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INFERTILITY AND THE RISE OF ASSISTED REPRODUCTIVE TECHNOLOGIES (ARTS)

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ABSTRACT

Infertility or Childlessness is a serious issue that affects 45-50 million couples worldwide. Primary infertility in India has declined from 1992 to 2015, while secondary infertility has observed a rise within the same period. It is seen that people with higher educational levels, working women, obese people and societal activeness are some of the factors that influence these infertility rates. This paper reviews the primary and secondary infertility trends among various countries and how assisted reproductive technologies have emerged and helped infertile couples all over the world, and in India, to have children and be able to experience the feeling of parenthood along with the measures taken by the Indian Government to provide monetary help to economically unstable couples.

KEYWORDS: Infertility, Fertility, Trends, Reproductive health, Assisted Reproductive Technologies, In-vitro Fertilisation, Government of India.

INTRODUCTION

Infertility is a worldwide health issue that affects both men and women. Even though infertility is a serious threat to a person's overall health, it is the least talked-about topic among the population. In the current world, where women's empowerment has gained a significant rise, women are still often blamed and disregarded for not being able to bear offspring. Approximately 8-12 per cent of couples all around the globe suffer from infertility.[1] The World Health Organization (WHO) has defined clinical infertility as "a disease of the reproductive system defined by the inability to establish a clinical pregnancy after 12 months or more of regular unprotected sexual intercourse.".[2,3]

The prevalence of infertility in the Western world is one in seven couples, while in developing countries, it affects one in four couples within the reproductive age.[4] Infertility in both men and women can be caused by various factors, ranging from anatomical complications, STIs, genetic problems, unhygienic obstetric practices, to lifestyle and socio-economic factors.[5] In broad terms, female infertility can be classified as Primary Infertility and Secondary Infertility. Those females who have never shown signs of a clinical pregnancy and have problems conceiving are grouped under primarily infertile women, and those who face complications after being previously diagnosed with a clinical pregnancy are grouped under secondary infertile women. The same can be used for men who have participated in initiating these pregnancies.[4] According to WHO, most of the infertile couples suffer from primary infertility.[6]

ARTs or Assisted Reproductive Technologies refer to in-vitro procedures which follow carefully curated, sequentially aligned steps such as controlled ovarian hyperstimulation, collection of ova from the female reproductive tract, insertion of sperm within the laboratory, embryo transfer, and so on in aseptic conditions,[2,7] OR in simple terms, ARTs consist of the handling of gametes and performing fertilization outside of a female's body to develop an offspring.[7] These techniques use various tools, highly engineered equipment, and trained professionals to help infertile couples conceive/ bear children.

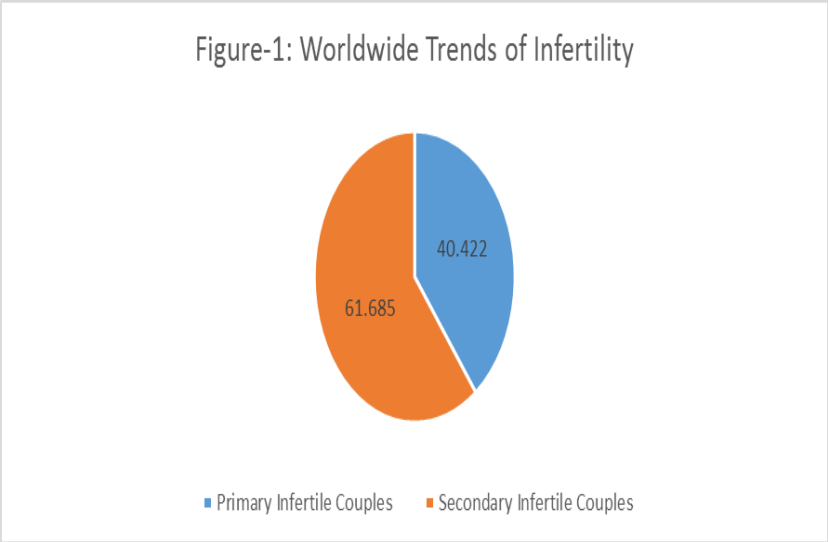
Infertility

Global Prevalence and Trends of infertility

The escalating prevalence of infertility is projected to have a significantly adverse impact on the overall health of individuals. Around 8-12% of couples in the U.K. are infertile.[5] A national average of 12.5-16% of infertile couples was observed in the Sub-Saharan Countries around 1990-2010. The Central and Southern regions of Africa were considered 'the infertile belt', where the infertility rates were as high as 32% in Namibia and 20-30% in Nigeria. Other South African countries noted infertility rates as 15-22% cumulatively in Zimbabwe,

Lesotho and Botswana. These rates were significantly higher than those of 8-13% in the East African Countries and Egypt combined.[5]

A WHO study showed that around 187 million ever-married females suffered from infertility in developing nations in 2010.[8]



Another study by Mascarenhas MN et. al. showed that around 47.5 million couples worldwide are childless. Out of these, 19.2 million are primarily infertile, and 29.3 million suffer from secondary infertility (Figure 1). A total of 14.4 million couples are residents of South Asia, and 10 million are from Sub-Saharan Countries.[3]

Within the Sub-Saharan and South East Asian regions, primary infertility decreased from 2.7% in 1990 to 1.9% in 2010.[3] Secondary infertility followed a similar trend, decreasing from 3.9% to 3.0% from 1990 to 2010.[3]

Effects of infertility in india

Infertility in India has undergone significant changes over the past years. One out of four couples among the reproductive age group suffer from childlessness due to infertility. According to the estimations of the Census of India, the trends of infertility varied unpredictably from 1981 to 2015.[6] Infertility rates increased from 13 per cent in 1981 to 16 per cent in 2001 and then again decreased between 1998-99 and 2005-06.[6,8]

The total number of infertile couples in India in 2007 was around 17.9 million. Primary infertility ranged from 4.9 to 5 million, leaving the rest being secondarily infertile.[1]

India is socially, culturally, and ethically a vast country. Different religions, castes and sects live together as one Nation. These differences, though, create a difference in the trends of infertility. The states of Goa, Lakshadweep and Daman and Diu among the union territories have shown highest rates of infertility among all the Indian states.[6] The reason being the prominence of drinking and smoking culture due to higher tourism rates in these areas. Percentage of women who underwent permanent sterilization in Bihar was around 34.8%, while in South Kerala, it was around 46.6%.[6]

Various factors affect a person's fertility. In most cases, the age of the female at the time of marriage, stress, drinking, smoking and Gonorrhea play an important role in determining the fertility of a woman. Some of these factors are further discussed in the paper.

Lifestyle factors

Lifestyle factors, or the habits and daily routine of an individual, are one of the factors that can be taken into direct account in the case of infertility. The food one eats, exercise or physical work one does all cooperate in determining and maintaining the overall health of an individual. The same goes for fertility. For men, consuming a high amount of fibre, folate, carbohydrates, and lycopene combined with fruits and vegetables improves semen quality.[9] A high fertility diet in women consists of carbohydrates, mono-unsaturated fats, high-fat dairy, vegetable proteins, lower glycemic load, and intake of iron and multivitamin supplements. This kind of diet reduces the risk of ovulatory disorders, ultimately leading to higher fertility.[9]

Obesity and body mass index (BMI) are other primary factors influencing fertility. Obese or pre obese women are at twice the risk of infertility as compared to women with normal BMIs, while obese men are three times more likely to have poor semen quality than normal-weight men.[9,10] Obesity leads to menstrual dysfunction and hormonal imbalances in females, which thereafter increases the risk of infertility.[10]

Amount of Caffeine intake and environmental factors such as air quality, radiation, and chemical exposures are additional factors that contribute to infertility.

Medical conditions

Medical conditions like hyperprolactinemia, cystic fibrosis, systemic diseases, and autoimmune diseases often affect the reproductive health of an individual.[4]

The most common cause of infertility is gonorrhea, which is caused by the pathogen *Neisseria gonorrhoea* that infects the fallopian tube.[4] Other than gonorrhoea, infection by the pathogen, *Chlamydia trachomatis* which causes sexually transmitted diseases(STIs) like urethritis, cervicitis, acute pelvic inflammatory diseases(PIDs), tubal factor infertility, ectopic pregnancies, etc.[11] was also observed in the medical history of many infertile men and women.[4]

Male factors

Both males and females have equal contribution to the conception of a pregnancy. While women are mostly blamed for a couple's childlessness, men are the cause in about 7 percent of infertile couples.[12] Male infertility can be due to various factors such as, congenital and acquired urogenital abnormalities, genetic factors, hormonal imbalance, increased scrotal temperature, immunological factors etc.[13] Among these cases, more than 90 percent of male infertility is due to OAT syndrome (Oligo-astheno-teratozoospermia) which in simple terms means poor sperm quantity, quality, and movement.[12,13] While 1-10% of male factor infertility is often curable, genetic factors and congenital factors are not.[12]

Female factors

It has been reported that childless women often opt for treatments from traditional healers, unqualified quacks and private physicians, which frequently results in either further complications or late diagnosis of the actual problem.[14] A combination of factors, such as genetic problems, infectious or parasitic diseases, stress, postponing parenthood, sexual mobility, extra-marital sex, etc., contribute to reproductive complications in females.[8]

Socio-economic factors

As societies evolve and experience significant socio-economic transformations, several factors come into play. Increased access to education empowers individuals, particularly women, leading to a greater understanding of family planning and reproductive health. Concurrently, urbanisation shifts lifestyles, often resulting in smaller family sizes due to the high costs associated with raising children in cities. Furthermore, advancements in healthcare have drastically reduced child mortality rates, allowing parents to focus on fewer children with the hope of providing them with better opportunities. As a result of these interrelated changes, actual fertility rates tend to decline, reflecting a profound shift in societal values and economic realities.[15]

Treatment/Assistance seeking

Although many people worldwide suffer from infertility, only some people actually seek treatments or assistance for their inability. This could be due to the social or religious stigmas attached to infertility.[5,16] A woman's body is anatomically designed to be a child bearer; hence, a female's well-being is often associated with her reproductive health. If there are problems in menstruating/conceiving, it is seen as undesirable by society. This leads to the medicalisation of infertility, and being childless poses societal oppression in various cases.[12] Cultural barriers and the inability of the male partner to encourage and support treatment usually hold many females back from seeking medical assistance.[16] Most successful treatments for women are those of clearly defined ovulatory disorders (~20%), especially those of amenorrhea. The rest 80% of the couples/females resort to in vitro procedures.[17]

Assisted reproductive technologies

Ever since Louise Joy Brown was born as the first live birth of an in-vitro baby in 1978, fertility clinicians have been overjoyed. Robert Edwards, Patrick Steptoe, and Jean Purdy performed the in vitro fertilization(IVF) of baby Louise.[7] Assisted Reproductive Technologies (ARTs) have surged immensely thereafter. It was estimated that around 8 million children worldwide have been conceived by ART as of 2020.[7]

ART encompasses all treatments and procedures involving in-vitro manipulation of sperm, oocytes, or embryos to achieve pregnancy.[2]

ARTs in the World and India

Approximately 1.93 million ART cycles were initiated worldwide (according to the data submitted by 76 countries), out of these, around 439,039 babies were born in the year 2014.[18] In comparison to this, only 65 countries submitted their data regarding ART treatments in 2011. On analysing, it was concluded that nearly 1.64 million Art cycles were initiated worldwide, which resulted in more than 394,662 live births.[19]

By the successful efforts of Dr. Subhash Mukhopadhyay, Durga, the first IVF baby of India, was born in Kolkata in 1981, but this was not considered by the government because of ethical and social conflicts. Harsha, who was born in 1986, by the efforts of Dr. T. C. Anand Kumar and Dr. Indira Hinduja, was considered by the Indian Council of Medical Research (ICMR) as India's first IVF-born baby.[20]

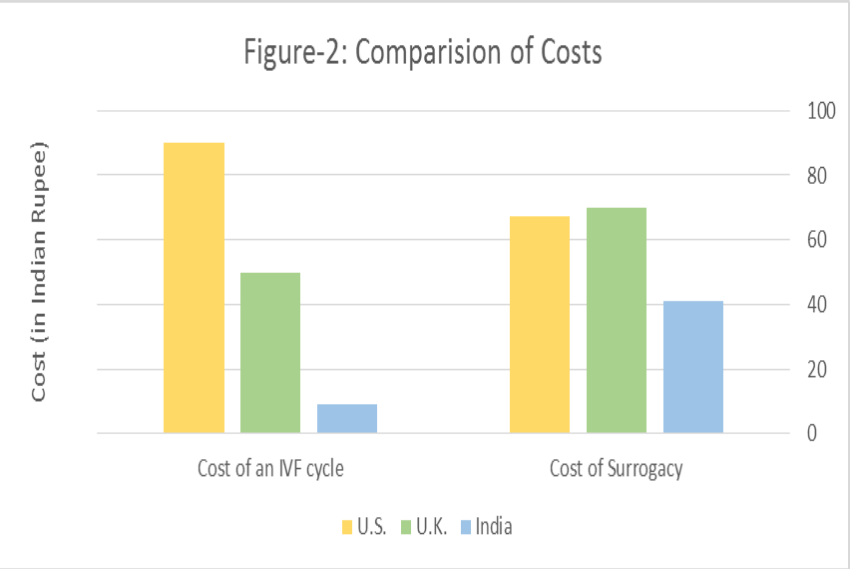
Since fertility clinics were ever-increasing within the country after the first successful live birth of an IVF baby, there was a need to impose strict rules and regulations to avoid unethical practices in the industry. Hence, the Assisted Reproductive Technology (Regulation) Act, 2021, was enacted on December 20, 2021, by Parliament to regulate assisted reproductive

technology (ART) clinics and ART banks in the country.[20]

The IVF-ICSI cycles initiated rose from 5600 in the year 2000 to 21,500 in the year 2006. The projected increase for the year 2011 was said to be 1,10,000 cycles.[21]

Cost of ART and Medical Tourism in India

Cost of ARTs varies greatly all over India. But the main reason for India attracting many infertile couples for treatment is the lower rates of IVF than in other countries.



The cost of an IVF cycle in the U.S. is about Rs. 9,00,000, and in the U.K., it is approximated to be around Rs. 5,00,000 as compared to the much lower Rs. 90,000 in India.[22]

The cost for surrogacy follows a similar trend and is about Rs. 6,75,000 in the U.S. and around Rs. 7,00,000 in the U.K., while in India cumulative cost of an IVF cycle and surrogacy sums up to be around Rs. 5,00,000.[22]

Government subsidies in india

As per the "GOVERNMENT OF INDIA, MINISTRY OF HEALTH AND FAMILY WELFARE DEPARTMENT OF HEALTH RESEARCH", a questionnaire was held in the 'Lok Sabha' on 7th April, 2017. To answer the question starred 493, the minister started by addressing the issue of rising infertility and further went on to state various schemes that have been launched by the government to help economically challenged couples get fertility treatments.[23]

Some of these include

- 'Pradhan Mantri Surakshit Matritva Abhiyan', to safeguard pregnant women up to the time of delivery of the baby.
- 'Matrutva Yojana' by the Government of Assam. The state government would provide monetary help up to Rs. 5 lakh for infertility treatment.
- The Government of Goa would provide assistance of up to Rs. 5 lakhs to Tribal couples of Goa for fertility treatment.
- 'Jiyo Parsi Program', funded by the Ministry of Minority Affairs, was aimed at helping low and middle-income Parsi couples with fertility treatments.[23]

Despite the concern of overpopulation, the Indian Government still promotes ARTs as infertility stands as the fifth leading cause of global disability, highlighting its profound effects on individuals' overall biopsychosocial well-being. The emotional toll of infertility can lead to psychological distress, while the physical aspects can challenge one's health and body image. Furthermore, the social implications often create barriers to forming or growing families, contributing to isolation and impacting relationships. The complex interplay of these factors underscores the importance of understanding and addressing infertility not just as a medical condition, but as a multifaceted issue that profoundly affects many aspects of life.[16]

CONCLUSIONS

Increasing modernisation has led to an increase in overall infertility rates all around the globe. Most couples suffer from secondary infertility. The lack of a proper diet, obesity and higher influences from the environment have led to this. The rates of initiation of ART cycles cannot be determined accurately as the data submitted by countries varies each year. While we can conclude that more and more fertility clinics are being established worldwide, and even the cultural and religious barriers are being somewhat lifted, infertility still remains a taboo topic in many parts of the world.

The better implementation and safer ART practices in India and other developing countries will require better infrastructure, skilled medical practitioners and laboratory experts. Educational institutions should provide proper courses and a well-structured curriculum for the training and skill development of infertility healthcare providers.

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