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Review Article

AYURVEDIC PERSPECTIVE ON GENETIC INHERITANCE

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ABSTRACT
Genetics is the science of inheritance, the blossom of scientific revolution in human genetics has been started since ancient period. There are vivid accounts in Ayurvedic *Samhitas* about the hereditary patterns through concepts such as *Prakruti*, *Shadgarbhakar Bhavas* and the fundamental genetic units- *Bija*, *Bijabhaga* and *Bijabhagavayava*. Ayurveda also gave importance to individualized concepts of understanding and treating diseases. Genetic mutations can arise spontaneously or be triggered by environmental influences. Not all genetic disorders are inherited. According to WHO, congenital anomalies account for about 17%–43% of infant deaths. When parents carry genes that predispose them to certain diseases, their children and even future generations have a higher likelihood of developing those conditions.

INTRODUCTION

In the classical texts, various genetic concepts were described long before the emergence of modern genetics. Among these, *Prakruti* stands out as a remarkable Ayurvedic contribution to the understanding of genetics. It reflects a genetic perspective that aids in classifying human populations based on phenotypic characteristics. The fundamental hereditary units are described as *Bija* (chromosome), *Bijabhaga* (gene) and *Bijbhagavayava* (subunit or part of a gene) [1]. *Acharya Charaka* states that alterations in the parental *Bija* and its subcomponents can lead to developmental abnormalities in the offspring, with the nature of these defects varying according to the child's sex.

Human genome research shows that many illnesses have an underlying genetic basis. Certain conditions arise from mutations acquired during an individual's lifetime, such as those triggered by exposure to radiation. Harmful lifestyle and environmental factors including smoking, alcohol intake, pollutants and mental stress can also induce such genetic changes. These mutations play a key role in hereditary diseases, which are passed from parents to their children through genes. The *Garbhotpadaka Chaturbhava* comprising *Ritu* (optimal time for conception), *Kshetra* (reproductive system), *Ambu* (nutritional fluids) and *Bija* (reproductive elements) along with the *Shadbhava* (six procreative factors), play a crucial role in preventing congenital anomalies and genetic disorders. Furthermore, following *Dinacharya* (daily regimen), *Ritucharya* (seasonal regimen), *Sadvrutta* (ethical conduct), maintaining balance in *Dharaneeya* and *Adharaneeya Vega* (suppressible and non-suppressible natural urges), practicing *Ritumaticharya* (guidelines for preparing a woman physically and mentally for conception) and implementation of *Garbhinicharya* (antenatal care) help maintain the equilibrium of *Doshas*, thereby supporting proper gene regulation and expression.

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Fertilization and Sex Determination

Many factors mentioned towards the study of developmental genetics including fertilization and sex determination, Ayurveda considered two basic factors in the development of human beings i.e. *Sukra* and *Shonita* to resemble that of sperm and ovum in modern medical science, which are responsible for the fertilization in the human beings. When pure *Shukra* and pure *Shonita* unite with each other inside the *Garbhashaya* in association with *Satva* and *Jivatma*, *Garbha* is formed. [2] In this context, *Acharya Charaka* mentioned that when *Shonita* predominates at the time of conception, it results in the birth of a female child,

whereas the predominance of *Shukra* leads to the birth of a male child.[3] The sex of an individual is determined by the X and Y chromosome. Presence of Y chromosome leads to maleness regardless of the number of X chromosome present, absence of Y chromosome results in female development.[4]

Concept of Genome

Prakruti, represents an individual's inherent constitution and should be considered from genomic perspective. *Prakruti* of an individual is not only dependent on *Shukra* and *Shonita* but also upon the time of conception and environment inside the uterus (*Kala - Garbhashaya prakruti*), dietetic regimen and behaviour of mother (*Matu Aharvihar prakruti*) and the nature of *Mahabhutas* (*Mahabhuta vikara prakruti*) comprising the fetus [5].

It is determined by their genetic makeup and the predominance of the three *Doshas*: *Vata, Pitta* and *Kapha*. This natural constitution is established at the moment of conception and remains constant throughout one's life, influencing physical, physiological, and psychological traits.[6] The concept of *Prakruti* is pivotal, as it influences health, disease susceptibility and response to treatments.[7]

Concept of Basic Unit of Genetics

As *Bija*, *Bijabhaga* and *Bijabhagavayava* are considered three fundamental hereditary units. In modern terms, *Bija* corresponds to the male and female gametes (sperm and ovum), *Bijabhaga* aligns with chromosomes and *Bijabhagavayava* represents the smaller chromosomal components, comparable to genes. Any defect in a specific portion of the *Bija* leads to abnormalities in the body structure derived from that defective segment. This view aligns with modern genetics, which holds that genes carry the information for various traits and that alterations in specific gene segments or chromosomes can lead to developmental defects or inherited disorders.

Acharya Charaka explained some genetic disorders cause morbidity in foetus due to vitiation of these basic units by *Doshas*. Vitiation of *Bija* undermines its ability to generate healthy progeny, leading to infertile or *Bandhya Santana*. Defects in *Bijabhaga* of either parent give rise to *Putipraja*, characterized by congenital malformations, impaired organogenesis, or reduced vitality. Further, derangement of the *Bijabhagavayava* governing the female reproductive component results in offspring that are feminine in appearance yet deficient in true female functional attributes, termed *Varta*, similarly impairment of the male *Bijabhagavayava* produces progeny with a masculine phenotype but lacking genuine male reproductive capacity, referred as *Trunaputrika*. [8]

Table 1: Significance of *Bijabhaga* and *Bijabhagavayava* to fetal developmental traits

1.	*Jatiprasakta*	Characters linked to specific race
2.	*Kulaprasakta*	Familial Characters
3.	*Deshanupatini*	Geographical Characters
4.	*Kalanupatini*	Seasonal Variation at time of conception
5.	*Vayanupatini*	Age dependent characters

Concept of Pattern of Inheritance

The six formative determinants, collectively termed *Shadgarbhakar bhavas- Matruja, Pitruja, Atmaja, Satmyaja, Satvaja* and *Rasaja*[9] play important role in embryogenesis. These determinants govern the structural development of organs along with the establishment of physical and psychological attributes. Any deviation in these factors can act as a contributory basis for hereditary conditions, genetic disorders and congenital malformations.

Matruja bhava

The features inherited from mother are - Skin, blood, muscle tissue, fat, umbilicus, heart, pancreas, gall bladder, spleen, kidney, urinary bladder, stomach, duodenum, small intestine, large intestine, omentum, rectum, anal canal and anus.

In *Atulyagotriya adhyaya* it has been clearly mentioned that marriages in two similar *Gotras* should be strictly avoided [10]. This aligns with contemporary genetic principles, wherein individuals from families with recessive disorders are more often heterozygous carriers than true homozygous normals. Furthermore, the text asserts that conception involving a female under 16 years of age and a male below 25 either fails to occur or results in intrauterine fetal demise. It also observes that younger maternal age is associated with an increased incidence of offspring affected by conditions such as Down syndrome.

Kula or *Gotra* of parents, maternal age at the time of conception, health of the reproductive organs of the female, time of conception, *Bija* of mother, maternal diet during pregnancy, drugs taken by a woman during her pregnancy and any disease in the mother during her pregnancy, can affect the health and normalcy of a fetus. Younger women give birth to a majority (80%) of children with Down Syndrome.[11]

Pitruja bhava

The factors derived from father- Hair, mustache, nail, teeth, bones, veins, ligaments etc. *Acharya Bhavamishra* has also mentioned the abnormality of *Shukra* as a cause of congenital blindness and so on.[12] In modern genetic terms, when the father carries a mutated X-linked gene, this altered X chromosome is transmitted to all daughters, rendering them carriers since they also receive a normal X from the mother. Sons, on the other hand, inherit the father's Y chromosome and therefore do not receive the defective gene.

Atmaja bhava

The third essential determinant of embryonic formation is the soul, also referred to as *Chetana Dhatu*. New life emerges from the convergence of the ovum, sperm and the soul. The fetus receives several attributes from the soul, such as its destined species, lifespan, self-awareness, mental faculties, regulation of sensory functions, movements of *Vata* including respiration and the capacity to retain knowledge. Characteristics such as distinctive physical appearance, voice quality, complexion, emotional tendencies such as joy and sorrow, likes and dislikes, consciousness, intellect, memory, ego, and motivation are collectively classified as *Atmaja bhava.*

Satmyaja bhava

Satmya refers to substances or habits that, despite differing from one's inherent constitution, do not produce harm and are well tolerated by the body. For an embryo to develop appropriately, it must receive nourishing and compatible influences through the mother's diet. The *Satmyaja* factor confers health, physical strength, emotional stability, sensory well-being, clarity of voice, healthy skin and proper formation of reproductive elements i.e., sperm and ovum, sexual well-being. The attributes endowed by *Satmya* to the developing embryo are termed *Satmyaja Bhava*. These characteristics play a crucial role in determining the embryo's capacity to thrive and its overall developmental potential.

Satvaja bhava

Manas governs specific psychological attributes known as *Satvaja bhavas*, which include attachment, conduct, purity, aversion, cognition, memory, confusion, altruism, jealousy, courage, fear, anger, enthusiasm, intensity, gentleness or harshness, depth, and instability. All living beings are categorized into three mental constitutions- *Satvika, Rajasa,* and *Tamasa.* Although all individuals possess features of all three *Gunas*, the predominance of a particular *Guna* determines the psychological constitution, by which a person is designated as *Satvika, Rajasa* or *Tamasa*. The psychological constitution of an individual is significantly influenced by deeds performed in previous lives, which manifest as inherent mental tendencies at birth.

Dauhrida Avastha of a pregnant woman represents a clear and observable expression of *Satvaja bhavas*, wherein the specific desires and emotional states of the mother reflect the psychological needs of the developing fetus. Classical texts emphasize that suppression of the desires of a *Dauhridini* may adversely affect the mental and emotional well-being of both the mother and the fetus.

Rasaja bhava

The digested, absorbed and assimilated products of food constitute *Rasa*, which forms the foundational nutritive essence for the body. Various physiological and developmental factors are influenced by *Rasa*, collectively referred to as *Rasaja Bhava.* They are origin of body, growth, satisfaction, nourishment, enthusiasm, physical structure, maintenance, strength, decay.

Maternal nutrition during conception and gestation plays a pivotal role in determining the growth, constitution and overall health of the developing fetus. Excessive consumption of each *Rasa* by mother imparts distinct effects on both the mother and the child, potentially influencing the offspring's physical attributes, physiological functions and predisposition to certain disorders.

Table 2: Influence of maternal dietary patterns on fetal development[13]

S.no.	***Rasa* consumed by mother**	**Effect on child**
1.	*Madhura Rasa*	*Prameha* (diabetes), *Atishtoulya* (obesity), *Mookatwa* (impaired speech)
2.	*Amla Rasa*	*Raktapitta* (internal hemorrhage), *Akshiroga* (ocular disorders), *Twakroga* (skin disorders)
3.	*Lavana Rasa*	*Khalitya* (baldness), *Palitya* (pre mature greying of hair)
4.	*Katu Rasa*	*Durbalta* (weakness), *Alpashukra* (scanty semen) and *Anapatya* (infertility)
5.	*Tikta Rasa*	*Shosha* (emaciation), *Abala* (weak), *Anupachita* (poor digestive power)
6.	*Kashaya Rasa*	*Shyava Varna* (dark complexion), *Anaha* (flatulence) and *Udavarta* (eructation)

Modern genetics recognizes that maternal and paternal chromosomes alone do not determine an individual's phenotype rather, epigenetic factors play a significant role. Most genetic disorders arise due to a combination of inherited traits from the parents and environmental influences. Among the factors mentioned, *Matruja, Pitruja* and *Atmaja bhavas* are fixed and inherited, whereas *Satmyaja, Satvaja* and *Rasaja bhavas* are modifiable and can be adjusted to promote the health of future offspring.

DISCUSSION

Ayurveda presents a comprehensive and integrative framework for understanding heredity, human development and disease susceptibility, demonstrating substantial conceptual alignment with contemporary genetic and epigenetic sciences. Long before the advent of molecular biology and the identification of DNA, chromosomes and genes, classical literature described hereditary mechanisms through the principles of *Bija, Bijabhaga* and *Bijabhagavayava*, which may be functionally correlated with gametes, chromosomes and genes or their subunits. The assertion that defects in specific hereditary components result in distinct structural or functional abnormalities in offspring reflects a sophisticated understanding of the relationship between inherited determinants and phenotypic expression.

The concept of *Prakruti*, established at the time of conception and remaining constant throughout life, may be interpreted in relation to an individual's intrinsic genomic constitution and its epigenetic modulation. It is influenced by multiple determinants, including parental constitution, intrauterine conditions, maternal nutrition and psychological status during pregnancy. This multifactorial causation indicates an early recognition of the interaction between inherited traits and environmental influences, a principle that is now well substantiated in genomic research. Lifestyle and environmental exposures can regulate gene expression through epigenetic mechanisms without altering the underlying DNA sequence.

The *Shadgarbhakar Bhavas* provides a multidimensional model for inheritance and embryogenesis. Within this framework, *Matruja* and *Pitruja Bhavas* closely parallel maternal and paternal genetic contributions described in Mendelian inheritance. Classical injunctions against consanguineous marriages reveal an empirical awareness of the increased risk of hereditary disorders due to the expression of recessive traits, a concept strongly supported by modern genetic evidence. Observations related to parental age, reproductive health and timing of conception further demonstrate factors influencing congenital anomalies and fetal viability.

The inclusion of *Atmaja Bhava* highlights the metaphysical and psychosomatic dimensions of human development. Although this concept does not directly correspond to molecular genetic models, it resonates with modern explorations of consciousness, neurodevelopmental programming and behavioural predispositions. Similarly, *Satvaja bhavas* highlight the role of the mother's mental and emotional state in shaping fetal development. This concept closely aligns with modern research, which shows that maternal stress and psychological well-being during pregnancy can influence fetal neuroendocrine function and lead to long-term neurobehavioral changes in the offspring through epigenetic mechanisms. *Satmyaja* and *Rasaja bhavas*, which are regarded as modifiable determinants of fetal development. Maternal dietary habits, predominance of specific *Rasas*, lifestyle practices and physiological adaptability play a crucial role in shaping fetal growth, constitutional traits and disease susceptibility. These classical insights are strongly corroborated by modern epigenetic research demonstrating that nutritional and environmental exposures during critical developmental windows can induce persistent alterations in gene expression, thereby influencing metabolic, endocrine and developmental health later in life.

CONCLUSION

Concepts like *Bija* and *Prakruti* mirror modern notions of genes and genomic makeup, while *Shadgarbhakar bhavas* like maternal *Rasaja* and *Satvaja* factors, emphasize the critical influence of nutrition, lifestyle and mental well-being on fetal growth and development. Ayurvedic principles offer a sophisticated and integrative framework for understanding heredity, combining the recognition of inherent genetic predispositions with the influence of modifiable maternal, environmental and lifestyle factors. By emphasizing the impact of nutrition, psychological well-being and physiological adaptability on fetal development and provides actionable strategies to mitigate the risk of genetic and congenital disorders.

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