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Review Article

Environmental Risk Factors for Infertility Focusing on Egypt: A Narrative Review

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Abstract

Infertility is a condition characterized by the failure to achieve a pregnancy after 12 months of regular, unprotected intercourse. 16-17.5% of couples are suffering from infertility worldwide. Genetic and environmental factors may play a role in infertility. Environmental risk factors include exposure to heat stress, infections, and pollutants. Endocrine-disrupting chemicals (EDC) like bisphenol A, phthalates, pesticides, dioxins, and polychlorinated biphenyls can mimic hormones and disrupt fertility. Air pollution, heavy metals, and microplastics could be hidden factors for infertility.

Unhealthy habits like smoking, excessive alcohol consumption, an unhealthy diet, and both obesity and underweight can negatively affect fertility. Poor socioeconomic status could affect fertility due to chronic exposure to stress and limited access to healthcare. These factors can have trans-generational effects, potentially leading to developmental issues and decreased reproductive fitness in offspring, highlighting the critical need for public health interventions to promote clean environments and healthy living habits.

In Egypt, around 12% of couples are affected by infertility, and the infertility rates have been increasing in the last few years. Research on infertility in Egypt is limited, but some studies have explored factors like heat stress, sexually transmitted diseases, vitamin D deficiency, EDC exposure, and psychological stress that could affect fertility. More research is needed to understand the specific environmental and lifestyle factors impacting Egyptians.

So, infertility is a complex issue with both genetic and environmental influences. By understanding the specific risk factors in a region like Egypt, we can develop targeted strategies to improve infertility management and reproductive health.

Keywords: Egypt; Endocrine-disrupting chemicals; Environmental risk factors; Infertility; Microplastics

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INTRODUCTION

Infertility is a condition characterized by the failure to achieve a pregnancy after 12 months of regular, unprotected intercourse when the female partner is under 35 years of age and after 6 months when the female partner is 35 years of age or older. So, the need for medical intervention is mandatory to resolve the condition [(1)].

This status could be classified as primary or secondary infertility. When a person never becomes pregnant, that is known as primary infertility, while secondary infertility occurs when an individual had at least one previous pregnancy. Secondary infertility is most common in regions of the world with high rates of unsafe abortion and poor maternity care, leading to post-abortive and postpartum infections [(1)].

Twenty to thirty percent of infertility cases are caused exclusively by men, fifty percent by women, and the other twenty to thirty percent are caused by common factors between the two partners. In males, causes of infertility are most commonly due to problems in the semen ejaculation, absence or low levels of sperm, or abnormal shape and movement of the sperm. On the other hand, female infertility can stem from various factors affecting their reproductive system. This might involve abnormalities in the ovaries, uterus, or fallopian tubes, or hormonal imbalances [(1, 2)].

16-17.5% of couples are suffering from infertility worldwide [(3)]. Globally, primary and secondary infertility prevalence has decreased in developed countries, but an upward trend has been observed in developing countries, especially in the Middle East and North Africa (MENA) countries, in the last few decades [(4)].

While the most reliable predictor of infertility is increasing women's age at conception, lifestyle and

environmental factors are sought to play an increasing role. Recent scientific literature suggests that environmental pollution contributes to the increasing trend of infertility rates and problems in conception. Even after the successful treatment of infertility, the next generation could suffer from health problems that could be related to the environmental risk factors that parents were exposed to [5].

Causes of infertility include factors affecting both sex (hypogonadotrophic hypogonadism, hyperprolactinemia, infection, systemic diseases as diabetes mellitus or renal failure), factors affecting females (disorders of ciliary motility inside fallopian tube**,** polycystic ovary syndrome, uterine fibroids), and factors affecting males (testicular deficiency, post-testicular impairment, or defects in sperm motility). All these factors could be due to genetic or environmental factors [2, 5].

In Egypt, according to the Ministry of Health and Population and World Bank data, the birth rate has declined in the past few years, from 3.5 births per woman in 2014 to 2.85 births per woman in 2023 [6, 7]. In parallel to this decreasing trend, the infertility rate is increasing, mostly due to increased exposure to environmental stressors and an unhealthy lifestyle [2, 3, 5]. Although the research about the environmental factors of infertility in Egypt is deficient, we tried to search for the common causes of this problem.

Aim of the study

The present study aimed to provide a comprehensive update of the risk factors associated with infertility and to investigate the different environmental risk factors of infertility in Egypt.

Plan of the work

This narrative review was performed to explore scientific data about risk factors of infertility. A thorough literature search using online databases such as PubMed, Scopus, and Google Scholar) was carried out. Articles were searched by using the following keywords: “infertility”, “classification of infertility”, “prevalence of infertility", “causes of infertility", “environmental risk factors of infertility", and “infertility in Egypt”. Factors with significant impact on fertility and validated by multiple studies were mainly selected for discussion. Data were extracted from the text and from the tables of the manuscript. Articles published between January 2011 and April 2024 were reviewed.

The researcher limited his search to selecting journals that focus on publishing peer-reviewed scientific articles related to infertility in recent years. After collecting the references, the researcher filtered them according to targeted objectives and then classified them into articles related to definition, prevalence, classification, genetic factors, environmental and lifestyle factors, and Egyptian data about fertility. Finally, the researcher extracted the most relevant data from each study and then built the conclusion and recommendations according to the findings.

FACTORS AFFECTING FERTILITY

Several biological processes, including organ formation and development, neuroendocrine regulation, hormone production, and meiosis and mitosis contribute to the high frequency and complex etiology of human infertility. Male causes of infertility are divided into three main categories [8].

1. Defective spermatogenesis due to endocrine disorders such as diabetes mellitus and hyperthyroidism could lead to azospermia or the formation of faulty sperms. Besides, testicular disorders such as undescended testis can also affect fertility.
2. Defective transport such as obstruction of the seminal vesicles or absence of the seminal ducts which affect the mobility of the sperms.
3. Ineffective delivery due to the psychosexual problems such as impotence, ejaculatory dysfunction, physical disability, hypospadias, or epispadias can affect fertility of males.

The causes of female infertility can be divided into three broad categories including defective ovulation, transport and implantation [8].

1. Defective ovulation:
    a. Endocrine disorders such as the dysfunction of hypothalamus, pituitary, adrenals, or thyroid glands may delay ovulation. If the corpus luteum, fails to produce enough progesterone required to thicken the uterine lining, the fertilized egg may not be able to implant.
    b. Physical disorders such as obesity, anorexia nervosa, and excessive exercise may lead to overweight or malnutrition, and affect the menstrual cycle.
    c. Ovarian disorders such as polycystic ovarian syndrome (PCOS) that can lead to infertility because of an increased amount of testosterone and luteinizing hormone (LH) and decrease uptake of glucose by muscle, fat and liver cells resulting in the production of large amounts of insulin by the pancreas. Low follicular stimulating hormone (FSH) levels also hinder the production of eggs from the ovarian follicles, and lead to form fluid-filled ovarian cysts that eventually cover the whole ovaries and prevent conception.
    d. Endometriosis refers to a condition in which sections of the uterine lining implant in the vagina, ovaries, fallopian tubes or pelvis. These implants form fluid- filled cysts that grow with each menstrual cycle, and

eventually turn into blisters and scars. These scars then block the passage of the egg and delay pregnancy.

2. Defective transport
    a. Defects in ovum transportation due to pelvic inflammatory disease (PID), gonorrhea, peritonitis, previous tubal surgery, and fimbrial adhesions can cause tubal obstruction; as a result, the egg is not released or trapped, therefore, delaying conception.
    b. Scar tissue after abdominal surgery may alter the movement of the ovaries, fallopian tubes, and uterus.
    c. Defects in sperm transportation due to psychosexual problems such as vaginismus, or dyspareunia.
    d. Cervical problems due to trauma, surgery or infection. The presence of anti-sperm antibodies in the cervical mucus may also delay pregnancy.
3. Defective implantation
    a. Congenital anomalies such as bicornuate uterus and fibroids may hinder the implantation.

All the previous causes could be due to genetic or environmental factors.

Genetic factors

Klinefelter syndrome (also known as 47,XXY), Turner syndrome (also known as 45,X), resulting in defects in hormonal secretion and gonadal dysgenesis. In Kallmann syndrome (KS), there is an insufficient GnRH and/or gonadotropin release caused by dysfunction of the pituitary gland or the hypothalamus mostly due to genetic abnormalities. Premature ovarian insufficiency (POI), sperm defects and oocyte defects could be due to genetic abnormality [9].

Environmental factors and lifestyle

Recently, many environmental risk factors have been implicated in the increasing incidence and prevalence of infertility. Due to modern life, many artificial substances have been introduced into the environment without sufficient study of their health effects. Due to modern technology, our lifestyles incorporate many unhealthy habits into our daily lives [10].

Epigenetics sheds light on the interplay between human genes and the environment. It explains how our experiences, from diet and stress to exposure to pollutants, can leave chemical marks on the DNA, influencing which genes are turned on or off. These marks can be temporary or even passed down to future generations, highlighting how the environment can shape human health and potentially the health of our children. Epigenetic marks in the germline can be inherited and cause effects in the following generations. The most studied epigenetic marks include methylation of the DNA strand at small RNAs. There is Accumulating evidence indicates that small RNAs inside sperm can carry lifestyle and exposure information between generations. In addition to the epigenetic effect of the pollution and lifestyle, environmental stressors could affect male and female fertility through disturbing the hormones, ova and sperm generation, and seminal fluid quality [11]. In the following part, lifestyle and environmental risk factors will be discussed.

A. Lifestyle factors

1. **Tobacco smoking:** Smoking could affect the fertility of both men and women. In men, even young smokers can have lower sperm quality, including a lower count, weaker movement (motility), and abnormal shapes. In addition, e-cigarette use has been linked to impaired semen quality. Interestingly, prenatal exposure of male fetuses to maternal smoking could lead to poor semen quality in their future lives. There is also evidence that female smokers have lower fertility than non-smokers. For women, smoking disrupts multiple stages needed for pregnancy, from ova development (folliculogenesis) to hormone production (steroidogenesis), embryo transport, endometrial receptivity, and uterine blood flow. The smoke contains heavy metals, polycyclic hydrocarbons, nitrosamines, and aromatic amines. In males, smoking negatively affects sperm production, motility, and morphology and is associated with an increased risk of DNA damage [10].
2. **Marijuana consumption:** In women, a disturbed menstrual cycle and a higher risk of prematurity have been observed after regular consumption of it. In men, consuming cannabis several times a week for 5 years causes a reduction in the ejaculated seminal volume and number of spermatozoa, as well as changes in morphology and motility with sperm hyperactivity and a reduction in their fertilization capacity [12].
3. **Alcohol consumption:** Alcohol consumption may reduce fertility through a rise in estrogens that is linked to a decrease in FSH secretion and impairment in ovulation [13]. There is strong evidence that chronic alcohol users have impaired spermatogenesis, reduced sperm counts, and decreased testosterone levels [10].
4. **Diet:** Infertility in women has been linked to decreased fruit consumption and increased fast food consumption during the preconception period. Remarkably, there has been a correlation between excessive consumption of beverages and infertility for both males and females [10].
5. **Body mass index:** Being overweight

increases the risk of decreased reproductive function in both sexes. Both partners should lower their BMI in order to improve the likelihood of conception. Excess weight disrupts hormone balance, particularly by increasing leptin and decreasing sex hormone-binding globulin. This can lead to irregular ovulation in women and hinder sperm production and quality in men. In women, obesity can also increase the risk of PCOS [14]. Additionally, there is evidence linking underweight to a higher chance of azoospermia or oligospermia [15].

6. **Physical activity:** While moderate level of physical activity has been associated with improved seminal fluid quality and increased fertility, high intensity physical activity is negatively correlated with fertility especially in females as it reduces the ovulation hormones and does not permit proper conditions for implantation [16].
7. **Heat stress:** Spermatogenesis is negatively impacted by testicular hyperthermia. Sperm DNA integrity, chromatin condensation, sperm motility, and morphology can all be adversely affected by prolonged scrotal heat stress. Although this is typically reversible, transient scrotal hyperthermia can also have a major negative effect on spermatogenesis by causing oxidative stress damage [17].
8. **Poor socioeconomic status:** People of low socioeconomic class could be more prone to infertility. This is attributed to several factors such as limited access to healthcare. Regular checkups and screenings for potential fertility issues are often less available or affordable for low-income individuals. Nutritional deficiencies can be an important cause as a balanced diet plays a crucial role in reproductive health. Limited access to healthy foods and a higher intake of processed foods can contribute to nutritional deficiencies that affect fertility in both men and women. Moreover, chronic stress can negatively impact hormone regulation and overall health, potentially leading to fertility problems. Financial insecurity, poor housing conditions, and lack of job security can all contribute to higher stress levels in low-income populations. In addition, low-income communities are often disproportionately located near environmental hazards like polluted air, contaminated water, or industrial waste sites. These exposures can have detrimental effects on sperm quality and overall reproductive health. Besides, unhealthy lifestyles such as smoking, excessive alcohol consumption and drug addiction are more prevalent among them. These habits can significantly decrease fertility for both men and women [18].

B. Infections

Sexually Transmitted Infections: Sexually transmitted diseases (STDs) resulted from bacteria, viruses, or parasites that are transmitted through venereal contact. In males, these STDs may either be asymptomatic or cause urethritis, epididymitis, orchitis, vasculitis, and prostatitis. Most of these infections could affect male fertility by affecting semen parameters like sperm count, motility, and morphology. Chlamydia trachomatis and Neisseria gonorrhea are involved in reproductive tract morbidities including tubal factor infertility and pelvic inflammatory disease [19].

C. Modern life materials and exposures

Huge synthetic materials have been added to the environment since the industrial revolution. It is important to remember that fossil fuels serve as both energy sources and the primary raw materials for the synthesis of over 100,000 synthetic compounds that are utilized in the creation of contemporary items like plastics, pesticides, medicines, cosmetics, furniture, clothes, and vehicles. In addition to direct contact, contaminants from wastes and byproducts can contaminate our air, soil, and water. Humans may become widely exposed to this pollution through the food we eat and the surroundings we live in [10].

1. Endocrine disrupting chemicals

Endocrine Disrupting Compounds (EDC) are exogenous chemicals or mixture of chemicals that interfere with any aspect of hormone action. The main EDC are Bisphenol A (BPA) (a synthetic chemical widely used in the manufacture of plastics and resins), Phthalates and their esters (plasticizers to provide flexibility to materials), the pesticide as dichloro-diphenyl-trichloroethane (DDT), dioxins (byproduct of plastics) and Polychlorinated Biphenyls (PCBs). All these materials can act as xenoestrogens and disturbing the hormonal balances of females. Some EDC can disturb hypothalamic-pituitary-testicular axis function and androgen biosynthesis, resulting in decreased testosterone levels and impaired spermatogenesis. In addition to the endocrine effects, some chemicals can cause direct toxic effects on accessory male sex organs and the testis. Moreover, prenatal EDC exposure may also be associated with epigenetic changes in sperm, which may be transferred to the offspring [20].

1.1. Bisphenol A: Bisphenol A (BPA) is widely used in plastic material production and is detected in containers for food and beverages, kitchen utensils, microwave-cooking plastic containers, and packaged food. It was also used in low-quality baby

bottles. The primary modes of BPA exposure are contaminated food intake and skin contact. BPA contamination increases when food has a long storage time in a container, is composed of fat, and is at high temperatures (>70 ℃). Rodprasert et al. (2021) reported that higher levels of BPA in urine were linked to lower sperm count, concentration, and motility in men [55]. Prenatal, perinatal, and postnatal exposure to BPA can impair several steps of ovarian development, induce ovarian morphology rearrangement, and impair ovarian function, particularly folliculogenesis, as well as impair uterus morphology and function [20].

1.2. Phthalates: Phthalates are widely used as plasticizers and additives to some materials to increase their flexibility. They can enter the human body by ingestion (heating plastic in the microwave), inhalation (burning of waste), intravenous administration (plastic bottles and syringes), and skin contact (skin and eye make-up, sunscreen, and nail polish). They are excreted into urine after a few hours of exposure; therefore, urinary levels of phthalates and their metabolites are the standard methods of evaluation of the level of exposure. Abdo et al (2023) observed a significant difference between cases (infertile females) and controls (fertile females) findings in phthalates exposure among Jordanian women (Adjusted OR = 1.66, 95% CI: 1.14, 2.40, *p*-value = 0.002) [21]. There is evidence of an inverse association between urinary phthalates and semen quality [20].

1.3. Pesticides: Pesticides contain several chemicals classified by mechanisms of action and biological effects into organochlorines, organophosphates, carbamates, pyrethroids, phenylpyrazoles, and neonicotinoids. Humans can be exposed to pesticides via ingestion of contaminated food, inhalation, and dermal contact, which can be from environmental or occupational exposure. Overall, the evidence suggests that pesticide exposure was associated with decreased semen quality with varied associations with each semen parameter [22]. Pesticide exposure was also found to alter the time-to-pregnancy (TTP); the significantly high level of pesticide exposure among female workers is associated with prolonged TTP. Women who are occupationally exposed to pesticides or those working in the agricultural sector have a higher risk of spontaneous abortion and stillbirth [23].

1.4. Dioxins: Dioxins are a group of highly persistent chemical by-products of industrial processes and by-products of the combustion of organic material. Due to their high lipophilicity and resistance to biological and environmental degradation, dioxins are able to bioaccumulate and biomagnify in food chains, which increases the potential burden of exposures to upper-chain consumers such as humans. Dioxins may induce epigenetic changes in the male germ cells of adults during spermatogenesis, leading to a reduction in sperm counts. Dioxin exposure is associated with an increased risk of infertility in women, as well as in their daughters [24].

1.5. Polychlorinated biphenyls: Polychlorinated biphenyls (PCBs) belong to a group of persistent organic pollutants (POPs). They are used in many industrial and commercial products, such as transformers, capacitors, electronic equipment, motors, and hydraulic oil. PCBs exposure can reduce fertility, with harmful effects on the reproductive system that can be passed on to offspring [20].

2. Radiation Exposure

Exposure to both ionizing (x-ray, gamma-ray) and non-ionizing radiation (electromagnetic, ultrasound, and radio waves) from medical, occupational, and industrial sources can affect tissue by generating heat or altering biochemical structures such as DNA and proteins. It can generate free radicals that injure cells. Gonads are highly sensitive to radiation exposure. Radiation exposure can damage germ cells and may impair sex steroid production. There is currently no strong evidence that non-ionizing radiation, like that emitted from mobile phones, affects fertility. Ionizing radiation exposure, especially more than 10 rad during pregnancy, has been found to increase the risk of implantation failure and spontaneous abortion[25].

3. Air pollution

Environmental pollution has become a major concern for human health worldwide. The most common air pollutants are nitrogen oxides (NO_X) and sulfur oxides (SO_x); beside ozone (O_3), particulate matter 2.5 and 10 micrometers in diameter ($PM_{2.5}$ and PM_{10}) generated in the lower layer of the atmosphere produce reactive oxygen species (ROS), leading to oxidative stress. They can alter gene expression or epigenetic marks. They can affect the regulation of ovarian follicle growth, ovarian steroidogenesis, and ovulation, as well as seminal fluid quality [26].

4. Heavy metals

Heavy metals are a major environmental concern

because they're everywhere - naturally occurring and used in countless industrial processes. These toxins are released into the air, water, and soil by various industries, making them some of the most common pollutants. Lead, cadmium, and mercury are three metals of concern. They can directly damage reproductive organs or indirectly disrupt hormone function. Some heavy metals have demonstrated potent estrogenic and androgenic activities in vivo and in vitro by directly binding estrogen and androgen receptors, and lead to a decrease in sperm concentration and motility. Heavy metal exposures increase the formation of reactive oxygen species, leading to oxidative stress, inducing DNA damage, and disrupting the blood-testis barrier causing apoptosis of spermatozoa[27].

5. Microplastics

Due to the problematic degradation properties of plastics, the decomposition of plastic results in the formation of numerous microplastics (MPs) less than 5 mm in diameter. These MPs enter the soil and the ocean, eventually passing through the air, water, or food chain back to the human body and harming human health. In the last 80 years, male semen analysis parameters have shown a significant decline for unknown reasons, speculated to be caused by pollutants. The relationship between human MPs exposure and male infertility has not been established, although several studies found this relation in animal experiments. Zhang et al. (2022) estimated that the minimum human equivalent dose of MPs leading to abnormal male semen quality is 0.016 mg/kg/d after extensive reviewing of animal studies. Interestingly, they found that MPs exposure in Japan and South Korea was close to this value. These results suggest that MPs can affect male semen quality [28].

RECENT DATA OF EGYPT

In Egypt, around 12% of couples are affected by infertility. This breaks down into two categories: primary infertility, which affects 4.3% of couples and refers to those who have never been pregnant; and secondary infertility, affecting 7.7% of couples, where pregnancy has occurred before but they are now struggling to conceive again [29]. For decades, Egypt's fertility rate (the average number of births per woman) had been steadily declining. However, this trend took a surprising turn in 2005, with a rise that peaked in 2014 and 2015, reaching around 3.5 births per woman. This wasn't sustained as the rate dipped again, falling to 2.88 births per woman in 2022 and 2.85 in 2023 [6, 7].

This recent decline can't solely be attributed to economic changes in Egypt. When we consider the rising infertility rate alongside the drop in fertility, it raises a red flag. It suggests environmental factors like pollution and other stressors might be impacting the health of Egyptians, particularly their reproductive health. This highlights the urgent need for in-depth research to pinpoint the causes and develop solutions. Moustafa et al. (2018) conducted a cross-sectional study in Fayoum city and reported that causes of Egyptian male infertility included sperm problems, ejaculation problems, erection problems, hormonal disturbances, urinary problems, hyperthermia, x-ray exposure, and mumps infection. Female causes of infertility involved ovarian dysfunction, pelvic inflammatory disease, endometrial problems, and fallopian tube dysfunction [30].

Eraky and Seif El-Nasr (2016) searched for risk factors for secondary infertility among women attending outpatient clinics at Cairo University Hospital. A significant relationship was found between secondary infertility and lifestyle risk factors such as irregular exercise, use of insecticidal agents, and use of recreational drugs ($p<0.05$) [31]. Reproduction is negatively influenced by obesity. The MENA countries have one of the highest prevalence rates of obesity in the world. Obesity could reduce ovarian reserve in females, leading to an impairment of the semen parameters in males. Parental consanguinity is prevalent in these countries and could lead to the appearance of recessive genes that affect the fertility of offspring[32].

One hidden factor for infertility is STDs, as they were not investigated in infertile couples. For example, the incidence of *Chlamydial* infection in Egyptian patients with unexplained infertility is relatively high (40% of cases), as proved by Abdella et al. [33].

Interestingly, vitamin D deficiency was endemic in the Middle East countries despite the abundance of sunshine. Vitamin D deficiency might impact ovarian reserve negatively. Many studies suggested that vitamin D deficiency and vitamin D receptor gene methylation may be involved in the pathogenesis of idiopathic male infertility [32]. Sanad, in a cross-sectional study in Minia Governorate, Egypt, stated that the prevalence of PCOS was 37.5% in infertile women [34]. Some environmental risk factors were found to be involved in the occurrence of PCOS. EDC are of particular interest to reproductive health, including PCOS. PCOS patients with vitamin D deficiency are more likely to have increased fasting glucose and insulin resistance. Obesity may be an additional factor for PCOS [35]. Psychological factors such as depression or anxiety could be hidden factors in unexplained infertility. These psychological stresses could lead to menstrual disturbances, dysmenorrhea, or frequent abortions [36].

The rising infertility rate in Egypt, with 12% of couples affected, highlights the complex interplay between various factors. While the specific environmental contributors in Egypt remain under-

researched, the global understanding points towards their involvement. This underscores the urgent need for more research projects within Egypt. These studies would be crucial to identifying the true scope of the problem and pinpointing the specific environmental risk factors. By gaining a deeper understanding of the causes, we can develop effective guidelines to investigate and treat infertility properly.

CONCLUSION AND RECOMMENDATIONS

Infertility is a multifactorial condition affecting couples worldwide, with genetic and environmental factors involved in it that could interact with each other. Epigenetics, which means environmental stressors that could affect the genetic material of parents and affect the next generation. Environmental risk factors that may be related to infertility involve exposure to heat stress, infections, endocrine disrupting chemicals (Bisphenol A, phthalates, pesticides, dioxins, and polychlorinated biphenyls), ionizing radiation, air pollution, heavy metals, and microplastics. Unhealthy lifestyle choices could be causes of infertility, such as smoking, alcohol consumption, poor socioeconomic status, vigorous physical activity, obesity or severe underweight, and consumption of an unhealthy diet. Although Egypt has a relatively high birth rate compared to other countries, it is observed that infertility problems are increasing. Around 12% of couples face this challenge. Few studies have assessed the causes of infertility in Egypt, which include exposure to hyperthermia, x-rays, sexually transmitted diseases, vitamin D deficiency, endocrine disrupting chemicals, and psychological stresses. These environmental risk factors could affect the next generation, having a deep impact on their health and productivity.

To create a healthier future for Egyptians, a multi-layered approach to infertility is needed. This includes government action on the environment, like promoting eco-friendly products and enforcing stricter environmental regulations, alongside public awareness campaigns to educate people about the link between environmental toxins and health issues. Additionally, individuals can adopt healthier lifestyles by quitting smoking, managing stress, maintaining a healthy weight, eating balanced diets, and exercising regularly. Finally, improved access to healthcare through expanded infertility services and clinician training on environmental factors and infections is crucial. Investing in research to identify specific environmental risks and collaborating with international experts in reproductive and environmental health will further strengthen these efforts. By taking these steps, Egypt can significantly improve the health of the current and next generations.

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