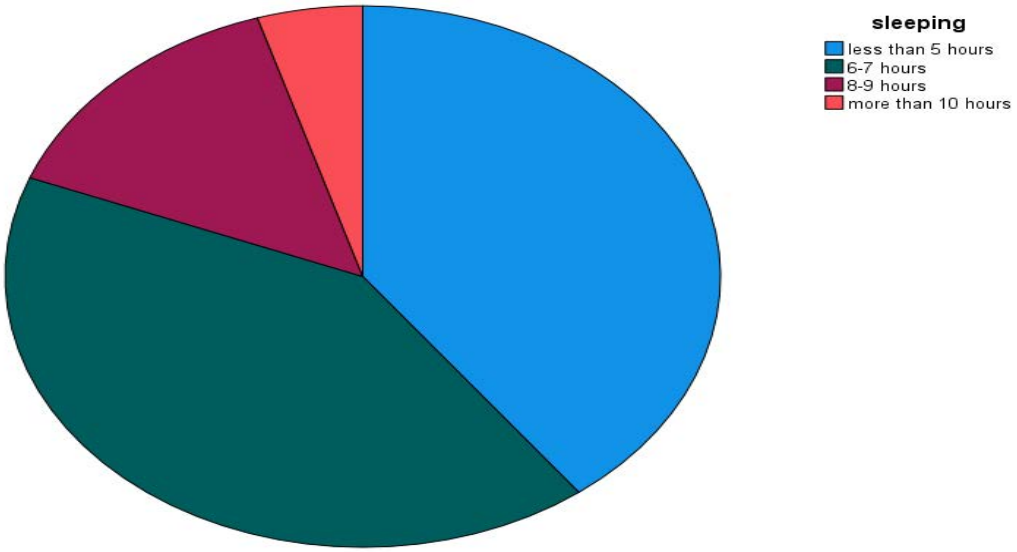

Figure 27: Distribution of Sleeping pattern among PCOS Patients.

8.7 Distribution of PCOS according to the Risk Factors.

Table 28: Frequency Table Distribution of Risk Factors among PCOS Patients.

Variable	**Group**	**N(%)**
BMI	Normal	34.9%
	Overweight	50.8%
	Obese	12.7%
Hirsutism	yes	50.8%
	No	49.2%
Acanthosis Nigricans	Yes	14.3%
	No	85.7%
Blood sugar	Normal	44.4%
	Impaired	49.2%

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	Diabetes mellitus	6.3%
Family History	Yes	22.2%
	No	77.8%
Hormonal Profile	1:1	4.8%
	2:1	66.7%
	>=3:1	9.5%
	1:2(Normal)	19%
Thyroid Hormone	Normal	71.4%
	Hypothyroidism	25.4%
	Hyperthyroidism	3.2%
S.Testosterone	Normal	85.7%
	High	14.3%
S.Prolactine	Normal	54%
	High	46%
Sleeping pattern	less than 5 hours	39.7%
	6-7 hours	41.3%
	8-9 hours	14.3%
	more than 10 hours	4.8%

Table 28 summarizes the distribution of the Risk factors among the PCOS patients and displays the percentages in which they are present.

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8.8 Association of PCOS during Treatment observation:

Table 29,30,31,32 and 33: Frequency Table Distribution of Treatment observations among PCOS Patients.

TVS_folliculometry

	Frequency	Percent	Valid Percent	Cumulative Percent
performed	63	100.0	100.0	100.0

Table 29 depicts that all the patients had performed TVS Folliculometry and none missed it.

Follicle

	Frequency	Percent	Valid Percent	Cumulative Percent
present	63	100.0	100.0	100.0

Table 30 shows that all patients had presence of follicles and the total % was 100 in total.

number_of_follicle

	Frequency	Percent	Valid Percent	Cumulative Percent
2	6	9.5	9.5	9.5
>=3	57	90.5	90.5	100.0
Total	63	100.0	100.0	

From the above Table 31, 90.5% had the number of follicles >=3 whereas 9.5% had 2 number of follicles and in total 100%.

Follicle_size

	Frequency	Percent	Valid Percent	Cumulative Percent
<18mm	2	3.2	3.2	3.2
18-32mm	61	96.8	96.8	100.0
Total	63	100.0	100.0	

Table 32 illustrates that 96.8% of the patients had 18-32mm of follicle size whereas only 3.2% had <18mm follicle size from 100%.

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Endometrial_thickness

	Frequency	Percent	Valid Percent	Cumulative Percent
<7mm	19	30.2	30.2	30.2
7-12mm	41	65.1	65.1	95.2
>12mm	3	4.8	4.8	100.0
Total	63	100.0	100.0	

The patient's Endometrial thickness was 7-12mm by 65.1% whereas, 30.2% had <7mm thickness, followed by 4.8% who had >12mm thickness as shown in table 33 above.

8.9 Association of PCOS patient's age with the risk factors:

Table 34: Cross-table analysis of Age with BMI.

Age * BMI Crosstabulation

% within Age

		BMI				
		Underweight (<18.5)	Normal(18.5-24.9)	Overweight (25-29.9)	Obsese(30-39.9)	Total
Age	20-25		44.4%	44.4%	11.1%	100.0%
	26-30	5.0%	25.0%	55.0%	15.0%	100.0%
	31-35		20.0%	60.0%	20.0%	100.0%
	36-40			100.0%		100.0%
Total		1.6%	34.9%	50.8%	12.7%	100.0%

Only 5 percent of people between 26-30 were underweight. 44.4%, 25% and 20% of patients between 20-25, 26-30, 31-35 were of normal weight. 44.4%, 55%, 60% and 100% of patients between 20-25, 26-30, 31-35 and 36-40 were overweight. And only 11.1%, 15% and 20% patients age between 20-25, 26-30 and 36-40 as shown in table 34.

Table 35: Cross-table analysis of Age with Hirsutism and Acanthosis Nigricans.

Age * Hirsutism Crosstabulation

% within Age

		Hirsutism		
		present	absent	Total
Age	20-25	52.8%	47.2%	100.0%
	26-30	60.0%	40.0%	100.0%
	31-35	20.0%	80.0%	100.0%
	36-40		100.0%	100.0%
Total		50.8%	49.2%	100.0%

Age * Acanthosis_Nigricans Crosstabulation

% within Age

		Acanthosis_Nigricans		
		present	Absent	Total
Age	20-25	11.1%	88.9%	100.0%
	26-30	20.0%	80.0%	100.0%
	31-35		100.0%	100.0%
	36-40	50.0%	50.0%	100.0%
Total		14.3%	85.7%	100.0%

Table 35 shows a cross sectional analysis of age with hirsutism and acanthosis nigricans. Here, we can see the percentage of hirsutism is highest in patients whose age range is between 26-30 and the percentage of acanthosis nigricans is highest in patients age between 36-40.

Table 36: Cross-table analysis of Age with Blood sugar levels.

Age * Blood_sugar Crosstabulation

% within Age

		Blood_sugar			
		Normal	impaired blood glucose	Diabetes mellitus	Total
Age	20-25	41.7%	55.6%	2.8%	100.0%
	26-30	50.0%	45.0%	5.0%	100.0%
	31-35	40.0%	40.0%	20.0%	100.0%
	36-40	50.0%		50.0%	100.0%
Total		44.4%	49.2%	6.3%	100.0%

Table 36 shows a cross table analysis of patients' age with blood sugar level.

Table 37: Cross-table analysis of Age with Family history of infertility.

Age * Family_history_of_infertility Crosstabulation

% within Age

		Family_history_of_infertility		
		yes	no	Total
Age	20-25	19.4%	80.6%	100.0%
	26-30	20.0%	80.0%	100.0%
	31-35	40.0%	60.0%	100.0%
	36-40	50.0%	50.0%	100.0%
Total		22.2%	77.8%	100.0%

80.6% of pcos patients aged between 20 - 30 do not have any family history of infertility. And 40% of patients aged between 31-35 have a family history of infertility. 50% of patients aged between 36-40 have family history of infertility as shown in table 37.

Table 38: Cross-table analysis of Age with Hormone profile.

Age * Hormonal_profile_LH_to_FSH_ratio Crosstabulation

% within Age

		Hormonal_profile_LH_to_FSH_ratio				
		1:1	2:1	>=3:1	1:2 (Normal)	Total
Age	20-25	5.6%	63.9%	13.9%	16.7%	100.0%
	26-30	5.0%	65.0%	5.0%	25.0%	100.0%
	31-35		100.0%			100.0%
	36-40		50.0%		50.0%	100.0%
Total		4.8%	66.7%	9.5%	19.0%	100.0%

Table 38 contains a cross sectional analysis of patients' age with their hormone profile.

Table 39: Cross-table analysis of Age with Thyroid hormone.

Age * Thyroid_hormone Crosstabulation

% within Age

		Thyroid_hormone			
		Normal	Hypothyroidism	Hyperthyroidism	Total
Age	20-25	83.3%	16.7%		100.0%
	26-30	60.0%	30.0%	10.0%	100.0%
	31-35	40.0%	60.0%		100.0%
	36-40	50.0%	50.0%		100.0%
Total		71.4%	25.4%	3.2%	100.0%

From table 39 we can see a cross sectional analysis of patients' age with thyroid hormone from where we can see most of the patients have normal levels of thyroid hormone whereas only 10% of the total patients have hyperthyroidism. And the rest of the patients have Hypothyroidism.

Table 40: Cross-table analysis of Age with S. Testosterone and S. Prolactin.

Age * S.Testosterone Crosstabulation

% within Age

		S.Testosterone		
		Normal	High	Total
Age	20-25	91.7%	8.3%	100.0%
	26-30	70.0%	30.0%	100.0%
	31-35	100.0%		100.0%
	36-40	100.0%		100.0%
Total		85.7%	14.3%	100.0%

Age * S.Prolactin Crosstabulation

% within Age

		S.Prolactin		
		Normal	High	Total
Age	20-25	38.9%	61.1%	100.0%
	26-30	75.0%	25.0%	100.0%
	31-35	60.0%	40.0%	100.0%
	36-40	100.0%		100.0%
Total		54.0%	46.0%	100.0%

Table 40 gives a short analysis of age with S. Testosterone and S. Prolactin.

Table 41: Cross-table analysis of Age with Sleeping Pattern.

Age * sleeping Crosstabulation

% within Age

		sleeping				
		less than 5 hours	6-7 hours	8-9 hours	more than 10 hours	Total
Age	20-25	38.9%	47.2%	8.3%	5.6%	100.0%
	26-30	35.0%	40.0%	20.0%	5.0%	100.0%
	31-35	40.0%	20.0%	40.0%		100.0%
	36-40	100.0%				100.0%
Total		39.7%	41.3%	14.3%	4.8%	100.0%

A cross sectional study between ages of the patients and their sleeping pattern is given under table no 41.

8.10 Association of PCOS patient's habitation with the risk factors:

Table 42: Cross-table analysis of habitation with BMI.

Habituation * BMI Crosstabulation

% within Habituation

		BMI				
		Underweight (<18.5)	Normal(18.5-24.9)	Overweight (25-29.9)	Obsese(30-39.9)	Total
Habituation	Urban		32.6%	53.5%	14.0%	100.0%
	Rural	5.0%	40.0%	45.0%	10.0%	100.0%
Total		1.6%	34.9%	50.8%	12.7%	100.0%

For cross-table analysis of habitation with BMI as depicted in table 42, for urban setting patients, 32.6% were normal, 53.5% were overweight and 14% were obese whereas for rural, 5% were underweight, 40% were normal, 45% were overweight and 10% were obese.

Table 43: Cross-table analysis of habitation with Hirsutism and Acanthosis Nigricans.

Habituation * Hirsutism Crosstabulation

% within Habituation

		Hirsutism		
		present	absent	Total
Habituation	Urban	48.8%	51.2%	100.0%
	Rural	55.0%	45.0%	100.0%
Total		50.8%	49.2%	100.0%

Habituation * Acanthosis_Nigricans Crosstabulation

% within Habituation

		Acanthosis_Nigricans		
		present	Absent	Total
Habituation	Urban	14.0%	86.0%	100.0%
	Rural	15.0%	85.0%	100.0%
Total		14.3%	85.7%	100.0%

As shown in table 43, for those from Urban areas, 48.8% had presence of hirsutism and 51.2% did not have any whereas, 14% had presence of Acanthosis Nigricans and 86% didn't have. For those living in rural areas, 55% had hirsutism and 45% did not whereas 15% had Acanthosis nigricans and 85% didn't.

Table 44: Cross-table analysis of habitation with blood sugar level.

Habituation * Blood_sugar Crosstabulation

% within Habituation

		Blood_sugar			
		Normal	impaired blood glucose	Diabetes mellitus	Total
Habituation	Urban	51.2%	41.9%	7.0%	100.0%
	Rural	30.0%	65.0%	5.0%	100.0%
Total		44.4%	49.2%	6.3%	100.0%

For Urban setting patients, 51.2% had normal blood sugar level, 41.9% had impaired levels and 7% had Diabetes mellitus whereas for those from rural setting, 30% had normal blood sugar, 65% had impaired blood glucose and 5% had diabetes mellitus as depicted in table 44.

Table 45: Cross-table analysis of habitation with Family history of infertility.

Habituation * Family_history_of_infertility Crosstabulation

% within Habituation

		Family_history_of_infertility		
		yes	no	Total
Habituation	Urban	20.9%	79.1%	100.0%
	Rural	25.0%	75.0%	100.0%
Total		22.2%	77.8%	100.0%

According to the Cross-table analysis, the patients from Urban setting, 20.9% had family history of infertility whereas 79.1% did not. To add for those from rural, 25% had family history of infertility and 75% didn't.

Table 46: Cross-table analysis of habitation with Hormone profile.

Habituation * Hormonal_profile_LH_to_FSH_ratio Crosstabulation

% within Habituation

		Hormonal_profile_LH_to_FSH_ratio				
		1:1	2:1	>=3:1	1:2 (Normal)	Total
Habituation	Urban	4.7%	67.4%	9.3%	18.6%	100.0%
	Rural	5.0%	65.0%	10.0%	20.0%	100.0%
Total		4.8%	66.7%	9.5%	19.0%	100.0%

As shown in table 46, for patients from urban settings, 5.7% had 1:1, 67.4% had 2;1, 9.3% had >=3:1 and 18.6% had a normal hormone profile. For those from rural settings, 5%had 1:1, 65% had 2:1, 10% had >=3:1 and 20% had a normal hormone profile.

Table 47: Cross-table analysis of habitation with Thyroid Hormone.

Habituation * Thyroid_hormone Crosstabulation

% within Habituation

		Thyroid_hormone			
		Normal	Hypothyroidism	Hyperthyroidism	Total
Habituation	Urban	79.1%	20.9%		100.0%
	Rural	55.0%	35.0%	10.0%	100.0%
Total		71.4%	25.4%	3.2%	100.0%

As depicted in table 47, for urban living patients, 79.1% had normal thyroid levels and 20.9% had hypothyroidism whereas for rural living patients, 55% had normal levels of thyroid whereas 35% had hypothyroidism and 10% had hyperthyroidism.

Table 48: Cross-table analysis of habitation with S. Testosterone and S. Prolactin.

Habituation * S.Testosterone Crosstabulation

% within Habituation

		S.Testosterone		
		Normal	High	Total
Habituation	Urban	88.4%	11.6%	100.0%
	Rural	80.0%	20.0%	100.0%
Total		85.7%	14.3%	100.0%

Habituation * S.Prolactin Crosstabulation

% within Habituation

		S.Prolactin		
		Normal	High	Total
Habituation	Urban	48.8%	51.2%	100.0%
	Rural	65.0%	35.0%	100.0%
Total		54.0%	46.0%	100.0%

For the Cross tabular analysis of habitation with sleeping pattern as shown in table 48, for urban habitation, 88.4% had normal S. Testosterone and 11.6% had high whereas, 48.8% had normal S. Prolactin and 51.2% had high. For those living in rural areas, 80% had normal S. Testosterone levels and 20% had high levels whereas, 65% had normal S. Prolactin and 35% had high S. Prolactin.

Table 49: Cross-table analysis of habitation with Sleeping Pattern.

Habituation * sleeping Crosstabulation

% within Habituation

		sleeping				
		less than 5 hours	6-7 hours	8-9 hours	more than 10 hours	Total
Habituation	Urban	34.9%	44.2%	16.3%	4.7%	100.0%
	Rural	50.0%	35.0%	10.0%	5.0%	100.0%
Total		39.7%	41.3%	14.3%	4.8%	100.0%

The cross-table comparison of residence with sleeping patterns, as shown in table 49, reveals the following percentages for urban habitation: 34.9% rested for less than five hours, 44.2% sleep for six to seven hours, 16.3% slept for 8-9 hours, and 4.7% slept for a period of time exceeding ten hours. In contrast, among individuals residing in rural areas, 50% reported sleeping for less than 5 hours, 35% sleep for six to seven hours, 10% slept for 8-9 hours, and 5% slept for longer than 10 hours.

8.10 Association of Economic status with the risk factors:

Table 50: Cross-table analysis of economic status with BMI.

Economic_status * BMI Crosstabulation

% within Economic_status

		BMI				
		Underweight (<18.5)	Normal(18.5-24.9)	Overweight (25-29.9)	Obsese(30-39.9)	Total
Economic_status	0-20,000 taka		40.0%	40.0%	20.0%	100.0%
	21,000 - 45,000taka	5.0%	35.0%	50.0%	10.0%	100.0%
	46,000- 65,000 taka		23.1%	69.2%	7.7%	100.0%
	66,000 - 1lakh taka		40.0%	50.0%	10.0%	100.0%
Total		1.6%	34.9%	50.8%	12.7%	100.0%

The cross-table analysis of Economic status with BMI has been depicted in the above table 50. For economic status 0-20000 taka, 40% were of normal BMI, 40% were overweight and 20% were obese whereas for 21000-45000 taka, 5% were underweight, 35% were normal, 50% were overweight and 10% were obese. To add, 23.1% were normal, 69.2% were overweight and 7.7% were obese for 46000-65000 taka whereas for 66000-1 lakh taka, 40% were normal, 50% were overweight and 10% were obese.

Table 51: Cross-table analysis of economic status with Hirsutism and Acanthosis Nigricans.

Economic_status * Hirsutism Crosstabulation

% within Economic_status

		Hirsutism		
		present	absent	Total
Economic_status	0-20,000 taka	50.0%	50.0%	100.0%
	21,000 - 45,000taka	50.0%	50.0%	100.0%
	46,000- 65,000 taka	69.2%	30.8%	100.0%
	66,000 - 1lakh taka	30.0%	70.0%	100.0%
Total		50.8%	49.2%	100.0%

Economic_status * Acanthosis_Nigricans Crosstabulation

% within Economic_status

		Acanthosis_Nigricans		
		present	Absent	Total
Economic_status	0-20,000 taka	15.0%	85.0%	100.0%
	21,000 - 45,000taka	10.0%	90.0%	100.0%
	46,000- 65,000 taka	30.8%	69.2%	100.0%
	66,000 - 1lakh taka		100.0%	100.0%
Total		14.3%	85.7%	100.0%

For 0-20000 taka, 50% had hirsutism and 50% didn't and 15% had Acanthosis Nigricans and 85% didn't. Likewise, for 21000-45000 Taka, 50% had hirsutism and 50% did not whereas 10% had Acanthosis Nigricans and 90% did not. To add, 69.2% had hirsutism and 30.8% did not have, whereas 30.8% had Acanthosis Nigricans and 69.2% didn't have economic status 46000-65000 Taka. Similarly, for 66000- 1 lakh Taka, 30% had presence and 70% had absence of Hirsutism whereas 100% had absence of Acanthosis Nigricans.

Table 52: Cross-table analysis of economic status with Blood sugar levels.

Economic_status * Blood_sugar Crosstabulation

% within Economic_status

		Blood_sugar			
		Normal	impaired blood glucose	Diabetes mellitus	Total
Economic_status	0-20,000 taka	45.0%	55.0%		100.0%
	21,000 - 45,000taka	35.0%	65.0%		100.0%
	46,000- 65,000 taka	61.5%	23.1%	15.4%	100.0%
	66,000 - 1lakh taka	40.0%	40.0%	20.0%	100.0%
Total		44.4%	49.2%	6.3%	100.0%

For table 52, it depicted the cross-table analysis of economic status with blood sugar levels as for 0-20000 taka, 45% had it normal and 55% had impaired blood glucose whereas for 21000-45000 Taka, 35% had it normal and 65% had impaired blood glucose. On the other hand, for

46000-65000 Taka economic status, 61.5% had normal levels, 23.1% had impaired glucose and 15.4% had diabetes mellitus whereas, for 66000- 1lakh Taka, 40% had normal, 40% had impaired and 20% had diabetes mellitus.

Table 53: Cross-table analysis of economic status with Family history of infertility.

Economic_status * Family_history_of_infertility Crosstabulation

% within Economic_status

		Family_history_of_infertility		
		yes	no	Total
Economic_status	0-20,000 taka	30.0%	70.0%	100.0%
	21,000 - 45,000taka	15.0%	85.0%	100.0%
	46,000- 65,000 taka	30.8%	69.2%	100.0%
	66,000 - 1lakh taka	10.0%	90.0%	100.0%
Total		22.2%	77.8%	100.0%

For table 53, according to the economic status of 0-20000 taka, 30% had family history of infertility whereas 70% did not. To add, for 21000-45000taka economic status, 15% had history of infertility in family whereas 85% did not and for 46000-65000 taka, 30.8% had family history of infertility whereas 69.2% did not. likewise, for 66000-1 lakh taka, 10% had family history of infertility and 90% did not have any.

Table 54: Cross-table analysis of economic status with Hormone profile.

Economic_status * Hormonal_profile_LH_to_FSH_ratio Crosstabulation

% within Economic_status

		Hormonal_profile_LH_to_FSH_ratio				
		1:1	2:1	>=3:1	1:2 (Normal)	Total
Economic_status	0-20,000 taka		70.0%		30.0%	100.0%
	21,000 - 45,000taka	5.0%	80.0%	15.0%		100.0%
	46,000- 65,000 taka	7.7%	61.5%	7.7%	23.1%	100.0%
	66,000 - 1lakh taka	10.0%	40.0%	20.0%	30.0%	100.0%
Total		4.8%	66.7%	9.5%	19.0%	100.0%

Table 54 depicts the cross-table analysis of economic status with hormone profile where for 0-20000 taka, 70% had 2:1 and 30% were normal, for 21000-45000 taka, 5% was 1:1, 80% was

2:1 and 15% was >=3:1, for 46000-65000 taka, 7.7% was 1:1, 61.5% was 2:1, 7.7% was >=3:1 and 23.1% was normal whereas for 66000-1 lakh taka, 10% was 1:1, 40% was 2:1, 20% was >=3:1 and 30% was normal.

Table 55: Cross-table analysis of economic status with Thyroid hormone.

Economic_status * Thyroid_hormone Crosstabulation

% within Economic_status

		Thyroid_hormone			
		Normal	Hypothyroidism	Hyperthyroidism	Total
Economic_status	0-20,000 taka	75.0%	25.0%		100.0%
	21,000 - 45,000taka	75.0%	20.0%	5.0%	100.0%
	46,000- 65,000 taka	46.2%	46.2%	7.7%	100.0%
	66,000 - 1lakh taka	90.0%	10.0%		100.0%
Total		71.4%	25.4%	3.2%	100.0%

For the economic status, 0-20000 taka, 75% had normal thyroid hormone and 25% had hypothyroidism whereas for 21000-45000 taka economic status, 75% were normal, 20% had hypothyroidism and 5% had hyperthyroidism. Also, for 46000-65000 taka, 46.2% were normal, 46.2 had hypothyroidism and 7.7 % had hyperthyroidism. furthermore, for 66000-1 lakh taka economic status 90% were normal and 10% had hypothyroidism as shown in table 55.

Table 56: Cross-table analysis of economic status with S. Testosterone and S. Prolactin.

Economic_status * S.Testosterone Crosstabulation

% within Economic_status

		S.Testosterone		
		Normal	High	Total
Economic_status	0-20,000 taka	80.0%	20.0%	100.0%
	21,000 - 45,000taka	90.0%	10.0%	100.0%
	46,000- 65,000 taka	76.9%	23.1%	100.0%
	66,000 - 1lakh taka	100.0%		100.0%
Total		85.7%	14.3%	100.0%

Economic_status * S.Prolactin Crosstabulation

% within Economic_status

		S.Prolactin		
		Normal	High	Total
Economic_status	0-20,000 taka	45.0%	55.0%	100.0%
	21,000 - 45,000taka	50.0%	50.0%	100.0%
	46,000- 65,000 taka	61.5%	38.5%	100.0%
	66,000 - 1lakh taka	70.0%	30.0%	100.0%
Total		54.0%	46.0%	100.0%

For table 56, the economic status of 0-20000 taka, 80% had normal S. Testosterone and 20% had high whereas 45% was normal for S. Prolactin and 55% was high. For 21,000-45000taka economic status, 90% had normal S. Testosterone and 10% had high levels whereas for S. Prolactin, 50% was high and 50% was normal. 76.9% were normal for S. Testosterone and 23.1% has high levels whereas 61.5% were normal and 38.5% was high for S. Prolactin for economic status 46000-65000 taka. also, for 66000-1 lakh economic status, 100% has normal S. Testosterone whereas 70% had normal S. Prolactin and 30% had high S. Prolactin.

Table 57: Cross-table analysis of economic status with Sleeping pattern.

Economic_status * sleeping Crosstabulation

% within Economic_status

		sleeping				
		less than 5 hours	6-7 hours	8-9 hours	more than 10 hours	Total
Economic_status	0-20,000 taka	25.0%	65.0%	10.0%		100.0%
	21,000 - 45,000taka	65.0%	15.0%	15.0%	5.0%	100.0%
	46,000- 65,000 taka	15.4%	53.8%	23.1%	7.7%	100.0%
	66,000 - 1lakh taka	50.0%	30.0%	10.0%	10.0%	100.0%
Total		39.7%	41.3%	14.3%	4.8%	100.0%

The cross-table analysis reveals that among individuals with an economic level ranging from 0 to 20000 taka, 25% reported having fewer than five hours of sleep, 65% reported having six to seven hours of sleep, and 10% reported having 8-9 hours of sleep. Among individuals earning between 21000-45000 taka, 65% reported sleeping less than 5 hours, 15% reported sleeping 6-7 hours, 15% reported sleeping 8-9 hours, and 5% reported sleeping more than 10 hours. In the economic bracket of 46000-65000 taka, 15.4% of individuals reported sleeping less than 5 hours, 53.8% reported sleeping for 6-7 hours, 23.1% reported sleeping for 8-9 hours, and 7.7% reported sleeping for more than 10 hours. Lastly, among individuals earning between 66000-1 lakh taka, 50% reported having fewer than five hours of sleep, 30% reported having six to seven hours of sleep, 10% reported having 8-9 hours of sleep, and 10% reported having greater than 10 hours of sleep.

8.11 Association of Abortion with the risk factors:

Table 58: Cross-table analysis of abortion with BMI.

Abortion * BMI Crosstabulation

% within Abortion

		BMI				
		Underweight (<18.5)	Normal(18.5-24.9)	Overweight (25-29.9)	Obsese(30-39.9)	Total
Abortion	yes		25.0%	62.5%	12.5%	100.0%
	No	2.1%	38.3%	46.8%	12.8%	100.0%
Total		1.6%	34.9%	50.8%	12.7%	100.0%

The cross-table analysis of abortion with BMI as shown above in table 58 illustrates that for women who had abortion, 25% were of normal BMI, 62.5% were overweight and 12.5% were obese whereas for those who didn't have abortion, 2.1% were underweight, 38.3% were normal, 46.8% were overweight and 12.8% were obese.

Table 59: Cross-table analysis of abortion with Hirsutism and Acanthosis Nigricans.

Abortion * Hirsutism Crosstabulation

% within Abortion

		Hirsutism		
		present	absent	Total
Abortion	yes	56.3%	43.8%	100.0%
	No	48.9%	51.1%	100.0%
Total		50.8%	49.2%	100.0%

Abortion * Acanthosis_Nigricans Crosstabulation

% within Abortion

		Acanthosis_Nigricans		
		present	Absent	Total
Abortion	yes	6.3%	93.8%	100.0%
	No	17.0%	83.0%	100.0%
Total		14.3%	85.7%	100.0%

For the cross-tabular analysis of abortion with Hirsutism and Acanthosis Nigricans, Table 59 depicts that for the women who did abortion, 56.3% had hirsutism and 43.8% did not whereas, 6.3% had Acanthosis Nigricans and 93.8% did not. To add, for those who didn't abort, 48.9% had hirsutism and 51.1% didn't whereas, 17% had presence of Acanthosis Nigricans and 83% didn't.

Table 60: Cross-table analysis of abortion with Blood sugar level.

Abortion * Blood_sugar Crosstabulation

% within Abortion

		Blood_sugar			
		Normal	impaired blood glucose	Diabetes mellitus	Total
Abortion	yes	37.5%	56.3%	6.3%	100.0%
	No	46.8%	46.8%	6.4%	100.0%
Total		44.4%	49.2%	6.3%	100.0%

The table 60 shows the cross-table analysis of abortion with blood sugar levels where, 37.5% had normal level, 56.3% had impaired blood glucose and 6.3% had diabetes mellitus for the patients who had abortion whereas for the ones who didn't undergo abortion, 46.8% were normal, 46.8% had impaired blood glucose and 6.4% had diabetes mellitus.

Table 61: Cross-table analysis of abortion with Family history of infertility.

Abortion * Family_history_of_infertility Crosstabulation

% within Abortion

		Family_history_of_infertility		
		yes	no	Total
Abortion	yes	12.5%	87.5%	100.0%
	No	25.5%	74.5%	100.0%
Total		22.2%	77.8%	100.0%

Based on the cross-table analysis, table 61 displays the relationship between abortion and a family history of infertility, the patients who underwent abortion, 12.5% of family history of infertility and 87.5% did not have any. For those who didn't undergo abortion, 25.5% had a family history of infertility whereas 74.5% didn't have any.

Table 62: Cross-table analysis of abortion with Hormone profile

Abortion * Hormonal_profile_LH_to_FSH_ratio Crosstabulation

% within Abortion

		Hormonal_profile_LH_to_FSH_ratio				
		1:1	2:1	>=3:1	1:2 (Normal)	Total
Abortion	yes	6.3%	81.3%	6.3%	6.3%	100.0%
	No	4.3%	61.7%	10.6%	23.4%	100.0%
Total		4.8%	66.7%	9.5%	19.0%	100.0%

To do a cross-table analysis of abortion with hormone profile, refer to table 62 above, women who had abortion had 6.3% had 1:1, 81.3% had 2:1, 6.3% had >=3:1 and 6.3% were normal. On the contrary, for women without abortion, 4.3% had 1:1, 61.7% had 2:1, 10.6% had >=3:1 and 23.4% had normal hormones.

Table 63: Cross-table analysis of abortion with Thyroid hormone.

Abortion * Thyroid_hormone Crosstabulation

% within Abortion

		Thyroid_hormone			
		Normal	Hypothyroidism	Hyperthyroidism	Total
Abortion	yes	81.3%	18.8%		100.0%
	No	68.1%	27.7%	4.3%	100.0%
Total		71.4%	25.4%	3.2%	100.0%

As depicted above in Table 63, the women who had abortion had normal thyroid hormones by 81.3% whereas 18.8% had hypothyroidism. Also, for the ones who didn't abort, 68.1% had normal thyroid levels whereas 27.7% had hypothyroidism and 4.3% had hyperthyroidism.

Table 64: Cross-table analysis of Abortion with S. Testosterone and S. Prolactin.

Abortion * S.Testosterone Crosstabulation

% within Abortion

		S.Testosterone		
		Normal	High	Total
Abortion	yes	93.8%	6.3%	100.0%
	No	83.0%	17.0%	100.0%
Total		85.7%	14.3%	100.0%

Abortion * S.Prolactin Crosstabulation

% within Abortion

		S.Prolactin		
		Normal	High	Total
Abortion	yes	50.0%	50.0%	100.0%
	No	55.3%	44.7%	100.0%
Total		54.0%	46.0%	100.0%

Table 64 presents the cross-table analysis of the relationship between abortion and the hormone levels of S. Testosterone and S. Prolactin. As seen above, for women who had abortion, 93.8% had normal S. Testosterone level and 6.3% had high levels of it whereas for S. Prolactin levels, 50% had normal levels and 50% had high levels. For those who didn't undergo abortion, the S. Testosterone level was normal for 83% and high for 17% whereas for S. Prolactin, 55.3% were normal and 44.7% had high levels.

Table 65: Cross-table analysis of Abortion with Sleeping pattern.

Abortion * sleeping Crosstabulation

% within Abortion

		sleeping				
		less than 5 hours	6-7 hours	8-9 hours	more than 10 hours	Total
Abortion	yes	31.3%	56.3%	12.5%		100.0%
	No	42.6%	36.2%	14.9%	6.4%	100.0%
Total		39.7%	41.3%	14.3%	4.8%	100.0%

The cross-table examination of Abortion with sleep pattern, as presented in table 65, reveals that among women who had an abortion, 31.3% reported having a minimum of five hours of sleep, 56.3% reported having 6-7 hours of sleep, and 12.5% reported having 8-9 hours of sleep. Among the women who did not have an abortion, 42.6% reported having less than five hours of sleep, 36.2% reported having seven to eight hours of sleep, 14.9% reported having 8-9 hours of sleep, and 6.4% reported having over ten hours of sleep.

8.12 Association of Menstrual cycle with the risk factors:

Table 66: Cross-table analysis of menstrual cycle with BMI.

Menstrual_cycle * BMI Crosstabulation

% within Menstrual_cycle

		BMI				
		Underweight (<18.5)	Normal(18.5-24.9)	Overweight (25-29.9)	Obsese(30-39.9)	Total
Menstrual_cycle	Regular		50.0%	25.0%	25.0%	100.0%
	Irregular		33.3%	55.6%	11.1%	100.0%
	Infrequent		38.5%	46.2%	15.4%	100.0%
	Oligomenorrhoea	10.0%	30.0%	50.0%	10.0%	100.0%
Total		1.6%	34.9%	50.8%	12.7%	100.0%

For menstrual cycles cross-table analysis with BMI as shown in Table 66, 50% was normal, 25% overweight and 25% obese for women with regular cycle whereas the ones with irregular cycles, 33.3% were of normal BMI, 55.6% were overweight and 11.1% were obese. To add, for infrequent cycles, 38.5% were normal, 46.2% were overweight and 15.4% were obese while, for oligomenorrhea cycle, 10% were underweight, 30% were normal, 50% were overweight and 10% were obese.

Table 67: Cross-table analysis of menstrual cycle with Hirsutism and Acanthosis Nigricans.

Menstrual_cycle * Hirsutism Crosstabulation

% within Menstrual_cycle

		Hirsutism		
		present	absent	Total
Menstrual_cycle	Regular		100.0%	100.0%
	Irregular	58.3%	41.7%	100.0%
	Infrequent	53.8%	46.2%	100.0%
	Oligomenorrhoea	40.0%	60.0%	100.0%
Total		50.8%	49.2%	100.0%

Menstrual_cycle * Acanthosis_Nigricans Crosstabulation

% within Menstrual_cycle

		Acanthosis_Nigricans		
		present	Absent	Total
Menstrual_cycle	Regular		100.0%	100.0%
	Irregular	13.9%	86.1%	100.0%
	Infrequent	23.1%	76.9%	100.0%
	Oligomenorrhoea	10.0%	90.0%	100.0%
Total		14.3%	85.7%	100.0%

To conduct a cross-table investigation of the relationship between the menstrual cycle and hirsutism and Acanthosis Nigricans., regular cycle had 100% absence of hirsutism and Acanthosis nigricans whereas for irregular cycle, 58.3% had presence and 41.7% had absence of hirsutism and 13.9% had presence and 86.1% had absence of Acanthosis nigricans. Furthermore, for infrequent cycles, 53.8% had hirsutism and 46.2% didn't whereas for Acanthosis nigricans,

23.1% had it and 76.9% didn't. To add, for the oligomenorrhea cycle, 40% had hirsutism and 60% did not while 10% had acanthosis nigricans and 90% didn't.

Table 68: Cross-table analysis of menstrual cycle with Blood sugar level.

Menstrual_cycle * Blood_sugar Crosstabulation

% within Menstrual_cycle

		Blood_sugar			
		Normal	impaired blood glucose	Diabetes mellitus	Total
Menstrual_cycle	Regular	50.0%	50.0%		100.0%
	Irregular	36.1%	55.6%	8.3%	100.0%
	Infrequent	53.8%	46.2%		100.0%
	Oligomenorrhoea	60.0%	30.0%	10.0%	100.0%
Total		44.4%	49.2%	6.3%	100.0%

The cross-table analysis of menstrual cycle with Blood sugar level shown in table 68 illustrates that for regular cycle, 50% had normal blood sugar level and 50% had impaired blood glucose. on the other hand, for irregular cycle, 36.1% had normal,55.6% had impaired and 8.3 had diabetes mellitus. Also, for infrequent cycles, 53.8% had normal level and 46.2% had impaired blood glucose. Furthermore, for the oligomenorrhea cycle, 60% had normal and 30% impaired and 10% had diabetes mellitus.

Table 69: Cross-table analysis of menstrual cycle with Family history of Infertility.

Menstrual_cycle * Family_history_of_infertility Crosstabulation

% within Menstrual_cycle

		Family_history_of_infertility		
		yes	no	Total
Menstrual_cycle	Regular	25.0%	75.0%	100.0%
	Irregular	22.2%	77.8%	100.0%
	Infrequent	15.4%	84.6%	100.0%
	Oligomenorrhoea	30.0%	70.0%	100.0%
Total		22.2%	77.8%	100.0%

Menstrual cycle and familial lineage of infertility cross-tabular analysis depicts that for those with family history of infertility, 25% had regular cycle, 22.2% had irregular cycle, 15.4% had infrequent cycle and

30% had oligomenorrhoea cycle whereas for those with no family history of infertility, 75% had regular cycle, 77.8% had irregular cycle, 84.6% had infrequent cycle and 70% had oligomenorrhoea cycles as depicted in table 69.

Table 70: Cross-table analysis of menstrual cycle with Hormone profile.

Menstrual_cycle * Hormonal_profile_LH_to_FSH_ratio Crosstabulation

% within Menstrual_cycle

		Hormonal_profile_LH_to_FSH_ratio				
		1:1	2:1	>=3:1	1:2 (Normal)	Total
Menstrual_cycle	Regular	25.0%	75.0%			100.0%
	Irregular	2.8%	58.3%	11.1%	27.8%	100.0%
	Infrequent	7.7%	69.2%	7.7%	15.4%	100.0%
	Oligomenorrhoea		90.0%	10.0%		100.0%
Total		4.8%	66.7%	9.5%	19.0%	100.0%

Table 70 shows the hormone profile and menstrual cycle cross-tabular analysis. For the regular cycle, 25% was 1:1 and 75% was 2:1. Also, for an irregular cycle, 2.8% was 1;1, 58.3% was 2:1, 11.1% was >=3:1 and 27.8% was normal i.e., 1:2. Furthermore, 7.7% was 1:1 and >=3:1,69.2% was 2:1 and 15.4% was normal for infrequent cycles whereas for oligomenorrhea cycle, 90% was 2:1 and 10% was >=3:1.

Table 71: Cross-table analysis of menstrual cycle with Thyroid hormone.

Menstrual_cycle * Thyroid_hormone Crosstabulation

% within Menstrual_cycle

		Thyroid_hormone			
		Normal	Hypothyroidism	Hyperthyroidism	Total
Menstrual_cycle	Regular	100.0%			100.0%
	Irregular	63.9%	30.6%	5.6%	100.0%
	Infrequent	76.9%	23.1%		100.0%
	Oligomenorrhoea	80.0%	20.0%		100.0%
Total		71.4%	25.4%	3.2%	100.0%

The cross-table analysis of menstrual cycle with thyroid hormone as shown in table 71 depicts that for regular menstrual cycle of a PCOS patient, the thyroid hormone was 100% normal,

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whereas for irregular cycle, it was 63.9% normal, 30.6% hypothyroidism and 5.6% hyperthyroidism. To add, for infrequent cycle, 76.9% was normal, and 23.1% was hypothyroidism. Moreover, for oligomenorrhea cycle, 80% was normal and 20% was hypothyroidism.

Table 72: Cross-table analysis of menstrual cycle with S. Testosterone and S. Prolactin.

Menstrual_cycle * S.Testosterone Crosstabulation

% within Menstrual_cycle

		S.Testosterone		
		Normal	High	Total
Menstrual_cycle	Regular	100.0%		100.0%
	Irregular	83.3%	16.7%	100.0%
	Infrequent	92.3%	7.7%	100.0%
	Oligomenorrhoea	80.0%	20.0%	100.0%
Total		85.7%	14.3%	100.0%

Menstrual_cycle * S.Prolactin Crosstabulation

% within Menstrual_cycle

		S.Prolactin		
		Normal	High	Total
Menstrual_cycle	Regular	50.0%	50.0%	100.0%
	Irregular	52.8%	47.2%	100.0%
	Infrequent	46.2%	53.8%	100.0%
	Oligomenorrhoea	70.0%	30.0%	100.0%
Total		54.0%	46.0%	100.0%

The above mentioned table 72, depicts the cross-table analysis of menstrual cycle with S. Testosterone and S. Prolactin whereby, for regular menstrual cycle, the S. Testosterone was normal whereas S. Prolactin was 50% normal and 50% high. Also, for irregular cycles, 83.3% was normal and 16.7% was high for S. Testosterone on the other hand, it was 52.8% normal and 47.2% high for S. Prolactin. For infrequent cycles, 92.3% was normal and 7.7% was high for S. Testosterone whereas for S. Prolactin, 46.2% was normal and 53.8% was high in infrequent cycles. To add, for Oligomenorrhea, 80% was normal and 20% high for S. Testosterone whereas 70% normal and 30% high for S. Prolactin.

Table 73: Cross-table analysis of menstrual cycle with sleeping pattern.

Menstrual_cycle * sleeping Crosstabulation

% within Menstrual_cycle

		sleeping				
		less than 5 hours	6-7 hours	8-9 hours	more than 10 hours	Total
Menstrual_cycle	Regular	25.0%	75.0%			100.0%
	Irregular	41.7%	36.1%	13.9%	8.3%	100.0%
	Infrequent	38.5%	46.2%	15.4%		100.0%
	Oligomenorrhoea	40.0%	40.0%	20.0%		100.0%
Total		39.7%	41.3%	14.3%	4.8%	100.0%

According to the data presented in Table 73, the cross-table comparison of menstrual cycle and sleeping pattern revealed that among women with a regular cycle, 25% reported sleeping for less than five hours, while 75% reported sleeping for 6-7 hours. In addition, among individuals with irregular menstrual cycles, 41.7% reported sleeping for less than five hours, 36.1% reported sleeping for six to seven hours, 13.9% reported sleeping for 8-9 hours, and 8.3% reported sleeping for longer than 10 hours. Furthermore, among those with irregular menstrual cycles, 46.2% reported having a sleep duration of 6-7 hours, whereas 38.5% reported sleeping for less than five hours, and 15.4% reported sleeping for 8-9 hours. In the case of Oligomenorrhea cycle, 40% of individuals experienced less than 5 hours of sleep, while another 40% had 6-7 hours of sleep. Additionally, 14.3% of individuals reported having 8-9 hours of sleep.

Chapter 9 Discussion

Patients receiving treatment for infertility at the hospitals took part in this study and out of the 70 individuals in total, 63 have been diagnosed with PCOS. Insulin resistance and hyperandrogenism, two metabolic and hormonal problems associated with PCOS, can cause weight gain and ultimately obesity. Based on the diagnostic criteria established by the National Institutes of Health (NIH), the prevalence of polycystic ovary syndrome (PCOS) has been found to range from 6% to 9% in several countries including the United States, United Kingdom, Spain, Greece, the Asia-Pacific region, Australia, and Mexico.

Around 90% of the total population of this study were found to be diagnosed with PCOS whereas 10% weren't. Although the study population consisted of 70 people, nevertheless, it helps conclude that more than 50% of the women suffering from infertility could be due to PCOS.

Furthermore, the mean difference between patients and their husband's age was calculated and it was found that the mean age of the patients was 25.9286 whereas the mean age of husbands was 34.6286. The mean difference was found to be about 8.7 years i.e., the age gap between the patients and their husband was significantly higher (8 years) which could be one of the reasons for infertility or complications. To add, most of the women reach their age of fertility by 20-30s and it was found that maximum of the patients was of age 20-30 with only few being older than 30 years. Which is why treatment should be provided since they are at their sprouting age.

From the study, it was found that certain socio-demographic factors could have been an influence in the infertility or diagnosis of PCOS in the patients. In addition, it was disclosed that maximum of the patients were either graduates or completed Class XI-XII, followed by those who completed Class V-VIII and very few were postgraduates. The education status among the patients could have an impact on them however, since most patients were Class X-XII and graduated, one cannot conclude that education could have been the factor to influence any

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results. According to the occupation, most patients were housewives (around 74.6%) whereas 22.2% were service holders and 3.2% were students. Although the study showed 100% of married and none were unmarried PCOS patients nevertheless, that doesn't indicate that PCOS only happens to married women, on contrary, young and single women frequently experience irregular periods due to PCOS (Choudhary et al., 2017).

According to the study, 68.3% of the patients were from Urban settings whereas 31.7% were from Rural areas which helps conclude that most of the women who are being diagnosed with PCOS are from Urban habitation. Also, since women of rural areas don't usually visit hospitals which could be one of the reasons for having less women being diagnosed from Rural areas and it could be that there are many who are suffering from PCOS but have no idea about it. Also, from the Economic status, most had earnings of 20,000 takas per month whereas least had earnings of 35,000 takas, 45,000 takas and 65,000 takas. Treatment for PCOS can be costly and most of the time it's left untreated due to financial problems which could have been avoided otherwise.

There are some risk factors associated with PCOS which could cause or be a reason for it and they are BMI, Hormonal imbalance, Blood sugar level, and etc. It was found that around 57.1% of the patients had irregular cycles, 20.6% had infrequent cycles, 15.9% had Oligomenorrhoea and 6.3% had normal cycles. Menstrual cycles act as an alarm for PCOS as infertility or PCOS is mainly due to the changes in the menstrual cycle and most of the time, women ignore those signs which leads to severe issues like PCOS.

Since even women with PCOS can become pregnant and give birth, the medical and surgical histories of the patient are important factors that may contribute to infertility. While 20.6% of PCOS patients had hypothyroidism, 4.8 had diabetes mellitus, and 1.6% had other illnesses or had previously undergone D&C and laparoscopy, 73% of PCOS patients had no medical history and 90.5% had no surgical history. Of the patients, 77.8% did not have a family history of infertility, whereas the remaining 22.2% acknowledged having a family history of the PCOS patients, 69.8% had never used or consumed any kind of contraception, compared to 27% who had OCP and 1.6% who had implants and 1.6% Cu-T. Primary infertility affects 73% of PCOS patients, whereas secondary infertility affects 27% of them in the study.

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Weight has been one of the factors in controlling PCOS symptoms or gaining fertility as being overweight or obese can cause fluctuations in hormones and also impact the overall blood glucose level. It was found that 50.8 % of the women were found to be overweight, 34.9% normal and 12.7% were obese. Also, fighting PCOS can only be achieved by controlling the weight. Moreover, Hirsutism and Acanthosis Nigricans were found to be present in PCOS patients however, in this study it was found that While 85.7% of people lacked Acanthosis Nigricans and 14.3% did, 49.2% of people lacked hirsutism and 50.8% had it. The patients' distribution was as follows: 44.4% were normal, 49.2% had impaired blood glucose, and 6.3% had diabetes mellitus. 57.1 percent of the patients did not complete the tubal patency test. Of those who completed, 28.6% had both right and left tube patents, 6.3% had both tube blocks, and 3.2% had both right and 4.8% left tube blocks. The hormone profiles of 66.7% of PCOS patients were 2:1, 19% were normal, 9.5% were >=3:1, and 4.8% were 1:1. Of these, 71.4% had normal thyroid function, 25.4% had hypothyroidism, and 3.2% had hyperthyroidism. 14.3% of patients exhibited elevated S. testosterone, while 85.7% of patients had normal levels. Furthermore, 46% had elevated S. Prolactin levels while 54% had normal S. Prolactin levels. Sleeping pattern is also one of the factors that acts as a risk factor for PCOS, and it was found that 41.3% of the PCOS patients slept for 6 to 7 hours followed by 39.7% who slept less than 5 hours, 14.35% slept for 8 to 9 hours and 4.8 % slept for more than 10 hours. This helps us conclude that maximum patients slept for less than 8 to 9 hours which is required to maintain a normal hormonal level.

To add, cross table analysis was done between age and the risk factors to check the relation between age and the risk factors. We found that maximum women are overweight between the age 20 to 40. Most of the patients we got were housewives and living in urban areas which could be one of the reasons for their weight gain. The percentage of Hirsutism is much higher in patients aged between 20 to 30 whereas the percentage of acanthosis nigricans is much less in patients of that age. To add, it was found that patients between the ages 20 to 25 had a higher percentage of impaired blood glucose followed by ages 26 to 30. Also, it was found that 77.8% patients did not have any family history of infertility whereas 22.2% had, with the highest percentage of no family history ranging from 20 to30 of age. It was found that maximum women did not have a normal level of LH to FSH ratio which is 1:2 and most of the PCOS patients have a normal level of thyroid which is 71.4%. For the PCOS patients 14.3% had high S. Testosterone

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and 46% patients had prolactin followed by 41.3%. Furthermore, cross table analysis was also done between habitation with risk factors, economic status with risk factors, abortion with risk factors and menstrual cycle with risk factors. It was found that habitation, economic status abortion and menstrual cycle had some level of association with the risk factors which might have led to PCOS.

All the mentioned statistics help conclude that although PCOS is usually accompanied by increase in weight, hormonal imbalance, impaired blood glucose or Diabetes mellitus, high levels of S. Testosterone, high levels of S. Prolactin and other factors however, each individual is built differently and so, they can have PCOS and different symptoms accompanied by it. However, the baseline that PCOS does have an impact on weight, hormones, blood glucose levels, etc would remain a threshold to identify the different cases and provide treatments accordingly.

To conclude, although observations are made which provide treatments, since there's no cure to PCOS, treating it with definite medications is not possible. However, according to different cases and symptoms, treatments such as medications and lifestyle modifications are provided to the patients wishing to conceive as with IVF, most PCOS-affected women have a 20–40% chance of becoming pregnant (Iftikhar, 2020). Moreover, the main issue the participants faced during this study was not being able to conceive even after months of treatment which left most of them heart broken.

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Chapter 10 Conclusion

Bangladeshi women encounter numerous obstacles and complexities across various domains of their lives, including limited healthcare accessibility, constrained career opportunities, limited political participation, and issues in financial administration. Ensuring the well-being of women's reproductive health is of utmost importance globally, yet it presents a significant obstacle, especially in countries with low or middle incomes like Bangladesh. The rights and privileges related to sexual and reproductive health (SRHR) for women are still seen as a delicate and socially frowned upon subject in our nation. The purpose of this study was to evaluate the frequency of polycystic ovarian syndrome (PCOS) amongst women in Bangladesh. Polycystic ovary syndrome (PCOS) is the prevailing endocrine condition among women in terms of reproductive health. The precise cause of these hormone alterations remains unknown. The issue has been proposed to potentially originate in the ovary itself, other hormone-producing glands, or the brain region responsible for regulating their synthesis. The alterations may also arise due to insulin resistance. The study lasted nearly a year and aimed to assess the prevalence of PCOS and identify different risk factors among women in Bangladesh. The findings obtained from this study are insufficient to ascertain the prevalence of PCOS among women due to the limited number of study participants, mostly because a significant portion of women in this nation do not actively seek medical intervention for reproductive health.

The survey that was done was just a small reflection of the condition of PCOS patients of Bangladesh however, although the number of patients the survey contained weren’t enough to know the condition of the PCOS patients nevertheless, it provides grasps of risk factors, symptoms and the severity of the situation each patient faces. Since the survey was conducted at the hospital by interviewing the patients, the patients were reluctant to open up and share some confidential or personal information about themselves, the survey couldn’t be of depth including the patient’s living style and details of their life. However, the results we achieved were enough to draw conclusions and state the impacts of each risk factor on the PCOS patients. The patients mostly studied up to 12 grade and were mostly housewives, which restricted their knowledge about reproductive health or about PCOS and that led to them not being able to freely discuss their reproductive health with the doctor.

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Moreover, Bangladesh is a conserved country with social and ethical restrictions which doesn't allow people, especially women, to be open in sharing about their reproductive system or anything related to that. Moreover, surveys were conducted in two hospitals located in close proximity, making the data insufficient for determining the prevalence of PCOS amongst women in Bangladesh due to the small sample size of only 70 participants. Moreover, a significant proportion of women refrain from seeking medical assistance, particularly for ailments pertaining to their reproductive health.

In conclusion, polycystic ovarian syndrome, also known as PCOS is a prevalent reproductive health issue in Bangladesh, and its prevalence could potentially be diminished by the involvement of researchers in studying the disease's etiology and genetic factors contributing to PCOS.

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