Men and Female Infertility: Multidisciplinary Review

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***Abstract*—Infertility is one of society's physical, social, and psychological difficulties. "Failure to obtain a clinical pregnancy after 12 months or more of regular unprotected sexual intercourse," according to the definition. Ovulation induction has remained a watershed moment in the lives of women. Infertility is a prevalent problem that is sometimes misunderstood. Male infertility has affected an increasingly large population over the past few decades, affecting over 186 million people globally. The advent of assisted reproductive technologies (ARTs) and artificial intelligence (AI) has changed the landscape of diagnosis and treatment of male infertility. Because of its effects on families, its importance to study in related fields such as fertility trends and reproductive health, and its implications for practitioners who work with individuals and couples facing infertility. Infertility is an important topic for family scientists. Inability or difficulty in conceiving is a physically and psychologically draining experience for a woman. Polycystic Ovary Syndrome (PCOS) has been determined as one of the serious health problems in women that affects the fertility of women and leads to significant health conditions. Therefore, early diagnosis of polycystic ovary syndrome can be effective in the treatment process**

Keywords—infertility; hormones; clinical data,PCOS,adolescene ,harmone,

I.INTRODUCTION

Infertility, as defined by the World Health Organization (WHO), is a condition of the reproductive system characterized by the failure to achieve a clinical pregnancy after 12 months or more of regular, unprotected sexual intercourse. This condition has significant implications for both men and women, affecting their ability to conceive and reproduce.. Female infertility is a major disorder that has changed people's lives in terms of lack of conception and reproducibility, a stressful environment, excessive radiation, a lack of biological food, genetically disorder, changing lifestyles, and increased electronic discharge.Fertility rates have dramatically decreased in the last two decades, especially in men.[34]

The Female reproductive system

The internal and external sex organs that operate in the reproduction of new children make up the male reproductive system as shown in figure 1.

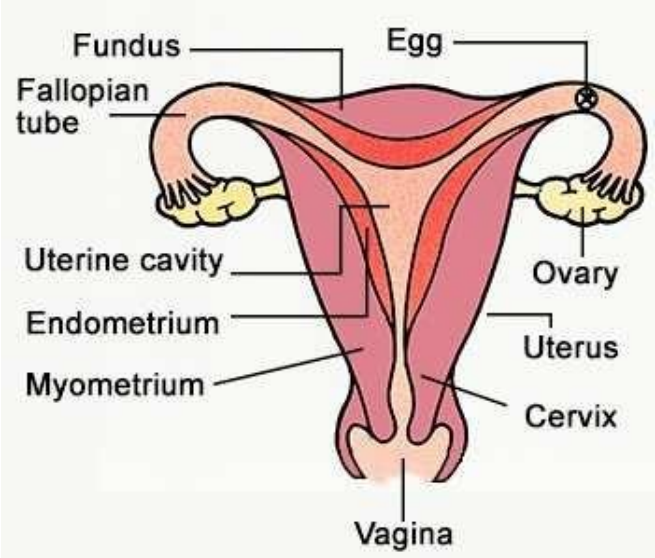

Figure 1: Female reproductive system

. The female reproductive system serves a variety of purposes. The egg cells, known as ova or oocytes, are produced by the ovaries. The oocytes are subsequently transferred to the fallopian tube, where they may be fertilised by sperm. The fertilised egg is subsequently transferred to the uterus, where the uterine lining has expanded in response to the reproductive cycle's typical hormones. The fertilised egg can implant into the thicker uterine lining and continue to develop once inside the uterus.

The uterine lining is lost as menstrual flow if implantation does not occur. The female reproductive system also produces female sex hormones, which help to keep the reproductive cycle going.Pregnancy will occur in roughly 85 percent of young and healthy hetero sexual couples who have frequent intercourse, with 93 percent of attempts at conception.

This guideline does not apply to couples in which the female is above 35 years old or when one or both partners have a history of reproductive issues. If the lady is above 35 and has been trying unsuccessfully for more than 6 months, she should seek additional counsel regarding investigation and therapy. If the female has a history of gynecological difficulties, or if the partner's sperm count is known to be low, they should consult a fertility specialist right away. Women aged 40 and up should begin their inquiry and treatment after three months.

Female Infertility

Female infertility is a prevalent cause of infertility in both men and women. A female spouse will be present in at least half of all infertility consultations. In the past, the female partner was expected to do the majority of the work and must shoulder most of the responsibility, and just approximately 5% of couples was assumed that seeking assistance with having a baby is desirable.

Infertility and childlessness cause a lot of pain and anguish in people's lives. In both men and women, female infertility is a common cause of infertility. At least half of all infertility consults will include a female partner.

1.Menarche is the beginning of the menstrual cycle in females**.**

(Adolescence is the phase of life between childhood and adulthood, from ages 10 to 19).

- **Earlyadolescence-eleven to fourteen;**
- **Middleadolescence-ages fifteen to seventeen**
- **Lateadolescence-ages eighteen to twenty-one**

2. Child bearing is the middle of age of childbirth.

3. Menopause is the ending phase of the menstrual cycle in females.

Male infertility:

Infertility in women can be caused by a variety of factors, including: problems with a fertilized egg or embryo surviving once attached to the uterine lining. Problems with the eggs' ability to attach to the uterine lining.

The initial evaluation includes a detailed sexual history and physical examination, together with 2 separate semen analyses. Hormonal testing and an optional scrotal ultrasound can then be performed if abnormalities are found. This is usually sufficient to make an initial determination of the nature and severity of the underlying problem. The key purpose for evaluating a male for infertility is to identify the contributing factors, offer treatment for those that are reversible, determine if the patient is a candidate for assisted reproductive techniques, and offer counseling for irreversible and untreatable conditions. As a result, age is becoming a more common source of infertility issues. Fertility issues affect about a third of couples with a woman over the age of 35.

Two distinct semen studies are performed as part of the first evaluation, together with a thorough physical examination and sexual history. If anomalies are discovered, hormonal tests and an optional scrotal ultrasound can be carried out. Usually, this is enough to determine the kind and degree of the underlying issue at first. Finding the contributing reasons, treating the reversible ones, determining whether the patient is a candidate for assisted reproductive procedures, and providing counseling for the irreversible and untreatable disorders are the main goals of screening a male patient for infertility.

Varicocele testis is considered one of the main reasons for men infertility. Authors present results of infrared thermography investigations carried on a group of 20 young men aged 13 to 16 who were patients of Clinic of Paediatric Surgery and Oncology, Medical University of Lodz. All of them suffered from left varicocele testis of 3rd degree (acc. to Dubin and Amelar).Only 2% of adolescents in this age group are thought to have right varicocele testis, compared to 16% of adolescents with left varicocele testis.

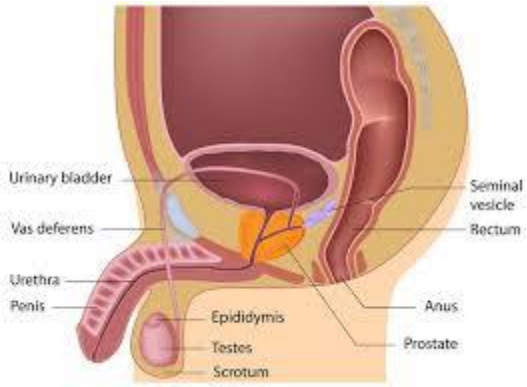

Figure 2: Male reproductive system

The male reproductive system

The male reproductive system **[Figure 2]** plays a crucial role in fertility and the development of sexual traits. It consists of both external and internal components, each of which has specific functions that contribute to reproductive health.

External Genitals

1. **Penis**:
   - **Function**: Delivers sperm into the female reproductive tract during intercourse.
   - **Structure**: Composed of the shaft, glans, and urethra, which serves as a conduit for both urine and semen.
2. **Testes**:
   - **Function**: Produce sperm (spermatogenesis) and secrete testosterone, the primary male sex hormone.
   - **Location**: Housed in the scrotum.
3. **Scrotum**:
   - **Function**: Protects and regulates the temperature of the testes, which is crucial for optimal sperm production.
   - **Structure**: A sac of skin and muscle that contracts or relaxes to maintain an ideal temperature for the testes.

Internal Parts

1. **Prostate Gland**:
   - **Function**: Produces seminal fluid that nourishes and transports sperm during ejaculation.
   - **Location**: Situated below the bladder and in front of the rectum, surrounding the urethra.
2. **Vas Deferens**:
   - **Function**: Transports mature sperm from the epididymis to the urethra in preparation for ejaculation.
   - **Structure**: A long, muscular tube that connects the epididymis to the ejaculatory ducts.
3. **Urethra**:
   - **Function**: Carries urine from the bladder to the outside of the body and transports semen during ejaculation.
   - **Structure**: A tube that runs through the penis and opens at the tip.

Hormonal Regulation

- **Hypothalamus and Pituitary Gland**:
  - **Gonadotropin-Releasing Hormone (GnRH)**: Released by the hypothalamus, stimulating the pituitary gland to secrete FSH and LH.
  - **Follicle-Stimulating Hormone (FSH)**: Promotes spermatogenesis in the testes.
  - **Luteinizing Hormone (LH)**: Stimulates the production of testosterone by the Leydig cells in the testes.
- **Testosterone**:
  - **Production**: Mainly produced by the testes, with small amounts from the adrenal glands.
  - **Function**: Essential for the development of male secondary sexual characteristics (such as increased muscle mass, deepening of the voice, and facial hair) and the maintenance of libido, spermatogenesis, and overall reproductive health.

Importance of Normal Functioning

- **Fertility**: Successful spermatogenesis and the ability to deliver sperm effectively rely on the proper functioning of the male reproductive system.
- **Sexual Traits**: Normal hormonal levels and the proper function of reproductive organs are essential for the development and maintenance of male sexual characteristics.

Any disruptions or abnormalities in these systems can lead to fertility issues and affect sexual health. Thus, understanding and maintaining the health of the male reproductive system is vital for overall reproductive well-being.

Symptoms

The inability to conceive is the most common sign of infertility. You may not be ovulating if your menstrual cycle is excessively lengthy (35 days or more), too short (less than 21 days), irregular, or missing. There may be no further symptoms or indicators visible to the naked eye. 5, diagnosing the female patients at an early stage is vital concern for everyone.

Types of Infertility

1. **Primary Infertility**
2. **Secondary Infertility**

1. **Primary infertility: A couple's inability to conceive is referred to as primary infertility.**

Endometriosis: Affects mostly women in their 30s and 40s, with roughly 40% of women suffering from endometriosis. This occurs when uterine lining is discovered outside of the uterus. Endometriosis will make it difficult to conceive. Scarring and adhesions that form a blockage appear to be the main cause of infertility in women with endometriosis 6.

PCOS (Polycystic Ovarian Syndrome): The bad news about PCOS is that it is one of the most common causes of infertility in women, but it is also one of the most underdiagnosed (less than 25% of women with PCOS are diagnosed). One of the main reasons it isn't diagnosed is that the syndrome's symptoms don't appear to be related to one another. PCOS is usually discovered only after a woman has difficulty getting pregnant and seeks expert treatment. Weight gain, acne, irregular or nonexistent periods, infertility, and failure to ovulate are all indications of PCOS. A battery of blood tests can be used to diagnose PCOS. It can be readily managed with the help of technology.

Ovulatory Disorders: Ovulation issues, such as irregular periods or failure to ovulate at all, account for about 40% of female fertility issues. These disorders can be brought on by a variety of factors.

POF (Premature Ovarian Failure): This is a distressing diagnosis because it indicates you are no longer menstruating despite being under the age of 40.

POF can be caused by birth defects (such as a chromosomal issue that results in faulty ovaries) or when your ovaries become resistant to your body's natural hormones in your 20s and 30s.

POF has also been linked to pelvic surgery, chemotherapy, and radiation. POF is only found in a small percentage of women's families.

Uterine Factors: This area includes any uterine issues you may have. If you've undergone reproductive testing, you'll almost certainly be given a particular diagnosis of the problem. Uterine fibroids, uterine didelphys (when your uterus is made up of two parts with a wall dividing them), a complete lack of a uterus, scar tissue in the uterus, or exposure to DES in the womb (DES was a drug given to pregnant women up until the late 1960s) are all possible factors that can affect your uterus and your ability to conceive. Children born to women who used this medicine had a high rate of birth abnormalities, including an abnormally formed uterus.

Multiple Miscarriages: Suffering from a miscarriage is terrible at any time, but it's especially difficult when you've been trying to conceive for months. While genetic disorders in the foetus are the most common cause of miscarriage, it can also be caused by difficulties with the uterus or cervix, atypical hormone levels, infections, or chemicals in the environment.

Luteal Phase Defect (LPD): This can be caused by two reasons, both of which involve the development of progesterone in your body. The initial reason of LPD is a lack of progesterone secretion by your ovaries. The second cause could be that your endometrium isn't responding to pregnancy. or isn't properly prepared for it, resulting in either fertility issues or an early miscarriage.

2. Secondary Infertility

Secondary infertility describes situations in which a couple has been successful in conceiving at least once but has failed to do so again. It's critical to maintain open lines of communication with your spouse so that you both understand what the other wants, aspires for, and is ready to do (or not do) in order to become parents again.

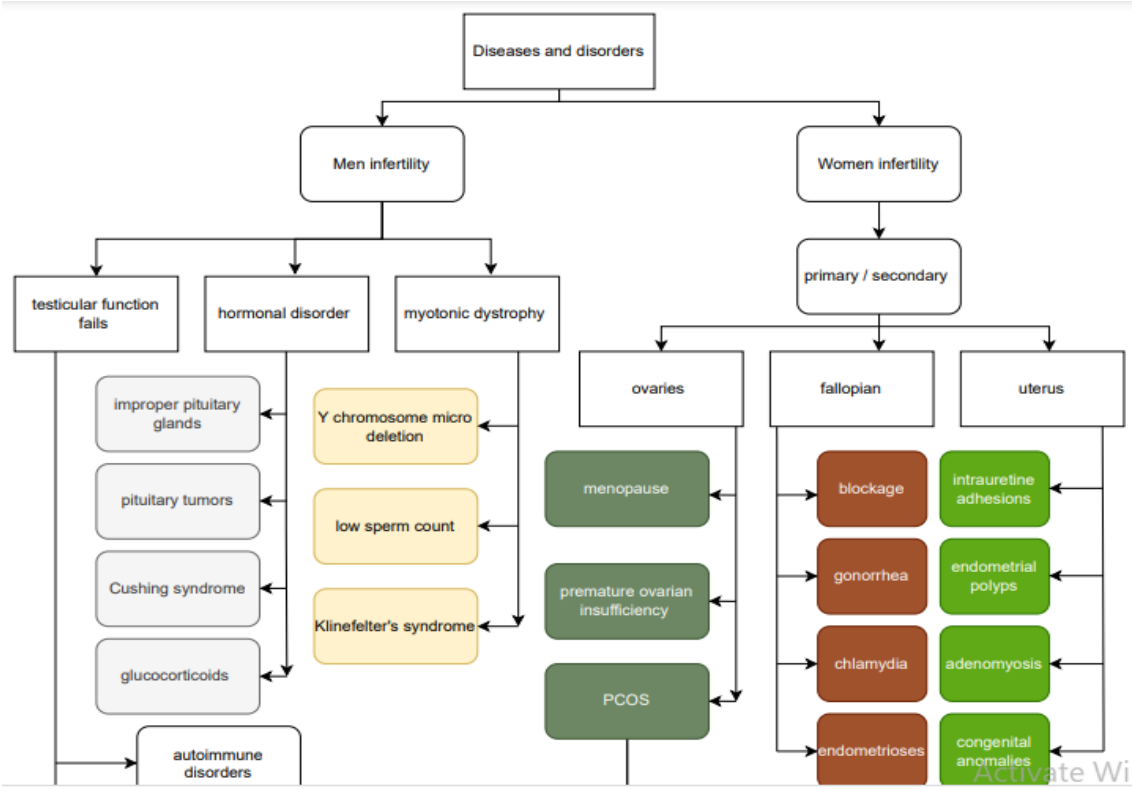

Figure 3: Types of infertility

Causes for Indian women to be infertile

Infertility affects 50 to 80 million couples worldwide at some time during their reproductive lives. The infertility situation in poor countries differs significantly from that in rich countries. A significant proportion of women suffers from preventable problems such as sexually transmitted infections, postpartum infections, post abortion infections, previous contraceptive complications, tubal damage, polycystic ovary syndrome (PCOS), and pelvic inflammatory diseases, in addition to anatomical, genetic, endocrinological, and immunological issues (PIDs).

With this in mind, the current study aimed to focus on the current infertility issue in India and its states, as well as to investigate the risk factors for infertility among women in India's high-infertility districts. The study also aims to discover how women seek therapy for their infertility issues, as well as the impact of infertility on fertility as shown in **Table1**.

Table 1: WHO statistics

SL No.	Type of disorder	Percentage
1	Ovulatory disorders((OD)	25%
2	Endometriosis	15%
3	Pelvic adhesions	12%
4	Tubal blockage	11%
5	Uterini abnormalities	1%
6	Hyperprolactinemia	7%

As shown in Figure 2 Ovulatory abnormalities account for 25% of all known causes of infertility in women. Because no oocyte is released monthly, oligo-ovulation or anovulation causes infertility. There is no chance of fertilisation or pregnancy in the absence of an oocyte.

The majority of cases of infertility are caused by ovulating infrequently or not at all. Ovulation abnormalities can be caused by issues with the hypothalamus or pituitary gland's management of reproductive hormones, as well as issues with the ovary.

Polycystic ovarian syndrome (PCOS) is a type of polycystic ovary (PCOS). PCOS results in a hormonal imbalance that interferes with ovulation. PCOS is linked to insulin resistance, obesity, abnormal facial or body hair growth, and acne. It's the most common cause of infertility in women.

Dysfunction of the hypothalamus. The pituitary gland produces two chemicals that stimulate ovulation each month: follicle-stimulating hormone (FSH) and luteinizing hormone (LH) (LH). Excessive physical or emotional stress, an extremely high or extremely low body weight, or a recent significant weight gain or loss can all alter hormone production and have an impact.

Primary ovarian insufficiency is a condition in which the ovary is not functioning properly. Premature ovarian failure, also known as autoimmune ovarian failure, is caused by an autoimmune response or the premature loss of eggs from your ovary, which can be caused by genetics or chemotherapy. In women under the age of 40, the ovary no longer produces eggs and oestrogen production is reduced.

There's too much prolactin in your system. Excess prolactin production (hyperprolactinemia) by the pituitary gland lowers oestrogen production and can lead to infertility. It's also possible that meds you're taking for another ailment are causing this.

Male infertility can indeed be a challenging and emotional issue. Here are some key points about its causes and treatments:

Causes of Male Infertility

1. **Low Sperm Production**: A low sperm count can make it difficult to conceive. Factors affecting sperm production include:
    - Genetic conditions.
    - Hormonal imbalances.
    - Undescended testicles.
    - Infections.
2. **Abnormal Sperm Function**: Sperm that cannot swim properly or have an irregular shape may struggle to reach and fertilize an egg. Causes include:
    - Genetic defects.
    - Health conditions like diabetes.
    - Infections, such as chlamydia and gonorrhea.
3. **Blockages**: Blockages in the tubes that transport sperm can prevent it from reaching the egg. These blockages can be caused by:
    - Previous surgeries.
    - Infections.
    - Injuries.
4. **Health and Lifestyle Factors**:
    - Chronic health issues like diabetes and obesity.
    - Substance abuse (alcohol, tobacco, drugs).
    - Exposure to environmental toxins.
    - Stress and psychological factors.

- Certain medications.

Treatment Options

1. **Medical Treatments**:
   - **Medication**: Hormonal treatments can address imbalances affecting sperm production.
   - **Antibiotics**: Treating infections that impact sperm quality.
   - **Counseling**: For psychological factors like stress or anxiety affecting fertility.
2. **Surgical Treatments**:
   - **Varicocele Repair**: Surgery to repair enlarged veins in the scrotum.
   -
   - **Vasovasostomy**: Surgery to reverse a vasectomy.
   - **Sperm Retrieval**: Techniques like testicular sperm extraction (TESE) or percutaneous epididymal sperm aspiration (PESA).
3. **Assisted Reproductive Technologies (ART)**:
   - **In Vitro Fertilization (IVF)**: Sperm and egg are combined in a lab, and the embryo is implanted in the uterus.
   - **Intracytoplasmic Sperm Injection (ICSI)**: A single sperm is injected directly into an egg.
4. **Lifestyle Changes**:
   - **Diet and Exercise**: Maintaining a healthy weight and balanced diet.
   - **Avoiding Toxins**: Reducing exposure to harmful substances.
   - **Quitting Smoking and Limiting Alcohol**: Improving overall health and sperm quality

Diagnostic Process for Male Infertility

1. **General Physical Examination and Medical History**:
   - **Examination**: A thorough physical examination of the genitals.
   - **Medical History**: Discussion of any inherited conditions, chronic health problems, illnesses, injuries, or surgeries that could affect fertility.
   - **Sexual History**: Questions about sexual habits and development during puberty.
2. **Semen Analysis**:
   - **Sample Collection**: Typically, a semen sample is obtained by masturbating and ejaculating into a special container at the doctor's office.
   - **Alternative Methods**: For those with religious or cultural reservations, semen can be collected using a special condom during intercourse.

Financial Considerations

1. **Insurance Coverage**: Infertility tests can be costly, and insurance coverage varies widely. It's essential to check what your medical plan covers in advance to avoid unexpected expenses.
2. **Multiple Tests**: Diagnosing infertility may require several tests, increasing the overall cost.

Key Points

- **Multiple Factors**: Infertility often involves more than one cause, so both partners should be prepared for thorough evaluations.
- **Unidentified Causes**: In some cases, the cause of infertility remains unknown despite extensive testing.

By understanding the diagnostic procedures and being proactive about checking insurance coverage, couples can better navigate the journey of diagnosing and treating infertilty.

Besides infertility, females with PCOS also suffer from hormonal imbalance, hair loss, and other serious illnesses like high blood pressure, heart disease, diabetes, mental disorders, and many more [3][29].However, timely care and early treatment, PCOS can still be treated successfully, and infertility can be avoided so that women can have a normal pregnancy. Treatment of PCOS involves clinical examination and analysis of some cardinal symptoms that includes anovulation, signs of hyperandrogenism, hirsutism, androgens, pelvic pain and menstrual irregularities. According to studies conducted in the United States, black women are more likely to develop PCOS than white women which has been reported at nearly 8% and 5%, respectively [5-

6]. These women are mostly affected by high blood pressure, obesity, cardiovascular disease, endocrine disorders, abnormal vaginal bleeding gynecological cancers, and diabetes (type-2). To prevent any serious effects of PCOS, diagnosing the female patients at an early stage is vital concern for everyone. Menstrual periods may be skipped or irregular as a result of PCOS.

Infertility is a problem that many couples face (inability to get pregnant). PCOS is, in fact, one of the most common reasons of female infertility. Cysts (small fluid-filled sacs) form in the ovaries.

A recent development in machine learning techniques has contributed to early detection of diseases, consenting for early treatment and reduced mortality. However, high dimensional data often results in under fitting issues and complex computations, which affects the accuracy of machine learning algorithms. In this paper the study aims to predict PCOS using ensemble learning mechanism applied on clinical dataset [7-8] of both men and women. Therefore, selecting the most significant data reduces over fitting risk and improves the performance of the classification models [9-10].

II.RELATED WORK

Table 2: Male and Female infertility

Author and year	Name of Journal	Findings
[1] Nikit Venishetty	The Role of Artificial Intelligence in Male Infertility: Evaluation and Treatment: A Narrative Review,MDPI	Research indicates that AI models can accurately estimate the quality of semen, diagnose problems with sperm, and provide guidance on reproductive health decisions.
[26] Harman Deep Gill et.la	*"Prevalence of polycystic ovary syndrome in young women from North India: A Community- based study* "	The study was aimed to assess the prevalence of PCOS in women 18-25 years of age, conducted in college girls from Lucknow, North India.
[27] R. Vidya Bharathi et la,*2017*	*"An epidemiological survey: Effect of predisposing factors for PCOS in Indian urban and rural population*" Middle East Fertility Society Journal	PCOS as a lifestyle disorder highly prevalent among middle and high income urban population as compared to rural population.
[24] *Preeti Chauhan*	"Comparative Analysis of Machine Learning	It is seen that most women overlook the common indication of PCOS and visit the doctor only when they face difficulty

et.al ,2021	Algorithms for Prediction of PCOS" IEEE Explorer	conceiving. If not diagnosed in time, the condition can cause serious health issues
28] *Amsy Denny et.la 2019*	IEEE Explorer	Polycystic ovary syndrome (PCOS), is one of the relevant, most prevalent hormonal disorder seen among the women of childbearing age. This is a heterogeneous endocrine disorder.
[6]sumia Islam et.al 2021	IEEE Explorer	PCOS is defined by a series of clinical expressions such as irregular period cycle, having cyst, hormonal imbalance, fatness and many more
[7] *Yash Upadhyay,2020*	Asia journal of pharmaceutical research	Symptoms of PCOS include weight gain, acne, and irregular or absent periods, infertility, and failure to ovulate. PCOS can be diagnosed through a series of blood test
[8] *Shraboni Patra,2017*	Global journal of medicine	In India, the prevalence of infertility problem ever experienced by currently married women was 8.8%, of which 6.7% women had ever experienced primary infertility and 2.1% women had ever experienced secondary infertility. The prevalence of currently infertile women was 4.6%
[23]*RABIA FAROOQ et al,2020*	"Short Review on Polycystic Ovarian Syndrome"	Early diagnosis and treatment along with weight loss may reduce the risk of long- term complications.
[4]Nitin et la	"Study on the proportion and determinants of polycystic ovarian syndrome among health sciences students in South India"	This study was done to assess the proportion of university students with PCOS and to study its risk factors

III. Machine learning Techniques in PCOS detection

The application of machine learning (ML) is being explored since many years for solving complex problems and automating the predictive tasks. It is being observed that PCOS detection using ML approaches has received less attention from the researchers from the viewpoint of computational task. A user desired key word (PCOS + machine learning) is used for the data extraction for conducting review of literature from various digital library. It is found the PCOS detection becomes an active research area in the recent years. However, it has been analyzed that there is total 33 research paper published on IEEE digital library to date. Among 32 are conference and only 1 research paper belongs to journal. Therefore, the proposed work considers springer, science direct, and some other useful sources to extract data for the review of literature.

A recent work carried out by Thakre et al. [11] in the context of PCOS detection using ML have implemented 5 supervised classifiers. This study uses clinical dataset available on Kaggle which consists of 45 raw features. The authors have applied chi-square technique for the selection of optimal features which further leads to generate 30 top features significant to PCOS.The comparative analysis shows effectiveness of random forest (RF) classifier with accuracy rate 90.9% compared to other classifiers such as logistic regression, K-neighbor classifier, linear and radial support vector classifier (SVC). However, feature selection is limited, needs more optimization concerning higher prediction accuracy and less time complexity.

Another work in the same line of research is carried out by the authors in the study of Mehr and Polat [12]. This study also has considered Kaggle clinical PCOS dataset which were introduced to ML classifiers. The features were reduced to 33, 30 and 28 by applying pearson method, sequential backword and RF embedded method respectively. The study has implemented three classifiers such as RF, extra tree and Adaboost. The study outcomes show RF has achieved good performance concerning prediction accuracy (98%) and feature optimization (28) when compared to other classifiers.Although, this study lacks novelty part since the implementation is done on the existing baseline approaches and no customization is done in the design principle of the classifier or feature engineering task. The study opens a scope for the feature optimization.

Silva et al. [23], evaluated the effectiveness of different classifiers such as SVM, RF, LR and gaussian naive bias on PCOS Kaggle dataset. The outcome reveals that RF could surpass other classifiers by achieving the accuracy and precision rate of 95% and 96% respectively. Similarly, the work of Munjal et al. [24] implemented three MLtechniques such as extratrees, RF and decision tree (DT)and genetic algorithms (GA) for the feature optimization. The implemented model is evaluated on Kaggle PCOS dataset with 9optimal features. The comparative analysis demonstratedbetter performance has been achieved by extra treeswith accuracy rate 88%.Another work on Kaggle PCOS dataset is done by Bharati et al. [21]. In this study the authors have applied univariate feature selection mechanism to optimize the input feature vector. Moreover, gradient boosting, RF, LR and a combined approach of RF and LR is presented to predict PCOS with ten optimal features. The performance assessment and outcome declare that combination of RF and LR is better than the other classifiers with accuracy and recall rate of 91.01% and 90% respectively.

The above discussed literatures are the similar to the proposed context. There are other research works presented by researchers in the context of PCOS detection considering different dataset. The study of Xie et al. [16] have presented a ML model by combining RF and artificial neural network (ANN) for the PCOS detection using to gene biomarkers. The presented model was evaluated on Gene Expression Omnibus database. The study outcome shows that proposed model has achieved AUC of 0.7273 and 0.6488 in microarray and RNA- seq dataset respectively. Guleken et al. [17] have attempted to detect PCOS usingraman spectroscopy and multivariate analysis. The work of Katarya et al. [18] presented automated diagnostic system PCOS detection on clinical data using ML technique. The authors have implemented swarm optimization technique for the Feature optimization. The study outcome exhibits 90.74% accuracy achieved by the presented system.

Eliyani et al. [19] computational model for the detection of follicles of form medical image. This study has performed pre- processing, speckle noise reduction, follicular segmentation, feature extraction, feature selection, and calculate the diameter of number follicles. Gopalakrishnan and Iyapparaja [20] introduced automated PCOS classification system from the ultrasound images. Gaussian low pass filter, is applied for image enhancement and multilevel thresholding is used for the segmentation. The result shows RF has achieved higher accuracy 91% compared to the other ML classifiers. The study of Denny et al. [20] applied principal component analysis (PCA) for feature optimization. The result shows the superiority of RF with PCA with 89.02% accuracy compared to the otherML classifiers. Prapty and Shitu [25] applied DT to select top features related to PCOS. The authors have also applied RF, SVM, NB and KNN to predict PCOS. The results optimization towards reducing computational complexity and enhancing perception performance. However, such approaches are limited to specific model design and feature optimization technique. They considered single feature selection technique which can not address the problem associated with both categorical and numerical feature in the dataset complexity.

VI. Conclusion

PCOS is a complicated reproductive, metabolic, and psychological illness with a wide range of clinical indications and is one of the leading causes of infertility. A serious health problem in women and men that affects fertility and leads to fatal health conditions is polycystic ovarian syndrome (PCOS). Hence, early diagnosis of PCOS is effective in the treatment process. Currently, existing methods and treatments do not provide adequate early detection or prediction of both men and women infertility. The scholar needs to identify unique approach of learning model with feature optimization process to assist with the early detection and prediction of men and women infertility treatment to overcome this issue using clinical dataset**.**

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