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## IMPRINTING OF DYNAMIC ENVIRONMENT ON REPRODUCTIVE HEALTH

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### ABSTRACT

Balanced ecosystem is the need for a healthy life for every organism inhabiting this earth. Of all kinds of fitness, the most needed fitness is physiological and most essentially reproductive fitness. Reproductive fitness of every organism is directly or indirectly related to the environment where they are residing. Numerous disorders noticed in humans include infertility, substandard quality of sperms, mediocre function of gonadal glands, breast cancer, testicular cancer etc. Reproductive health damages include; altered growth, chromosomal damage, chromosomal aberration, fetal abnormalities, postnatal viability, premature aging and so on. Exposure to environmental hazardous substances can leave their impact on endocrine system which may further affect reproductive health. Reproductive health of mammals including humans can also be affected by heat stress. Nutritional deficits can create problems with oocyte development, blastocyst abnormality, and can produce cardiovascular, behavioral effects etc. Dehydration can cause issues with sperm and uterine health. Thus, it becomes important to review and mitigate these changing effects for a better reproductive health.

**Keywords:** Imprinting, Reproductive health, Toxicants, Heat Stress, Nutritional deficit, Dehydration.

### INTRODUCTION

Balanced ecosystem is the need for a healthy life for every organism inhabiting this earth. Even minor imbalance in our surroundings can leave great imprinting on the organisms dwelling in it. If this imbalance becomes chronic then it can even lead to permanent damage. The changes in our environment are inevitable and dynamic and may not always be in the favor of its inhabitants. This happens because most of the changes are a result of various unwanted anthropogenic activities. These activities could take the form of deforestation, excessive use of non-biodegradable fuel, chemicals, overgrazing, population burst etc. Population of flora and fauna both get affected via imbalance in environment leading to unwanted changes in their physiology, ethology, psychology etc. and also affect their interspecific relationships.

These kinds of active environments can create stress over the population. The number of individuals in a population can increase or decrease according to and depending on the condition of environment hence it is important to pay attention on the management of such changes. If these changes are temporary then the species and its populations bear generational stress but if these changes are able to imprint at the gene level, then it will produce irreversible changes which could be unfavorable for evolution.

Of all kinds of fitness, the most needed fitness is physiological and most essentially reproductive fitness. This is for the simple reason that species survival and its future progression is dependent on reproductive fitness. Reproductive fitness of every organism is directly or indirectly related to the environment where they are residing.

When it comes to human populations and their detected imbalanced fitness many disorders are found related to reproductive health of male and female. The causes behind these are several notable changes occurring in new world's environs due to unmindful activities attributed to humans.

Numerous disorders noticed in humans include infertility, substandard quality of sperms, mediocre function of gonadal glands, breast cancer, testicular cancer, prezygotic and post zygotic barriers which restrict development of fetus and mating etc. Apart from these reproductive health damages include; altered growth, chromosomal damage, chromosomal aberration, fetal abnormalities, postnatal in viability, premature aging and so on.

### **ENVIRONMENTAL TOXICANTS AND REPRODUCTIVE HEALTH**

It is very easy to get exposed to a number of environmental risk factors present in our daily environs such as environmental toxicants including chemicals which can be injurious to men and women equally. Especially in the case of women who are conceiving fetus; replacement of epigenetic marker of parents with the new epigenetic marker in totipotent zygote; is influenced via environmental toxicants or chemicals.

Various diseases also pass through the parents to their children after getting exposed to hazardous chemicals or toxicants. Management of all such hazardous components is important for sustainability of the population. Exposure to environmental hazardous substances can leave their impact on endocrine system which may further affect reproductive health.

In Bhopal, India exposure of toxic chemical had killed thousands in 1984 followed by physiological, behavioral and genetic implications. Methyl mercury caused neurological damage in the fetuses and infants (Broughton, 2005).

Industrial plants release toxic pollutants are related to the complication on early pregnancy. Unwarranted climate changes like flood, severe storm and drought lead to increased risk factors include food stress, heat stress, cold stress, etc. (Watts, *et.al.*, 2015).

### **TEMPERATURE FLUCTUATIONS AND REPRODUCTIVE HEALTH**

Every organism living on earth has their own habitat and temporal range to reproduce which can be wavered by fluctuating environment. The Greenhouse gas emissions increase the temperature of earth's surface. Earth temperature has exceeded approximately 0.85°C during 1880 to 2020. As intense increase of greenhouse gas is still continuing the temperature of present earth surface is rising simultaneously (Riahi *et.al.*, 2011, Stocker *et.al.*, 2013). The green house gases and changes in climate have had a serious implication and detrimental effect on sexual and reproductive fitness (<https://womendeliver.org/wp-content/uploads/2021/02/Climate-Change-Report.pdf>).

However, as research has progressed, some recent investigations have interpreted another aspect to this problem. Change in temperature can create early labor, changes in the LH and FSH level within the female body especially in mammals. Research from the Hong Kong University of China on IVF treatment interpreted that fluctuation in environmental temperature can alter the rate of pregnancy (Zhao *et.al.*, 2019).

Considering environment and reproductive health as an important factor World Health Organization has taken initiatives under The Human Reproduction Programme to manage all such issues and the relationship between environment and reproduction to chalk out the adverse outcomes are being closely investigated logically by the world-wide programs. (Kulin *et.al.*, 1995).

Reproductive health of mammals including humans can also be affected by heat stress (Jensen *et.al.*, 2021). Two mechanisms can disrupt reproductive processes under heat stress namely homeokinetic changes and homeokinetic control. Homeokinetic changes regulate body temperature that can trade off reproductive function. Blood flow redistribution to the periphery from the core of the body is an example of homeokinetic whereas reduced feed intake under heat stress is an example of homeokinetic control (Lam and Miron, 1991).

Location of mammalian testes outside the body allows for decrease in intratesticular temperature via countercurrent mechanism. It is a thermoregulatory procedure and helps in healthy survival of sperms. Heat stress shows deleterious effects not only on spermatogenesis but also on oocyte development, oocyte maturation, early embryonic development, fetal and placental growth and lactation (Takahashi, 2012).

It has been observed that the establishment of pregnancy and fetal development can be greatly affected by the reduce feed intake as well because of change in energy balance and nutrient availability (Hansen, 2009).

### **NUTRITIONAL DEFICIT AND REPRODUCTIVE HEALTH**

As already discussed in the above paragraphs there are a number of factors which can influence reproductive health out of which nutrition and water are chief components. They can together cause severe impact. It has been observed that the developing fetuses can have both short- and long-term effects depending upon availability of nutrition and its discrepancies. Apart from this water content or rather lack of water or dehydration can also influence reproductive health.

#### **❖ Short-Term Effects Of Nutritional Deficit On Reproductive Health**

This includes nutritional effects on oocyte quality that can originate when ovarian follicles emerge from the primordial pool and become committed to growth before the time of ovulation. Poor-nutrition at this time reduces the number of follicles that emerge and therefore the number available to ovulate (Ashworth *et.al.*, 2009). These short-term effects can be observed during:

- **Ovulation rate:** Studies show that the types of feed are correlated to the rate of ovulation (Robinson *et.al.*, 2009).
- **Oocyte maturity:** Nutrition affects both the number of oocytes and their quality. While the measure of oocyte quality is its ability to form a blastocyst, and undeniably the viable young, numerous emissary measures of oocyte quality is used, including the attainment of metaphase II following in vitro maturation and the expression of key genes (Rooke *et al.*, 2009).
- **Blastocyst development and function:** the development and function of blastocysts are directly or indirectly affected by the maternal diet (Ashworth *et. al.*, 2008).

## ❖ Long Term Effects Of Nutritional Deficit On Reproductive Health

During the peri-conception period brief alterations in nutrient supply can display long term or permanent effects on fetal life or on the offspring. These effects include:

- **Cardiovascular effects:** Several studies have reached on an inference that nutrition has its vital effect directly on the developing fetus. Substandard or under-quality of nutrition during the early months of the pregnancy increases the blood pressure of neonatal or developing fetus and in adults as well (Marshall *et.al.*, 2022). Under-nutritional studies done from the beginning of pregnancy in larger mammals such as sheep show disturbed cardiovascular function in lamb and in adults, augmented interventricular septal wall thickness were also figured out (Cleal *et.al.*, 2007).
- **Reproductive effects:** Quite a few series of studies during the different stages of the pregnancy have postulated diverse effects, based on the onset of time duration for nutritional deficiency, for example undernutrition for minimum 50 days of pregnancy fluctuates the steroidogenic capacity of the testis of the fetus as opposed to no effect on testis development following low nutrition circumscribed to first 30 days of pregnancy (Rae *et.al.*, 2002).
- **Behavioral effects:** under-nutritional diets alter behavioral pattern of mating and developmental growth of an embryo including early cleavages. Mice fed on poor nutritional food show anxiety related behavior during mating and likewise reduction in exploratory behavior (Watkins *et.al.*, 2008).

## WATER DEFICIT AND REPRODUCTIVE HEALTH

Water deficit or dehydration is another important factor which can act as a stressor for reproductive health. Dehydration has direct relationship to reproductive health of an organism. Low level of water can cause infertility which means that male and female are unable to produce sperms and ova.

Another association of infertility is related to inviability of offsprings produced by male or female. Hence staying hydrated is important for maintaining good reproductive health as well as it is important to perform most metabolic activities. Researches have figured out that dehydration can lead to low sperm count and can subside egg health (Verta, 2021).

Balanced hydration improves vaginal dryness and affects the follicular growth in females. Hydration is important not only for hormonal regulation but also for the production of cervical fluid (Pelletier *et.al.*, 2023).

There are several effects of hydration on fertility (Emokpae and Brown, 2021, Barbieri, 2022). Some of them include:

- **Cervical Mucus Quality:** Proper hydration has key importance for maintaining the quality and quantity of cervical mucus. Throughout the menstrual cycle cervical mucus fluctuates and it creates a favorable environment for sperm. Cervical mucus increases the chances of successful fertilization.
- **Ovulation:** Dehydration interrupts the hormonal regulation necessary for the ovulation.
- **Anovulation:** Insufficient water intakes may cause disturbance in menstrual cycles which may lead to cause.
- **Uterine Health:** proper blood flow is also ensured via hydration. For the implantation of fertilized embryo, a hydrated uterine wall lining play vital role.
- **Sperm Health:** motility and production of sperm needs proper hydrated environment inside of the men's body.
- **Detoxification:** water detoxifies the body from toxins and waste.

## CONCLUSION

It has been interpreted and well established by several investigations that changes in the environment can leave a huge impact on the reproductive life of organisms. The studies have found clear evidences between the relationship of stressors and subsequent modifications in many physiological, cytological and metabolic activities.

This review intended to check the impact of dynamic and everchanging environment on the reproductive ability of organisms. Dynamic changes in the environmental health can directly as well as inversely correlate with the health of men, women and their pregnancy, fertility intents, sexual vulnerability and over all sexual health.

Pregnant women are highly sensitive to the climatic change. Change in temperature can create early labor and many complications during pregnancy corresponding to change in the LH and FSH level within the female body especially in mammals. Increased level of LH and FSH hormones changes the level of progesterone and estrogens in the organism this may further cause the complication in pregnancy (Ipas, 2022).

There are several studies in support to interpret the impact of changes in environmental health is related to the change in male fertility rates as well as the production of sperm. Temperature also plays an important role to change the quality of sperm count as well as the reproductive health of male organisms.

It has been proven via experimentations that the quality of food can change the timing of menarche in female. This occurs because environmental changes releases toxicants in surroundings which further effect the quality of available resource such as food, water, photoperiod etc. A series of studies supports that underrated food quality may lead to miscarriage.

Menarche gets affected by environmental changes and this can further lead to increased risk of cardiovascular diseases, also causing stress or mental illness and fertility related issues. (Avakian, 2021).

The toxicants in the environment can also leave their effect on the endocrinal glands such as gonads and pituitary gland as well as thyroid glands. The changes associated to these glands may directly correlate to the reproductive health of female as well as male.

There are two major toxicants Polychlorinated Biphenyls (PCBs) and Diethylstilbestrol (DES) which effect can be seen in an organism. These toxicants alter the neurodevelopment when includes utero exposure, Endometriosis, decrease the fertility ability, underrated production of semen quality, Abortions, complicated pubertal development and malformations in reproductive tract (Kelly, 2022).

Such interpretations confirm the importance of the balanced nutritional diet in the development of the oocyte and early cleavage-stages of embryo on post-natal behavior. Appropriate amount of water leaves positive impact on the reproductive organs and overall fertility health (Warrior, 2023).

Considering that so many factors are involved in maintaining reproductive health it becomes important for all organisms to maintain their physical, mental and physiological state. This will help them mitigate the unwanted alterations happening within their system and preserving future generations from these harmful after effects.



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