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Understanding Endocrine Disruptors and Their Impact on Hormonal Health: A Comprehensive Review With Special Reflections on Concept of Dūṣiviṣa.

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Abstract:

Background: Hormones play crucial roles in the human body and are involved in functions like growth, metabolism, reproduction, and mood balance. Unfortunately, it also means that human beings are in contact with endocrine-disrupting chemicals (EDCs), which interfere with the physiological equilibrium.

Objective: This article aims to review EDCs, their effects on hormonal health and how they work, ways of accessing them, overall risk to health, with preventive measures reminiscing about chronic toxin buildup of Dūṣiviṣa.

Method: Peer-reviewed articles on reproductive, metabolic, thyroid, and neurodevelopmental effects of EDCs have been discussed particularly from daily use cosmetics and food packing.

Result: Several EDCs such as BPA, phthalates, parabens, and pesticides have been found to have high prevalence rates with a prevalence rate of over 90% of the population. These interfere with hormonal fluctuations and possess the toxic property of Dūṣiviṣa.

Conclusion: EDCs are considered a threat to public health across the world. Safe decisions, increased awareness, and better legislation are needed to ensure the appropriate hormonal balance in the present and future generations.

Keywords: Endocrine Disruptors, Endocrine Disrupting Chemicals (EDCs), Dūṣiviṣa, Hormonal Imbalance.

Introduction :

Hormones are the excretory products of ductless glands that **induce physiological, morphological, and biochemical reactions**. These substances involve themselves in the various functions like the **growth, metabolism, reproduction ,and emotions** also. The glands include the pituitary gland, the thyroid gland, the adrenal glands, the pancreas and gonads and they ensure the balance of these hormones for homeostasis purposes in the body.[1] In recent decades, however, this balance of hormones has been threatened by environmental pollutants known **as Endocrine Disrupting Chemicals (EDC).** These external compounds can mimic,inhibit or pose competition to the normal hormones in the body and this with other things that can lead to more catastrophes. EDCs are present in almost all manufactured products and in many industrial

chemicals, pesticides, plastics, personal care products, and some pharmaceuticals.[2] Interestingly, Ayurveda has described the idea of toxic substances that constantly accumulate in the body and in the long term it affects health. Based on the Ayurvedic texts, toxins can come from **inanimate** objects **(sthavara),**from **animate** objects **(jangama),**or **artificial sources (Kritrima);** if toxins are not fully expelled from the body or are only weak but reside in the body for several years, they can be referred to as **Dūṣiviṣa.**[3] The idea is similar to the modern understanding of how long-term, low amounts of EDCs exposure may produce physiological disturbances through the passage of time. This problem cannot be dismissed lightly; for example, more than 90% of people on the planet have traces of these chemicals in their bodies. Research has shown that exposure to EDC's has been linked to **major health issues such as reproductive issues, metabolic problem of thyroid** that it does disrupt.[4] Thus, the aim of the current paper is to understand the role of the endocrine system, identify the pathways EDC's act, and learn about the Ayurvedic vision by analyzing the **Dūṣiviṣa** and lastly, indicate measures that can be taken to prevent exposure and possible future research areas with regards to the above discussed hazardous compounds.

Content of the study

1.An Overview of the Important Hormones and the Endocrine System [5]

The endocrine system uses hormones to target particular tissues, hence regulating overall body balance. **Key hormones include Estrogen, Progesterone, and Testosterone** – are very important in maintaining reproductive health. **Thyroxine and Triiodothyronine** are necessary in the maintenance of the metabolism of the body. **Insulin and Glucogon** maintain blood glucose concentrations in normal ranges. • **Cortisol and adrenaline** are very important for the body stress response which helps to cope with the stress. The maintaining of hormonal balance is central to the sustenance of metabolic processes and reproductive well-being, immune function, and brain health.

2.What are Endocrine Disruptors? [6]

Endocrine disruptors refer to external substances that interfere with the body hormonal communication system.

- Mimicking natural hormones (agonists).
- Blocking hormone receptors (antagonists).
- Altering hormone metabolism.
- Modifying hormone synthesis and elimination.

3.The Shocking Reality [7]

- **Prevalence:** about 90% on the general population that tests positive for endocrine disruptors.
- **Impact**: The secretion of hormones controls growth, reproduction, metabolism, and mood – disruption leads to chronic diseases. Fact: From 1989 to 2005:
- **A 32.2% decrease in sperm concentration.**
- A **significant 33.4% decline** in the formation of the sperm (Rolland et al., 2013).

4.Common classes of endocrine disruptors: and their corresponding impact on hormonal health. [8]

- **Industrial chemicals:** Polychlorinated biphenyls (PCBs), dioxins.
- **Plastics and plasticizers:** Bisphenol A (BPA), phthalates.
- **Pesticides:** Organophosphates,DDT,atrazine.
- **Personal care products:** Parabens, triclosan.
- **Heavy metals:** Lead, cadmium.

Table 1 : Common endocrine disruptors and their associated health risks.

Source	Disruptor Chemical	Action	Health Risk
Food Packaging	Bisphenol A (BPA)	Mimics estrogen	Infertility, menstrual irregularities
Pesticides	Organophosphates	Affecting nerve signaling	Neurodevelopmental issues, cognitive deficits
Cosmetics	Parabens	Disrupts reproductive health	Hormone-dependent cancers, breast cancer
Baby Toys	Phthalates	Disrupts testosterone production	Developmental and reproductive issues
Non-Stick Cookware	Perfluoroalkyl Substances (PFAS)	Alters thyroid function	Thyroid disorders, cancer issues
Processed Foods	Artificial Hormones	Mimics natural hormones	Early puberty, hormone-dependent cancers
Plastics	Polyvinyl Chloride (PVC)	Mimics reproductive hormones	Developmental delays
			

5. Routes of Exposure: Humans are exposed to EDCs includes

- **Ingestion**- Contaminated food and water.
- **Inhalation** -Airborne particles and fumes.
- **Dermal absorption** -Contact with cosmetics and personal care products.
- **Tran's placental transfer** -From mother to fetus.

6. Understanding the Mechanisms of Disruption [9]

There are several different ways in which **EDCs** affect hormone communication.

- **Hormone mimicry**: Some EDCs work on a similar chemical framework of natural hormones and can attach to hormone receptors and trigger unhindered responses such as bisphenol A (BPA) acting like estrogen.
- **Hormone blockade**: Some substances bind to hormonal receptors without initiating a response, therefore blocking the entry of natural (hormones such as phthalates which act as anti-androgens).
- EDCs affect the alteration of **production**, **movement**, and **breakdown** of hormones. EDCs exposure may disrupt the function of enzymes participating in the synthesis and degradation of hormones thus leading to hormonal imbalance.
- **Epigenetic modifications**: With the exposure to certain endocrine disruptors during critical developmental stages, this can lead to inherited alterations in the patterns of behavior of the genes though the DNA remain unaffected.

7.Ayurvedic Perspective on Persistent Toxins [3]

The Ayurvedic sources place Dūṣiviṣa as residual toxin from plants, animals or artificial sources, weakened with treatment continuing in the body. While it may seem harmless in the short term, *Dūṣiviṣa* exerts its effects by harming bodily tissues over the long term.

Characteristics :

- Poison that has aged, been antagonised by antidotes, dissipated through air, fire, sun or natural decay or which is naturally less potent is poisonous and is designated as Dūṣiviṣa.
- Despite the mild effects it produces it deserves attention as opposed to ignoring it. It attaches itself to the body for a long time; its attachment being caused by Kapha (Kaphāvṛtatva).
- If particular external or internal circumstances, such as geographical (Deśa),(Kāla), dietary (Anna), and daytime sleeping (Divāsvapna) are present, Dūṣiviṣa gets activated.
- In its early phase, it does not manifest as obvious symptoms but quietly gets to other bodily tissues as time goes on. In case the right circumstances develop, complications known as upadravas may appear.

Effects on Health:

- Based on location of the disturbance cause diseases of Kapha, Vāta or Pitta.
- Chronic conditions such as blood disorders, gastrointestinal, fainting, vomiting as well as unconsciousness.
- Major symptoms include overall weakness, baldness, systemic disorders all over the body.
- Thus the concept of Dūṣiviṣa tracks quite closely to the modern understanding of endemic, sub-clinical chemical exposures that quietly undermine long-term well-being.

Discussion

Exceptionally high levels of endocrine disruptors pose a serious risk to the overall population. The results of animal studies, epidemiological investigations, and clinical assessments always indicate a consistent association between exposure to EDCs and hormonal imbalances. Vulnerable life stages such as pregnant women, infants, and adolescents are particularly sensitive to the adverse effects of endocrine disruptors due to the critical of their hormonal development stages.[10] Widespread presence and complex exposure routes are some of the major challenges in minimising the risk of EDCs. A large number of individuals are exposed at once to a cocktail of various endocrine disruptors which makes risk estimation and restrictions more complicated. In order to understand the long term consequences of endocrine disruptors in the body, comparisons can be closely aligned with concept of persistent toxins like Dūṣiviṣa is mentioned, supporting longer exposure effects over time.

Table 2: Core principles of Dūṣiviṣa and endocrine-disrupting chemicals EDCs.

Feature	Dūṣiviṣa (Ayurveda)	EDCs (Modern Physiology)[6]	Remarks
Nature	Latent, residual, persistent toxin	Persistent hormone-disrupting chemical	Silent and accumulative in nature
Potency	Low potency but chronic effects	Subtle effects with long-term consequences	Needs long-term monitoring
Source	Natural/Artificial improperly neutralized toxins	Industrial chemicals in plastics, cosmetics, etc.	Both sources are environmental in nature
Impact	Disrupts Dhātus, systemic diseases	Mimics/disrupts hormones, chronic illnesses	Leads to multi-systemic impact
Duration	Stays hidden for years	Bioaccumulates over extended time	Invisible burden on the body

Table 3: Absorption of endocrine-disrupting chemicals through skin – Modern and Ayurvedic comparison[8]

Aspect	Modern Justification	Ayurvedic Justification
Absorption through Skin	Fat-soluble EDCs like parabens and phthalates penetrate via pores and follicles	Bhrajaka Pitta facilitates absorption and processing of topical substances
Initial Distribution	EDCs enter bloodstream and reach endocrine organs	Absorbed toxins enter Rasa Dhatu for primary tissue nourishment
Systemic Circulation	Transported via blood to distant organs like thyroid, ovaries, liver	Vyana Vata spreads Rasa Dhatu (and toxins) systemically
Impact on Endocrine System	EDCs mimic or block hormones, disrupting signaling	Disturbance in Sadhaka & Ranjaka Pitta leads to systemic dysfunction
Chronic Effects	Infertility, thyroid dysfunction, metabolic disorders, cancers	Agnimandya and Dushi Visha accumulation causing chronic imbalance
Toxin Accumulation	Stored in fat cells, causes delayed damage	Meda Dhatu stores toxins leading to metabolic disturbance
Elimination	Liver and kidneys excrete EDCs (partially)	Ama processed by Agni, excreted via sweda, mutra, and purisha
Preventive measures	EDCs free products, detox pathways by diet ,lifestyle	Panchakarma,herbal remedies and patya ahara

Preventive measures are accompanied by a Call to Action

- Read labels and ingredients.
- Choose natural, certified products.
- Advocate for stricter legislative standards on the matters of EDCs.
- Promoting safer alternatives' usage in consumer goods.
- Educating the public on reducing exposure.
- Strengthening regulatory frameworks.
- Empowering further research of safety of under-studied chemicals.

Future Research Directions : It is essential to:

- Ways to improve research on the long term effects of EDCs on human subjects.
- Strengthen bio monitoring efforts to support identification of EDC-risk populations.Develop safer alternatives in consumer products.
- Call attention to the medical staff and community members concerning ways of avoiding exposure.

- **Holistic Health Approach**
- Strengthen natural defenses: Boost metabolism and immunity.
- Enhance the use of Ayurvedic practices and modern scientific achievements to improve the hormonal health

Takeaway: Reduce your dependence on risky materials to protect you and the environment.

Key Message: Knowing risks and informed choices are crucial in reducing exposure levels.

Conclusion

Endocrine disruptors can remain hidden from daily practices but have great and long-lasting influence on our health. They interrupt hormonal balance and can cause chronic diseases including infertility, thyroid problems, metabolic syndrome and hormone-related cancers which build up within us unnoticed. The long-lasting characteristics in addition to the ability to bioaccumulate of EDCs interrelate with the ancient theories of Dūṣiviṣa; this is a silent yet real threat given for years. The Daily activities make us vulnerable to endocrine disruptors through packaged foods, cosmetic products, environmental pollutants, and dermal contact with parabens and phthalates in skin care. Thus, knowing how exposure occure helps in taking appropriate preventive action. Ancient philosophies and modern research alike indicate the importance of collective action which look for safer products, promoting greater legislation, and promote further scientific inquiry. Cultivating hormonal balance is a common task that goes beyond individual action into societies for generations. By being mindful today, we preserve better health for the future genrations, immune to the unseen agents that destabilize the balance of our body.

Conflict of Interest:

The authors declare that they have no conflict of interest.

Ethical Approval:

This article does not involve any studies with human participants or animals performed by any of the authors.

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