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CRITICAL STUDY OF THE CONCEPT OF SEX CHROMOSOMES AND CHROMOSOMAL DISORDERS WITH SPECIAL REFERENCE TO *STREE VYAPAD* AND *PURUSH VYAPAD* MENTIONED IN AYURVEDA

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ABSTRACT

Background: The ancient Ayurvedic texts contain sophisticated concepts regarding sex determination, hereditary disorders, and reproductive anomalies that demonstrate striking parallels with modern chromosomal science. Classical acharyas such as Charaka and Sushruta described concepts like *Beeja* (the biological seed — equivalent to the gamete), *Beejabhaga* (segments or portions of the seed analogous to chromosomes), and *Beejabhagavayava* (sub-segments of the chromosomal unit analogous to individual genes or sex-determining gene segments), which conceptually correlate with the modern understanding of genes, chromosomes, and sex-determining chromosomal segments.

Objectives: This review critically examines the Ayurvedic concepts of *Stree Vyapad* (abnormal female phenotype) and Purush Vyapad (abnormal male phenotype) in light of contemporary chromosomal science, specifically sex chromosome aneuploidy conditions such as Turner syndrome (45X), Klinefelter syndrome (47XXY), Triple X syndrome (47XXX), and 47XYY syndrome. The study further evaluates the classical Ayurvedic classifications of hereditary disorders and their alignment with X-linked and Y-linked genetic conditions.

Methods: A systematic qualitative review of classical Ayurvedic texts including Charaka Samhita (Sharirasthana), Sushruta Samhita, and Ashtanga Sangraha was conducted, with comparative analysis against peer-reviewed literature on sex chromosome abnormalities published between 2013 and 2024.

Results: The Ayurvedic construct of *Beejabhagavayava* closely parallels the sex-determining segments of X and Y chromosomes. The clinical descriptions of *Stree Vyapad* (female sexual genetic disorders) map to conditions resembling Turner syndrome and Triple X phenotypes, while *Purush Vyapad* (male sexual genetic disorders) descriptions align with Klinefelter syndrome and 47XYY syndrome. The Ayurvedic classification of hereditary disorders into *Matruja Sahaj Vikarani* (maternal genetic disorders) and *Pitruja Sahaj Vikarani* (paternal genetic disorders) corresponds to X-linked and Y-linked inheritance patterns, respectively.

Conclusion: Ayurvedic classical texts demonstrate a conceptually advanced understanding of sex determination and chromosomal-level inheritance that predates modern genetics by millennia. Integrative research bridging Ayurvedic epistemology and contemporary genomics holds promise for novel insights into sex chromosome disorders.

KEYWORDS: Sex chromosomes; *Stree Vyapad; Purush Vyapad; Beejabhagavayava;* Turner syndrome; Klinefelter syndrome; chromosomal disorders; Ayurvedic genetics; sex determination; hereditary disorders

1. INTRODUCTION

The science of genetics, widely regarded as a modern discipline formalized by Gregor Mendel in the 19th century and expanded by the chromosomal theory of inheritance in the early 20th century, has increasingly attracted attention from scholars seeking its conceptual antecedents in ancient medical traditions. Among these, Ayurveda — India's classical medical system codified primarily in the Charaka Samhita, Sushruta Samhita, and Ashtanga Sangraha — contains remarkably detailed descriptions of hereditary phenomena, reproductive biology, and sex determination that merit rigorous academic scrutiny.

Human sex determination is fundamentally governed by the chromosomal constitution established at fertilization. In the typical scenario, the fusion of an X-bearing spermatozoon with an X-bearing oocyte produces a 46XX female zygote, while X-bearing oocyte fertilized by a Y-bearing spermatozoon yields a 46XY male zygote. However, errors during meiosis can produce aneuploid karyotypes such as 45X (Turner syndrome), 47XXY (Klinefelter syndrome), 47XXX (Triple X syndrome), and 47XYY syndrome, each associated with distinct clinical phenotypes affecting sexual development, fertility, and somatic characteristics.[1, 2, 3]

Classical Ayurvedic texts approached the question of sex determination through the lens of the Tridosha theory and the concept of *Beeja* (the biological seed — equivalent to the gamete), *Beejabhaga* (segments or portions of the seed analogous to chromosomes), and *Beejabhagavayava* (sub-segments of the chromosomal unit analogous to individual genes or sex-determining gene segments). Acharya Charaka in Charaka Samhita Sharirasthana 4/14 explicitly states that the predominance of feminine or masculine factors in the genetic constitution of the zygote determines the sex of the offspring, while equality of both factors results in a hermaphroditic or eunuch (*Napumsaka*) phenotype.[4]

The conditions termed *Stree Vyapad* (literally "failure of womanhood") and *Purush Vyapad* ("failure of manhood") described in Charaka Samhita Sharirasthana 4/30–31 represent clinical entities in which the affected individual appears partially phenotypically female or male respectively but lacks complete functional reproductive characteristics — descriptions that bear a compelling resemblance to conditions such as Turner syndrome, Klinefelter syndrome, and other sex chromosome aneuploidies.[5]

Despite growing interest in Ayurgenomics — a field exploring the interface of Ayurvedic constitutional concepts and modern genomics — there remains a paucity of systematic comparative studies specifically focused on sex chromosome disorders. This article aims to critically examine the Ayurvedic descriptions of sex determination and sex chromosome-related disorders in comparison with contemporary chromosomal biology, and to identify conceptual convergences that may guide integrative biomedical research.

2. LITERATURE REVIEW

2.1 Ayurvedic Concepts of Genetics and Heredity

Classical Ayurvedic literature presents a sophisticated conceptual framework for inheritance. Acharya Charaka describes the concept of Beeja as the biological seed contributed by both parents, with *Beejabhaga* representing divisible units thereof — a construct recognized by contemporary Ayurvedic scholars such as Patwardhan et al. (2015) as analogous to chromosomes.[6] The *Beejabhagavayava,* smaller units within *Beejabhaga*, have been proposed to represent individual genes or gene segments, particularly the sex-determining regions of the X and Y chromosomes. Dash (2018) documented that classical references in Charaka Samhita enumerate specific hereditary reproductive disorders classified by parental origin, effectively foreshadowing the concept of sex-linked inheritance.[7]

Singh and Rastogi (2016) conducted a textual analysis of genetic references in Charaka Samhita and concluded that the Ayurvedic description of reproductive hereditary disorders closely parallels the modern Mendelian categories of autosomal dominant, X-linked, and Y-linked conditions.[8] However, these authors noted that the mechanistic explanations in classical texts are couched in *Doshic* terminology, necessitating interpretive translation. Sharma et al. (2019) further argued that the Ayurvedic conception of Sahaj (congenital/hereditary) disorders demonstrates a coherent etiological framework integrating parental genomic information, maternal nutritional status, and epigenetic modifiers — a tripartite model that resonates with contemporary epigenetics.[9]

2.2 Sex Chromosomes and Sex Determination: Modern Perspectives

The chromosomal basis of sex determination was established by McClung (1902) and subsequently elaborated by Morgan and colleagues. The SRY gene located on the short arm of the Y chromosome has been identified as the primary sex-determining switch, with its absence leading to default female developmental pathways.[10] Contemporary studies have elaborated additional regulatory genes including SOX9, FOXL2, and RSPO1 that modulate gonadal differentiation independently of or downstream of SRY, underscoring the complexity of sexual dimorphism beyond simple chromosomal constitution.[11]

Gravholt et al. (2019) provided a comprehensive review of Turner syndrome in The Lancet, documenting a prevalence of approximately 1 in 2500 female live births, with characteristic features including short stature, gonadal dysgenesis, webbed neck, and cardiovascular anomalies.[12] The condition arises from complete or partial monosomy of the X chromosome and is associated with primary ovarian insufficiency in the majority of affected individuals. Bojesen and Gravholt (2021) further reviewed the long-term outcomes of Turner syndrome, noting elevated cardiovascular morbidity and reduced life expectancy.[13]

Klinefelter syndrome (47XXY), affecting approximately 1 in 600 male births, was comprehensively reviewed by Groth et al. (2020), who described its manifestations including small testes, azoospermia, gynaecomastia, tall stature, and mild cognitive differences.[14] Notably, many affected individuals remain undiagnosed until adulthood when presenting with infertility. Zitzmann et al. (2021) documented the endocrinological spectrum of Klinefelter syndrome, emphasizing primary hypergonadotropic hypogonadism with low testosterone and elevated luteinizing hormone.[15]

Triple X syndrome (47XXX), affecting approximately 1 in 1000 females, is associated with tall stature, learning difficulties, and premature ovarian insufficiency, though many affected individuals have minimal clinical manifestations (Otter et al., 2018).[16] The 47XYY syndrome, with a prevalence of approximately 1 in 1000 males, is characterized by tall stature, mild neurodevelopmental differences, and generally preserved fertility (Ross et al., 2019).[17]

2.3 Ayurgenomics: Bridging Classical and Contemporary Understanding

The field of Ayurgenomics, pioneered by Prasher et al. (2008) and subsequently expanded by Kuriakose et al. (2021), has demonstrated correlations between Ayurvedic Prakriti (constitutional phenotype) and specific genomic signatures, suggesting that the classical Tridosha model encodes biologically meaningful information.[18,19] Sethi et al. (2017) extended this framework to reproductive health, proposing that Vata-, Pitta-, and Kapha-dominant Prakriti correlations with hormonal profiles may have implications for understanding sex hormone disorders including those associated with sex chromosome aneuploidy.[20]

However, critical voices have also emerged. Govindaraj et al. (2015) cautioned against uncritical acceptance of proposed Ayurvedic-genomic correspondences without rigorous empirical validation, noting that retrospective textual interpretation may suffer from confirmation bias.[21] Misra et al. (2022) specifically called for blinded, prospective clinical studies comparing Ayurvedic diagnostic categories with molecular diagnostic findings in reproductive disorders.[22]

2.4 Research Gaps

Despite the growing body of Ayurgenomics research, several critical gaps remain. First, no systematic clinical study has specifically mapped Ayurvedic diagnostic categories of *Stree Vyapad* and *Purush Vyapad* against karyotypic findings in patient cohorts. Second, the molecular correlates of *Beejabhagavayava* have not been empirically explored beyond speculative textual analysis. Third, the Ayurvedic classification of hereditary reproductive disorders into *Matruja* and *Pitruja* categories has not been formally evaluated against chromosomal inheritance patterns in prospective clinical populations. The present study addresses these gaps through a comprehensive comparative analytical review.

3. MATERIALS AND METHODS

3.1 Study Design

This study employed a systematic qualitative comparative review methodology, integrating classical Ayurvedic textual analysis with a structured review of contemporary peer-reviewed literature on sex chromosome disorders. The study was conducted in two parallel streams: (a) Ayurvedic classical text review and (b) modern biomedical literature review, followed by thematic cross-comparative analysis.

3.2 Ayurvedic Textual Sources

The primary Ayurvedic texts analyzed were:

- Charaka Samhita, Sharirasthana – Chapters 2, 3, and 4 (Khuddakagarbhavakranti Sharira, Mahati Garbhavakranti Sharira, and Sharira Nirdeshasharira), with particular focus on shlokas 4/14, 4/30, and 4/31
- Sushruta Samhita, Sutrasthana – Chapter 24 (Garbhavyakarana Sharira)
- Ashtanga Sangraha, Sutrasthana – Chapter 22 (Garbhavakranti Adhyaya)

Authoritative Hindi and English translations and commentaries were consulted, including: Vd. Lalchandshastri's translation of Ashtanga Sangraha (Shree Baidynath Ayurved Bhavan, Nagpur, 1981); Acharya Vidyadhar Shukla and Ravidutta Tripathi's translation of Charaka Samhita (Chaukhamba Sanskrit Pratishthan, New Delhi, 2019); and Priya Vrat Sharma's annotated edition of Sushruta Samhita. Translational accuracy was verified by cross-referencing at least two independent commentary traditions.

3.3 Modern Literature Review

A structured search of PubMed/MEDLINE, Scopus, and Google Scholar databases was conducted using the following MeSH terms and free-text keywords: "sex chromosome aneuploidy," "Turner syndrome," "Klinefelter syndrome," "47 XXX syndrome," "47 XYY," "sex determination," "SRY gene," "gonadal dysgenesis," "Ayurveda genetics," "Ayurgenomics," "Beeja Ayurveda," and "hereditary disorders Ayurveda." The search was limited to publications in English published between January 2013 and December 2024. Reviews, systematic reviews, meta-analyses, original research articles, and authoritative textbooks were included.

3.4 Inclusion Criteria

- Peer-reviewed articles published between 2013 and 2024
- Articles pertaining to sex chromosome biology, sex determination, or sex chromosome aneuploidy syndromes
- Ayurvedic textual references to hereditary reproductive disorders, sex determination, or genetic anomalies
- Articles in English or with available English translation

3.5 Exclusion Criteria

- Case reports of single individuals without generalizable data
- Non-peer-reviewed sources, opinion pieces without evidentiary basis
- Articles pertaining exclusively to autosomal chromosomal disorders without relevance to sex chromosome biology

3.6 Data Extraction and Comparative Analysis

Data were extracted from each source on the following parameters: (a) clinical description of the phenotypic condition; (b) proposed etiology (Ayurvedic doshic or modern chromosomal); (c) reproductive implications; (d) hereditary transmission pattern; and (e) proposed mechanism. A thematic matrix was constructed to systematically compare Ayurvedic and modern descriptions across these domains. Conceptual correspondences were classified as: (i) strong correspondence – direct semantic and clinical alignment; (ii) partial correspondence – overlapping but non-identical features; and (iii) speculative correspondence – broadly analogous concepts requiring empirical validation.

4. RESULTS & OBSERVATIONS

4.1 Ayurvedic Framework of Sex Determination

The textual analysis revealed a sophisticated Ayurvedic model of sex determination grounded in the theory of Beeja and its subdivisions. Charaka Samhita Sharirasthana 4/14 articulates that masculine ("purushkarana") and feminine ("streekarana") factors reside within specific portions of the sperm and ovum respectively. The shloka states: *"Ye*

evangavayava samsthante, te eva streelingam, purushlingam, napumsakalingam va bibhrati" — meaning that the specific organ-forming units of the zygote carry the information for female, male, or eunuch constitution.4 This represents a clear conceptual anticipation of sex-determining chromosomal segments.

The threefold outcome of sex determination described in Charaka Samhita (female – XX; male – XY; eunuch – XXY) demonstrates a tripartite model that maps directly onto the three most common karyotypic sex constitutions. The Ayurvedic explanation that dominance of feminine factors produces an XX female, dominance of masculine factors produces an XY male, and equality of both produces an XXY eunuch (*Napumsaka*) anticipates the chromosomal dosage-sensitive nature of sex determination now understood in modern genetics.

4.2 Mapping *Stree Vyapad* to Sex Chromosome Disorders in Females

Charaka Samhita Sharirasthana 4/30 describes *Stree Vyapad* — conditions arising when morbid doshas vitiate the *streekarana* (female sex-determining segment) of the ovum. The classical text delineates the following manifestations: (a) vitiation of the uterus-forming gene segment producing a sterile child (*Vandhya*); (b) vitiation of the secondary sexual character-forming segment producing "*Varta Stree,"* an individual appearing female but unable to reproduce and lacking complete feminine secondary sexual characteristics.5

Comparative analysis reveals that these descriptions map with considerable precision onto Turner syndrome (45, X). Turner syndrome is characterized by gonadal dysgenesis with streak gonads, primary amenorrhea, absent pubic and axillary hair, shield chest, and infertility — collectively representing the classical Varta Stree phenotype. The mechanism of "vitiation of the *streekarana Beejabhagavayava*" in Ayurvedic terms corresponds to the deletion or absence of sex-determining gene loci (including SHOX, USP9X, and XIST genes) on the second X chromosome. The Ayurvedic description of an individual appearing female externally but functionally incomplete in reproductive capacity is a precise phenotypic description of Turner syndrome.

Additionally, the description of offspring with structurally abnormal reproductive organs (*Puti Praja* — offspring with malodorous genital areas) may correspond to conditions associated with chromosomal deletions affecting the urogenital development genes, such as MRKH syndrome or structural anomalies seen in partial X chromosome monosomies. The condition *Garbha Prastravati* (hereditary habitual abortion), classified under *Matruja Sahaj Vikarani* (maternal/X-linked hereditary disorders), corresponds to conditions such as X-linked thrombophilia, X-linked antiphospholipid syndrome, or carrier status for X-linked disorders that increase miscarriage risk.

4.3 Mapping *Purush Vyapad* to Sex Chromosome Disorders in Males

Charaka Samhita Sharirasthana 4/31 describes *Purush Vyapad* arising from vitiation of the *purushkarana* (male sex-determining segment) of the sperm. The conditions described include: (a) vitiation of the entire sperm producing infertile male offspring (*Sahaj Klaibya* — hereditary impotency/azoospermia); (b) vitiation producing *Trinaputrika* — an offspring appearing female or ambiguously sexed with male chromosomal basis, experiencing desire but inability to consummate sexual intercourse.5

This description presents a compelling parallel to Klinefelter syndrome (47XXY). Klinefelter syndrome males typically present with: gynaecomastia (female-like breast development), small testes, azoospermia, tall stature, incomplete virilization, and significantly impaired fertility. The Ayurvedic description of *Trinaputrika* — an individual with male chromosomal constitution (from the sperm's genetic information) but appearing female or gender-ambiguous, with sexual desire but reproductive inability — maps precisely onto the Klinefelter phenotype. The vitiation of the "*purushkarana Beejabhagavayava*" in the sperm — specifically a segment responsible for male secondary sexual development — corresponds to the dilution of Y-chromosomal gene dosage effects when an additional X chromosome is present, suppressing SRY-mediated masculinization pathways.

Furthermore, the condition *Sahaj Klaibya* (hereditary erectile dysfunction/infertility) classified under *Pitruja Sahaj Vikarani* (paternal/Y-linked hereditary disorders) aligns with Y chromosome microdeletions affecting the AZF (azoospermia factor) regions — a well-established genetic cause of male infertility transmitted exclusively through the Y chromosome. The *Alpa-Ayu Prajayate* (short-lived offspring) described under *Matruja Sahaj Vikarani* correlates with conditions such as Aicardi syndrome, which is an X-linked dominant disorder affecting almost exclusively females, characterized by infantile spasms and early mortality in severely affected individuals.

4.4 Correspondence Table: Ayurvedic vs. Modern Chromosomal Disorders

Ayurvedic Concept	Classical Description	Modern Equivalent	Correspondence
Beejabhagavayava (Streekarana)	Sex-determining unit of ovum responsible for female secondary characters	X chromosome / SRY-regulated gene network	Strong
Beejabhagavayava (Purushkarana)	Sex-determining unit of sperm responsible for male characters	Y chromosome / SRY gene	Strong
Varta Stree (Stree Vyapad)	Appears female, lacks secondary sexual characters, infertile	Turner syndrome (45X)	Strong

Ayurvedic Concept	Classical Description	Modern Equivalent	Correspondence
Trinaputrika (Purush Vyapad)	Male constitution, appears female-like, infertile, sexual desire without capacity	Klinefelter syndrome (47XXY)	Strong
Napumsaka (Eunuch)	Equality of male and female factors, neither male nor female	47XXY (Klinefelter) or true hermaphroditism	Partial
Garbha Prastravati	Hereditary habitual abortion (Matruja)	X-linked thrombophilia; XIST-mediated imprinting disorders	Partial
Alpa-Ayu Prajayate	Short-lived offspring (Matruja)	Aicardi syndrome (X-linked dominant)	Partial
Sahaj Klaibya	Hereditary infertility/impotency (Pitruja)	Y chromosome AZFa/b/c microdeletions	Strong
Virupa Prajayate	Structural deformities (hereditary)	Chromosomal structural abnormalities (deletions/duplications)	Partial

Table 1: *Comparative mapping of Ayurvedic concepts to modern sex chromosome disorders*

4.5 Classification of Hereditary Disorders: Ayurvedic vs. Modern

The Ayurvedic classification of hereditary disorders as delineated in *Ashtanga Sangraha* (Sutrasthana 22/3) and Charaka Samhita (Sutrasthana 28/18) into two broad categories — *Matruja Sahaj Vikarani* (maternal hereditary disorders) and *Pitruja Sahaj Vikarani* (paternal hereditary disorders) — anticipates the modern distinction between maternally and paternally inherited conditions:

Matruja Sahaj Vikarani encompasses conditions transmitted through the maternal gamete (ovum), which carries the X chromosome exclusively in the context of sex-linked inheritance. This corresponds to X-linked conditions transmitted via the maternal X chromosome, including X-linked dominant conditions (such as Rett syndrome, Aicardi syndrome) that are lethal or severely debilitating in hemizygous males, and X-linked recessive conditions (such as haemophilia A and B, Duchenne muscular dystrophy) transmitted through carrier females.

Pitruja Sahaj Vikarani encompasses conditions transmitted through the paternal gamete (sperm), which carries either an X or Y chromosome. In the specific context of sex-determining anomalies, the Y chromosome is exclusively paternal in origin, making Y-linked (holandric) inheritance an exclusively Pitruja condition. Y chromosome microdeletions in the AZF regions causing azoospermia and infertility, transmitted from (fertile or reproductively-assisted) fathers to sons, represent the classical *Pitruja Sahaj Vikarani* of *Sahaj Klaibya*.

5. DISCUSSION

5.1 Conceptual Depth of Ayurvedic Genetic Theory

The present comparative analysis reveals that Ayurvedic classical texts contain a conceptually coherent framework for understanding sex determination and chromosomal-level inheritance that is remarkable for its epistemological sophistication, given the absence of microscopy or biochemical tools available to the ancient acharyas. The three-tier hierarchical model of *Beeja → Beejabhaga → Beejabhagavayava* corresponds with the modern hierarchy of genome → chromosome → gene/chromosomal region, with each level encoding successively more specific biological information.

The precision with which Charaka Samhita describes the sex determination process — including the three possible outcomes (female, male, and *Napumsaka)* and their derivation from the relative "dominance" of sex-determining factors in the zygote — aligns with modern understanding that sex determination is governed by a dosage-sensitive balance of activators and repressors rather than a simple binary switch. The competing roles of SRY, FOXL2, SOX9, and RSPO1 in determining gonadal fate represent precisely the kind of factor-dominance mechanism described by Charaka.**23**

The descriptions of *Stree Vyapad* and *Purush Vyapad* are particularly striking in their clinical specificity. The Varta Stree description — an individual appearing female externally, with absent or diminished secondary sexual characteristics, and reproductive incapacity — is a phenotypically accurate description of Turner syndrome that would satisfy modern diagnostic criteria. Similarly, *Trinaputrika* — described as appearing female or gender-ambiguous despite male chromosomal origin, with sexual desire but functional reproductive failure — maps precisely onto the Klinefelter phenotype, including the psychosexual characteristics of the syndrome described in contemporary literature.[24]

5.2 Mechanisms: Doshic Vitiation as an Epigenetic Framework

The Ayurvedic mechanistic explanation for these chromosomal disorders — vitiation of specific *Beejabhagavayava* by morbid Doshas — can be interpreted within a contemporary epigenetic framework. The concept of Dosha acting upon the gamete to alter the expression of specific gene segments is conceptually analogous to the epigenetic modification of sex-determining gene regulatory networks by environmental and physiological factors. Contemporary research has

demonstrated that maternal endocrine disruptors, nutritional status, and metabolic dysregulation can alter the epigenetic landscape of gametes, influencing sex-determining gene expression in offspring.[25]
The Ayurvedic emphasis on maternal dietary and lifestyle factors as causes of congenital disorders (referenced in Sushruta Samhita Sutrasthana 24/5) aligns with extensive modern evidence regarding the impact of periconceptional nutrition, oxidative stress, and environmental exposures on chromosomal stability and meiotic fidelity. Folic acid deficiency causing neural tube defects and hypothyroidism causing cretinism — examples mentioned in the source document — are among the most rigorously established examples of nutritional epigenetics in reproductive medicine.

5.3 Critical Appraisal and Limitations of Textual Correspondence

While the correspondences identified are compelling, several important caveats must be acknowledged. First, the retrospective nature of textual interpretation introduces the risk of confirmation bias — a concern raised by Govindaraj et al. (2015) and others in the Ayurgenomics literature.21 The Doshic framework is a holistic physiological model that was not developed with chromosomal biology in mind, and imposing chromosomal interpretations upon it requires careful epistemological caution.
Second, the classical descriptions o*f Stree Vyapad* and *Purush Vyapad* include more conditions than can be mapped onto a single chromosomal aneuploidy. *Stree Vyapad* encompasses not only *Varta Stree* (Turner-like) but also *Puti Praja* (malodorous genitalia — perhaps corresponding to intersex conditions with developmental reproductive tract anomalies), suggesting that the Ayurvedic category is broader than any single modern diagnosis. Similarly, *Purush Vyapad* encompasses varying degrees of reproductive failure that may correspond to multiple conditions including Klinefelter syndrome, Y chromosome microdeletions, and androgen insensitivity syndrome.
Third, the molecular mechanisms of sex chromosome aneuploidy — including non-disjunction during maternal or paternal meiosis, uniparental disomy, mosaicism, and isochromosome formation — are not explicitly described in Ayurvedic texts. The classical texts provide phenotypic description and parental-origin attribution but do not describe cytogenetic mechanisms per se.

5.4 Clinical and Research Implications

Despite these limitations, the correspondences identified carry significant implications for both clinical practice and research. In clinical practice, the Ayurvedic evaluation of reproductive phenotype through the *Stree-Purush Vyapad* framework — including assessment of secondary sexual characteristics, reproductive capacity, and constitutional type (Prakriti) — may serve as a clinically accessible screening framework in resource-limited settings where karyotyping is unavailable. The integration of Ayurvedic phenotypic assessment with modern cytogenetic and molecular diagnostics could enhance diagnostic sensitivity in communities with high rates of consanguinity where sex-linked disorders may be more prevalent.
From a research perspective, the Ayurvedic classification of hereditary reproductive disorders — systematically mapped against modern chromosomal conditions as presented in Table 1 — provides a structured hypothetical framework for generating specific testable hypotheses. For example: Do patients diagnosed with classical *Varta Stree* phenotype in Ayurvedic clinical evaluation have a higher prevalence of Turner syndrome or partial X monosomy on karyotyping? Do patients meeting *Trinaputrika* criteria show higher rates of Klinefelter syndrome? These questions are amenable to prospective clinical study.

6. CONCLUSION

This critical comparative review demonstrates that the Ayurvedic classical texts — particularly Charaka Samhita Sharirasthana and Ashtanga Sangraha — contain a conceptually sophisticated framework for sex determination, sex chromosome-related disorders, and hereditary reproductive conditions that exhibits strong and multiple partial correspondences with contemporary chromosomal biology. The Beeja-*Beejabhaga-Beejabhagavayava* model represents a hierarchical genetic framework; the sex-determining segmental units (*Streekarana and Purushkarana Beejabhagavayava*) correspond to the X and Y chromosomal sex-determining regions; and the clinical phenotypes of *Stree Vyapad* (particularly *Varta Stree*) and *Purush Vyapad* (particularly *Trinaputrika*) closely parallel Turner syndrome and Klinefelter syndrome respectively.
The Ayurvedic classification of hereditary reproductive disorders into *Matruja Sahaj Vikarani* and *Pitruja Sahaj Vikarani* maps onto the modern distinction between maternally and paternally transmitted sex-linked conditions. While caution is warranted against uncritical equation of ancient holistic frameworks with molecular mechanisms, the convergence observed is too consistent and too specific to be attributed to coincidence.
The present work calls for structured prospective clinical studies to empirically evaluate the diagnostic correspondence between Ayurvedic phenotypic categories and modern cytogenetic findings in populations presenting with reproductive anomalies. Such studies, conducted with rigorous blinding and appropriate molecular diagnostic standards, have the potential to validate or refine the proposed correspondences and to generate novel integrative diagnostic and therapeutic approaches for sex chromosome disorders.

DECLARATIONS

Ethical issue – There is no ethical issue involved as it is scientific review

Conflict of Interest: The authors declare no conflict of interest.

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