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Exploring the Ayurveda principles of teratology: a conceptual study.

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ABSTRACT

Background Genes play a crucial role in maintaining the molecular integrity of an individual. They are under constant stress, and while they are efficient in handling it most of the time, various factors can cause alterations in their structure. These alterations can either be beneficial or pathogenic, contributing to variations in individuals of each species and their subsequent generations. The internal and external environment of parents is responsible for these alterations in their gametes, and the maternal genomics and environment's reciprocity influence the development of the zygote. Teratology, the study of abnormalities of physiological development, has drawn the attention of many researchers in this field, as they recognise the impact of maternal lifestyle on her gametes and the fetus growing inside her body. **Objectives** This article discusses teratology in Ayurveda and modern science. **Data Source:** Data is collected from various classical texts, writings and contemporary texts.

Review Method: A systematic review was explained as a research method and process for identifying and critically assessing relevant research and collecting and analysing data from said research and texts.

Conclusion: It's worth noting that Ayurveda has exhaustively discussed various factors that can potentially affect fetal outcomes. These factors are of utmost importance during pregnancy and before the female child reaches puberty and conceives. Ayurveda refers to these factors as garbhopaghatakara bhavas or teratogens, which can have severe and adverse effects on the developing fetus. This paper focuses explicitly on teratogens and their detrimental impact on fetas.

Keywords: teratogen, *garbhopaghatakara bhava*, congenital disabilities.

INTRODUCTION

Parents must know that they contribute half of their offspring's genetic makeup through haploid gametes. The mother's physical and emotional health can also impact fetal development, as can the condition of the uterus and the nutrients supplied through the placenta. To ensure a healthy pregnancy and birth, doctors utilise ultrasound and maternal serum screening techniques to monitor growth and provide the best possible care. It is essential to know that birth defects, congenital malformation, and congenital anomalies are distinct terms used to describe disorders present at birth.

Teratology studies how disorders affect the body's structure, behaviour, function, and metabolism. This field is essential, as it provides valuable insights into the complexities of human development and can lead to better outcomes for those affected by these disorders. [1] It's concerning to learn that many live-born infants may experience structural anomalies. Studies have shown that up to 3% of infants may experience significant structural abnormalities, and this percentage may increase to 6% by the time they reach age 5. These birth defects are also a leading cause of infant mortality, which accounts for about 21% of infant deaths. It's essential to raise awareness about this issue and work towards preventing these defects. [3]. "They are a significant contributor to disabilities and the fifth leading cause of years of potential life lost before the age of 65 years." [4]

Ayurveda confidently identifies various teratological factors that can lead to the occurrence of birth defects. These factors include abnormalities in the ovum and sperm and the mother's diet and lifestyle. Despite these factors, structural anomalies are still relatively common in live-born infants. It is essential to understand and address these factors to minimise the occurrence of such birth defects. [5]. The portion of bija being vitiated is often associated with chromosomal or genetic abnormalities. Teratogens, on the other hand, can cause a range of issues, including structural, behavioural, functional, and metabolic disorders in the child. In some cases, these teratogens can also have psychological effects on the parents and lead to financial burdens on the family and society.

TERATOGENS, ACCORDING TO AYURVEDA

Consanguinity[6]: Research has shown that consanguineous couples are more likely to experience higher rates of abortion, postnatal mortality, congenital malformations, and genetic disorders as compared to non-consanguineous couples. This is especially true for hereditary disorders, particularly those that are autosomal recessive, which are more prevalent in children born to such parents.

Hereditary[7]: Some genetic disorders have been mentioned in ancient texts, such as skin disorders like kushtha, intellectual dysfunction like jadya, and blindness. However, the transmission mode of these disorders may not be straightforward and can vary from disorder to disorder.

Maternal and paternal age (genetic mutations) [8]: When the female is below 16 or older, and the male is below 25 years or too old, the risk of fetus intrauterine death is higher. A female below 16 years is considered a pediatric age group, where all body systems are anatomically and physiologically immature. As a result, the

substandard quality of the gamete and immaturity of the female reproductive system usually do not result in successful pregnancy outcomes. This can affect the quality of bija (ovum/ sperm) and may not be suitable for producing healthy offspring. Similarly, too old age is a phase of degeneration where all body systems are anatomically and physiologically in the degeneration phase, resulting in substandard quality of gamete that may not be suitable to produce healthy offspring.

Coital act during menstruation that results in pregnancy: The coital act on the 1st, 2nd, or 3rd day of menstruation will lead to intrauterine death, death within a few days of delivery, defective body parts, and short-lived [9]. Coital acts during menstruation may increase the risk of infection. Infection during conception or later in pregnancy can lead to adverse outcomes such as intrauterine death, abortion, and pre-term labour.

Positioning of the female body during the coital act: The woman should not have coitus in the humpback or right or left lateral place [10]. The woman should not mount the man. Such kind of position during copulation is said to result in a child who may have hermaphroditism[11].

Maternal diet: Pregnant women should avoid hot, pungent foods, alcohol, and meat. These substances can harm the fetus. [12].

Maternal routine and behaviour [13]: Lifting heavy weights, riding on animals or chariots, suppressing natural urges, squatting in abnormal postures for prolonged periods, sleeping on their back for extended periods, waking up at night, and sleeping during the day can all potentially lead to abortion, IUD, or fetal abnormalities.

Maternal psychological status[14]: Psychological trauma, grief, fear, terror, and exciting stories can trigger abortion, especially in women who are prone to it.

Maternal illness [15]: Microorganisms and physical agents can potentially harm the genetic sequence. TORCH infection and maternal diseases can cause abortion, IUD, or congenital anomalies.

Maternal intake of drugs[16]: The accidental use of abortifacient drugs such as Abrus precatorius, Gloriosa superba, and others after conception can lead to abortion, IUD, IUGR, and obstructed labor.

Therapeutic procedures used during pregnancy[17]: Excessive use of oil massage, nasal drops, oleation, blood-letting, emesis, purgation, and other purifying measures can potentially trigger abortion.

Sinful acts done by pregnant women during pregnancy: [18] Ancient researchers in this field have observed for years and concluded that teratogens in different forms can have harmful effects on the fetus or postnatal life. The pathophysiology in Ayurvedic terms explains how these factors are harmful under specific circumstances. However, if the pathophysiology is unexplained, it is attributed to sinful acts or deeds done in a previous life.

[Citations of the table - 1: 19 to 56, Citations of the table - 2: 57 to 68, Citations of the table - 3: 69-77]

Table – 1: Possible mode of teratogenic effects of etiological factors on the fetus:

Aharaja bhavas (food items)		
Teratogens	**Teratogenic effects**	**Probable mode of action**
Consumption of excessive hot potency food items, e.g., excessive use of black pepper. [19]	Abortion, IUD, preterm labour, IUGR[20]	Chemicals and nitrates can have adverse effects on red blood cells, reducing their ability to carry oxygen and leading to decreased uteroplacental flow. For instance, cocaine is a vasoconstrictor that can cause placental abruption and risk of vascular disruption in the fetus, potentially resulting in abortion or stillbirths. [21].
Excess consumption of corrosive[22]	IUGR, Preterm labor[23]	Solvents are found in many consumer products, including plastics, dyes, detergents, and cleaning products. However, they pose a significant health risk to workers in industrial settings. [24] Tannin, found in tea, can interfere with the absorption of iron. [25].
Excessive consumption of dry and dirty food items (foods which are found to have higher level of pesticides)[26]	IUD, preterm labor , IUGR[27]	Inadequate calorie intake before pregnancy appears to magnify the effect of malnutrition during pregnancy and it also associated with lower birth weight in infants leads to an impaired fetal growth. Inadequate nutrients during pregnancy can lead to delayed labor, much like obstructed channels can block water from reaching a field. [28]
Excessive heavy food, excessive satiation[29].	Macrosomia[30]	Pregnancy toxemia can cause an increase in the body weight of both the mother and the fetus. This may lead to difficulties during labor, especially if the fetus is overweight.[31]

Regular use of alcohol daily[32]	Thirsty, short memory, flickering mind. [33]	Drinking alcohol during pregnancy can cause Fetal Alcohol Syndrome (FAS), which results in abnormal fetal development. FAS can lead to a range of physical, behavioral, and cognitive problems in children. [34] Alcohol consumption during pregnancy is particularly harmful during the first trimester because this is the crucial time when the baby's organs are developing.
Frequent use of pork meat as a food[35]	Red eye, rough body hair and obstructed breathing, snoring. [36]	Pig can be a host to a variety of parasites, e.g. Toxoplasma gonodii[37] an intracellular protozoan parasite. If mother is having this type of infection. Maternal to fetal transmission occurs almost when the primary infection is acquired during pregnancy. If a pregnant woman contracts a Toxoplasma gondii infection within the first ten weeks of conception, the consequences for the fetus can be particularly severe. Miscarriage or fetal abnormalities may occur, and neonatal features of the infection can include hydrocephalus, microcephaly, intracranial calcification, and developmental delay. The classical triad of congenital infection includes chorioretinitis and hydrocephalus, pneumonitis, and respiratory problems. [38]
Eating fish daily[39]	Fixed eyes (fixed gaze or strabismus), delayed blinking	Eating fish has become the primary source of mercury exposure in humans, which can harm the developing nervous

	of eye , ophthalmopathy of trigeminal nerve)[40]	system of an embryo or fetus, leading to learning disabilities. Some fish contain high levels of mercury, which can be harmful to both the mother and the developing fetus.[41] Mercury can be passed from a pregnant woman to her developing baby through the placenta, and the developing nervous system of the fetus is particularly sensitive to its effects. The impact on memory, language, attention span, and other developmental milestones may not be noticeable until later. In June 2003, the Joint Food and Agriculture Organization (FAO) and World Health Organization (WHO) Expert Committee on Food Additives reviewed studies on this topic and recommended that pregnant women reduce their consumption of fish known to contain high levels of mercury. [42]
Excessive sweet items e.g. sugarcane, sweets, chocolates, and sugared beverages[43]	Diabetes and obesity[44]	Maternal glucose levels are directly related to macrosomia, a condition in which a baby is born larger than average. The carbohydrate available to the fetus leads to increased insulin secretion and fetal hyperinsulinemia. [45].
Excessive salty food[46]	Early wrinkling, graying of hairs and baldness.[47]	Sodium chloride is a major component of salt, and sodium is found outside of cells while potassium is inside of cells. These electrolytes help maintain the balance of osmotic pressure, moisture, and acid-base levels in the body. Disrupting this balance can cause sodium levels

		to increase and lead to hair loss, premature graying, and skin aging. [48]
Excessive spicy food e.g. chilly, black pepper.[49]	Weak, possess less quantity of sperm and infertile. [50]	Processed meats contain irritants, chemicals, and nitrates that can reduce the ability of red blood cells to carry oxygen. This can lead to a reduction in utero-placental flow during pregnancy. [51]
Excessive bitter food e.g. bitter melon and gourd, turmeric, fenugreek seeds[52]	Suffers from emaciation [53]	Excessive consumption of chocolate, which contains flavonoids, can lead to oxidative stress in cells and negatively impact uteroplacental circulation during pregnancy. [54]
Excessive astringent food. e.g. pomegranate, sprouts [55]	Suffers from flatulence and eructation [56]	

Table 2: Life style related teratogenic effects

Teratogens	**Effects on fetus or baby**	**Scientific reason**
Trauma and pressure on abdomen, travelling on jerk vehicles, peeping in to well. [57]	Premature delivery, or abortion [58]	Trauma during pregnancy can cause placental abruption and separation, while sudden increases in intra-abdominal pressure during activities like vehicle riding can lead to abortion. [59]
Sleeping in supine in stretched out position[60]	Umbilical cord encircles the neck of fetus and troubles it[61]	The supine position during pregnancy can disrupt circulation to the fetus and increase blood pressure in the mother, potentially leading to preeclampsia and fetal distress. [62].
Prolonged squatting and abnormal postures[63].	Premature labor, abortion[64]	Physical Stress during pregnancy can affect placental and uterine blood flow, potentially leading to premature labour or miscarriage. [65]
Excessive exercise, coital act[66]	Lazy (lethargic) [67]	This could be due to rare unexplained hereditary

		conditions such as myopathy, which is usually diagnosed in early or late childhood [68]

Table 3 : Maternal psychological effects on fetus (maternal impression)		
Excessive grief, anger, fear, jealousy [69]	Still born, intrauterine death, abortion [70]	Maternal impression is not accepted by modern human genetics. Fetal perception of pain and pleasure begins when sense organs are established. The fetus can express desires based on previous experiences through quivering. The fetal heart is connected to the maternal heart through rasavahini dhamanis, which occurs during the third and fourth month of pregnancy when the fetal sense organs are established. [71] At this stage, all manasika bhavas of the mother influence their character and affect the manas of the fetus, e.g. extreme anger and grief (during pregnancy), giving birth to a child with a short life span.
Consanguinity[72]	Abortion, congenital malformations and genetic disorder. [73]	The inbred individual may carry two copies of a gene that was present in a single copy in the common ancestor of his/her consanguineous parents. A recessive gene may thus come to light for the first time in an inbred descendant after having remained hidden for generations. For this reason, consanguinity influences the incidence of some inherited diseases. [74]
Heredity [75]	skin disorders *(kushtha),* intellectual dysfunction *(jadya),* blindness, etc [76]	Consanguinity can lead to the expression of a recessive gene in an inbred descendant that was present in a single copy in the common ancestor of their parents, increasing the incidence of some inherited diseases [77]

MODERN PRINCIPLES OF TERATOLOGY *[78]*

1) tThe outcome of a pregnancy is determined by the interaction between the genotype of the conceptus and the environment, including the maternal body and uterus. Throughout the entire process from oogenesis to delivery, the maternal genome also plays a role in fetal development through ongoing biochemical and molecular techniques, resistance to disease, metabolism of drugs, and exposure to infections. Taking care of oneself during pregnancy is crucial to ensure a healthy outcome for both the mother and baby.[79]

2) The third to eighth weeks of gestation is the most sensitive period of embryogenesis for inducing birth defects. During this time, a cleft palate can be generated at various stages of development, such as the blastocyst stage, gastrulation, early limb bud stage, or when the palatal shelves are forming. Therefore, taking care of oneself during pregnancy is crucial to ensure a healthy outcome for both the mother and baby *[80]*
3) The abnormal development depends on the dose and duration of exposure to a teratogen. *[81]*
4) Teratogens are substances that can cause abnormal development of cells and tissues during embryogenesis. These substances can inhibit specific biochemical or molecular processes, leading to cell death, decreased cell proliferation, or other cellular phenomena. It is essential to be aware of teratogens and their potential effects, especially during pregnancy, to ensure the health and well-being of the developing fetus *[82]*
5) Exposure to teratogens during fetal development can result in severe consequences such as malformation, growth retardation, functional disorders, and even death. To safeguard the healthy development of the fetus and ensure a successful pregnancy, it is absolutely crucial to avoid exposure to these substances. It's imperative to remain vigilant of potential sources of teratogens in the environment and take all necessary precautions to eliminate any risk *[83]*

Perinatal diagnosis [84] :

Monitoring the growth and development of the fetus during pregnancy is crucial for ensuring a healthy pregnancy and successful birth. Various techniques such as ultrasound, amniocentesis, chorionic villus sampling, and maternal serum screening can be used to assess the overall health of the fetus, detect malformations and genetic abnormalities, and identify any potential complications. By utilising these techniques in combination, doctors can provide the best possible care for both the mother and the developing fetus.

PREVENTION OF BIRTH DEFECTS: *[85], [86]*

There are many ways to prevent birth defects, and starting action before conception is essential. For instance, adding iodine to salt or water can prevent mental retardation and bone deformities caused by cretinism. Women with particular defects or PKU can reduce the risk of congenital disabilities in their children by closely monitoring their metabolism before getting pregnant. Folate supplementation is another effective method and is already included in India's national program. Avoiding drugs and alcohol during pregnancy also lowers the incidence of birth defects. Following proper menstrual and periconceptional care outlined in Ayurvedic texts can help ensure a healthy pregnancy and baby.

DISCUSSION

It is fascinating to learn about the ancient researchers' knowledge of embryology and the development of hereditary disorders and teratogens. It seems that they understood the consequences of congenital malformations and knew the importance of healthy gametes. Additionally, a pregnant woman's age is significant in ensuring a healthy pregnancy and baby. Unfortunately, in modern times, we have seen an increase in the incidence of habitual abortions, IUGR, and complications during delivery, which certain behaviors or habits may cause. It is crucial to follow proper menstrual and periconceptional care to

prevent such complications and ensure a healthy pregnancy.

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सार

पृष्ठभूमि: अपनी आणविक अखंडता बनाए रखने के लिए जीन लगातार तनाव में रहते हैं। अधिकांश समय यह कुशलता से बनाए रखा जाता है। हालांकि, विभिन्न कारकों में उनकी संरचना को बदलने की क्षमता है। ये परिवर्तन फायदेमंद या रोगजनक हो सकते हैं। परिवर्तन प्रत्येक प्रजाति के व्यक्तियों और बाद की पीढ़ियों में व्यक्तियों में भिन्नता के लिए योगदान करते हैं। माता-पिता के आंतरिक और बाहरी परिवेश उनके युग्मकों में इन परिवर्तनों के लिए जिम्मेदार होते हैं, जबकि पर्यावरण के साथ मातृ जीनोमिक की पारस्परिकता युग्मनज के विकास को प्रभावित करती है। लगभग चार दशक पहले मातृ जीवन शैली को उसके युग्मक और उसके शरीर में विकसित होने वाले भ्रूण पर इसके प्रभाव के लिए नजरअंदाज कर दिया गया था, लेकिन अब इसने इस क्षेत्र में काम करने वाले कई शोधकर्ताओं का ध्यान आकर्षित किया है, जिसे टेराटोलॉजी कहा जाता है। उद्देश्य इस लेख को आयुर्वेद और आधुनिक विज्ञान के अनुसार भू-विज्ञान की अवधारणा को समझने के लिए डिज़ाइन किया गया है

डेटा स्रोत: डेटा विभिन्न शास्त्रीय ग्रंथों, लेखों और आधुनिक ग्रंथों से एकत्र किया जाता है।

समीक्षा विधि: एक व्यवस्थित समीक्षा को एक शोध पद्धति और प्रासंगिक शोध की पहचान करने और गंभीर रूप से मूल्यांकन करने के साथ-साथ उक्त शोधों और ग्रंथों से डेटा एकत्र करने और विश्लेषण करने की प्रक्रिया के रूप में समझाया गया था।

निष्कर्ष: आयुर्वेद ने ऐसे कई कारकों और भ्रूण के परिणाम पर उनके संभावित प्रभावों पर बहुत विस्तार से चर्चा की है। हालांकि, महत्व न केवल गर्भावस्था के दौरान दिया जाता है, बल्कि इससे पहले कि महिला बच्चा यौवन प्राप्त करे और वह बाद में गर्भधारण करे। आयुर्वेद इन्हें गर्भोपघटकर भाव (टेरेटोजेन्स) कहता है। वर्तमान पेपर टेराटोजेन्स और भ्रूण पर उनके प्रतिकूल प्रभावों पर चर्चा की गई है।

मुख्य शब्द: टेराटोजेन, गर्भोपघटकर भव, जन्म दोष।

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