Topics

- X Chromosome linked disease
- Why a waterfall appears white ?
- ‘Water, air pollution and carbon footprints of conspicuous/luxury consumption in India’ Report
- FAME -II Scheme
- Kangei Maru
- Mains

By saurabh Pandey

THE HINDU

Target Mains -2024/25

Q ‘’ Now social inequality and economic inequality will determine the environment impact of individual’’ Explain

प्रश्न "अब सामाजिक असमानता और आर्थिक असमानता व्यक्ति के पर्यावरण पर प्रभाव को निर्धारित करेगी" स्पष्ट करें

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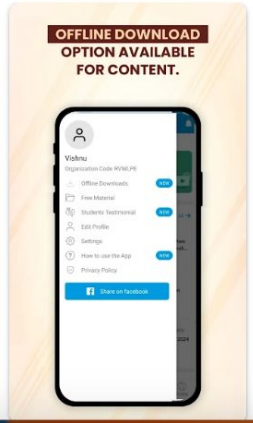

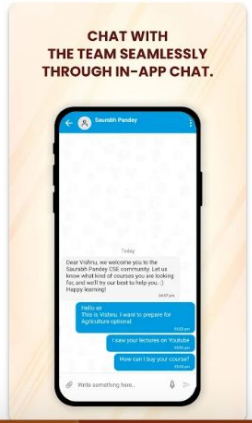

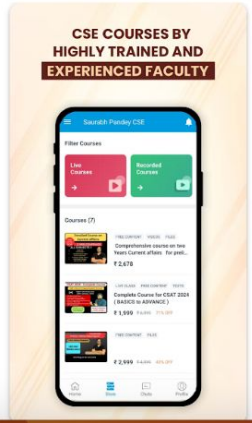

App support

X chromosome revival in older women increases risk of autoimmune disease

Researchers have suggested for a while that a number of immune diseases — including systemic lupus erythematosus, rheumatoid arthritis, and Sjögren's syndrome — are more common in females than males. Of particular note are autoimmune diseases in which antibodies act against specific proteins

Sridhar Sivasubbu
Vinod Scaria

In 1961, Mary Frances Lyon argued that one of the X chromosomes in females is randomly inactivated during early embryonic development to prevent the overexpression of X-linked genes. Representative image. BLACKJACK3D/GETTY IMAGES

THE GIST

There are more than 500 X-linked genetic diseases, and they mostly affect males. Many of the X-linked traits and diseases are not uncommon in the general population. For example, red-green colour blindness is X-linked, and affects around 8% of males

Researchers unravelled X inactivation when they discovered Xist. The body deactivates X using Xist and another non-protein-coding RNA, called Tsix. The regulation of these two genes means that in the X chromosome that is to be deactivated, the Xist RNA is overexpressed such that it coats the chromosome

French researchers perturbed the expression of Xist in female mice, and found that previously inactive genes on the inactive X chromosome were reactivated. The result was the spontaneous development of lupus-like inflammatory signs in the female mice

In mammals, the females have two copies of the X chromosome, while the males carry a single copy. The X chromosome is more significant for its role in determining sex. Recent genomic studies have shed light on the fundamental biological processes the X chromosome modulates and the genes it encodes. The gathering evidence suggests, in fact, that it plays a part in a variety of biological functions as well as controlling the sex-specific susceptibility to certain diseases.

The human X chromosome encodes around 800 genes, which in turn code for proteins. A loss of function for these genes could thus lead to a variety of genetic diseases. Broadly, the diseases whose onset and/or progression the X chromosome influences can be grouped into three types: (i) X-linked genetic diseases, (ii) diseases influenced by XCI escape, and (iii) those linked to X-chromosome aneuploidy.

There are more than 500 X-linked genetic diseases, and they mostly affect males. Many of the X-linked traits and diseases are not uncommon in the general population. For example, red-green colour blindness is X-linked, and affects around 8% of males. Duchenne muscular dystrophy, caused by mutations in the dystrophin gene and affecting 1 in every 3,500-5,000 boys born in India and agammaglobulinemia, an immunodeficiency disorder that affects around 1 in 200,000 live births, are also X-linked.

Scientists are also aware of numerical abnormalities – or aneuploidies – of the X chromosome. For example, Klinefelter syndrome is characterised by an extra X chromosome (XXY) and Turner's syndrome by a loss of one X chromosome in females (X instead of XX).

Inactivation of X chromosome

In mammalian species, females typically carry two X chromosomes, while males possess one X and one Y chromosome. Each of the X chromosomes is inherited from the parents. In 1961, an English geneticist named Mary Frances Lyon argued that since females have two copies of the X chromosome, one of the X chromosomes is randomly inactivated during early embryonic development, in a process called X chromosome inactivation (XCI), to prevent the overexpression of X-linked genes in females.

In this process, epigenetic changes silence most genes on one X chromosome (epigenetics refers to the processes by which genes are influenced by the environment in which they operate). XCI ensures a balance in gene expression, but scientists are also learning that it plays a role in various genetic disorders. Issues such as incomplete inactivation (a.k.a. escape) or skewed inactivation can lead to the abnormal expression of genes, which contributes to diseases including X-linked disorders, certain cancers, and autoimmune conditions.

Three decades after Dr. Lyon's hypothesis, researchers unravelled the molecular mechanisms of X inactivation when they discovered Xist, a non-protein-coding RNA. The body deactivates the X chromosome with the help of Xist and another non-protein-coding RNA, called Tsix (reverse of Xist). The differential regulation of these two genes means that in the X chromosome that is to be deactivated, the Xist RNA is overexpressed such that it coats or covers the chromosome.

However, inactivation of the X chromosome is not absolute. As many as a fourth of all genes encoded by the X chromosome could escape inactivation and express themselves, as researchers at the Whitehead Institute in the U.S. reported in a paper published in the journal *Cell Genomics* last year.

Autoimmune diseases

Researchers have suggested for a while that a number of immune diseases – including systemic lupus erythematosus, rheumatoid arthritis, and Sjögren's syndrome – are more common in females than males. Of particular note are autoimmune diseases, in which antibodies act against specific proteins.

> The human X chromosome encodes around 800 genes, which in turn code for proteins. A loss of function for these genes could thus lead to a variety of genetic diseases

In a paper published on May 3 in *Science Advances*, French researchers perturbed the expression of Xist – which triggers XCI – in female mice, and found that previously inactive genes on the inactive X chromosome were reactivated. This was particularly true of genes involved in the Toll-like receptor 7 signalling pathway in immune cells. The result was the spontaneous development of lupus-like inflammatory signs in the female mice, including an increased level of autoantibodies and altered immune cell populations.

The reactivation of specific X-linked genes in response to XCI alteration varies across immune cell types, which is to say diverse molecular pathways are affected. The resulting effects in autoimmune diseases are likely due to a combination of reactivation events in different cell types and global changes in gene expression. The findings reinforce the molecular link between altered XCI and autoimmune diseases, and pave the way for possible new drugs to treat them in the future.

X and Alzheimer's disease

Another disease with a sex bias and linked to the X chromosome is Alzheimer's disease. Women seem to have a higher risk of getting it; worldwide, almost twice as many women have Alzheimer's as men. In a study published in the journal *Cell* in October 2022, researchers from Case Western Reserve University in the U.S. suggest a gene called ubiquitin-specific peptidase 11 (USP11), involved in a protein-modifying process, encourages tau protein to accumulate in the brain. Based on studies of mice brains, the researchers suggested the gene escapes X inactivation and is expressed more in females. This also opens new avenues to develop treatments for Alzheimer's.

In humans, the Y chromosome has been shrinking over time, so the X chromosome is possibly evolution's best bet and thus plays a pivotal role in human health and disease. Its evolutionary genomics and emerging insights into its participation in biological processes illuminate the complex interplay between genetic inheritance, epigenetic modifications, and disease manifestation. Cracking all this to get the full picture could also lead us to new drugs and therapies.

(The authors are senior consultants at the Vishwanath Cancer Care Foundation and adjunct professors at IIT Kanpur and Dr. D.Y. Patil Vidyapeeth.)

X Chromosome linked diseases

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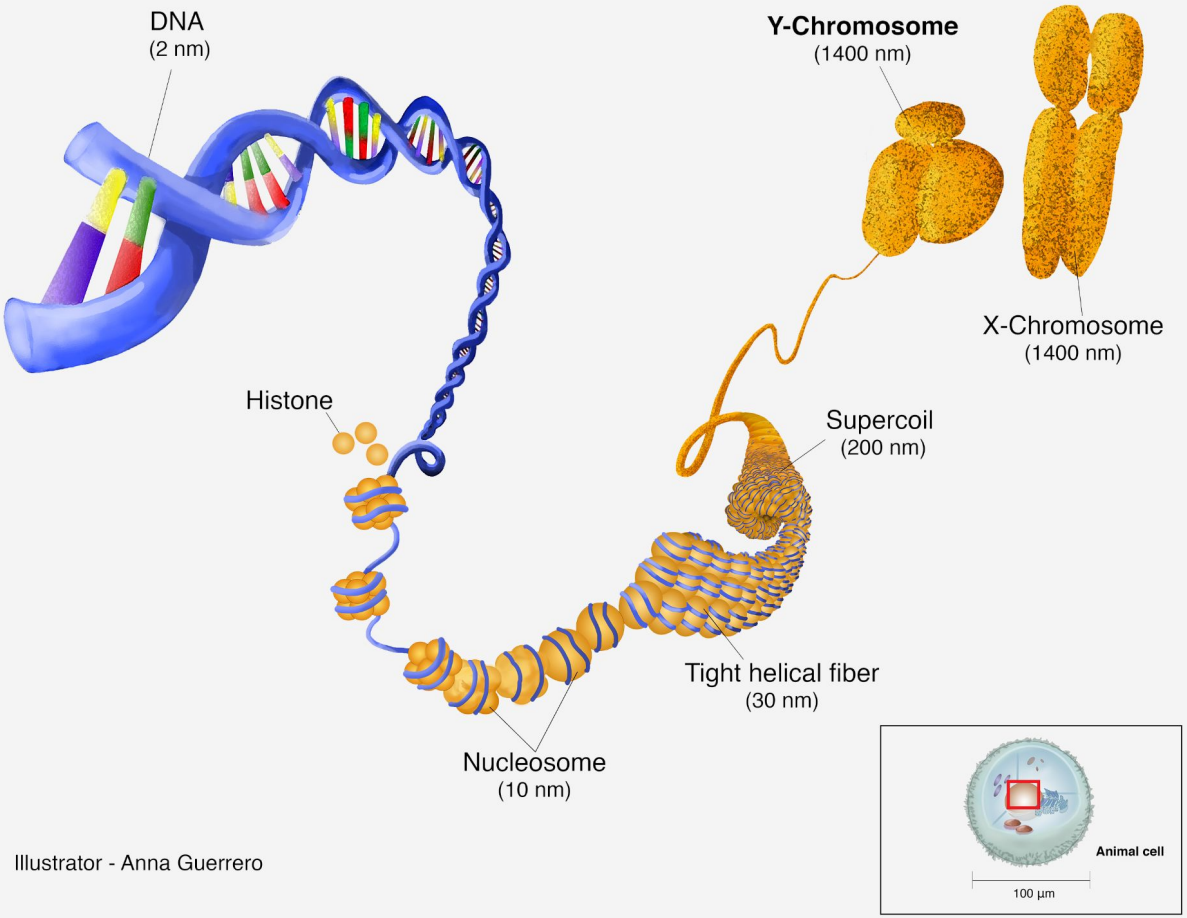
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(1400 nm)
Histone
Supercoil
(200 nm)
Tight helical fiber
(30 nm)
Nucleosome
(10 nm)
Animal cell
100 µm
Illustrator - Anna Guerrero

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QUESTION CORNER

Why a waterfall appears white

Q: Why does water appear white in a waterfall even though it is colourless?

A: When all colours are reflected from the surface of an object, it appears white. In a waterfall, water drops can be thought of as being suspended in air and as an inhomogeneous mixture of water and air.

We know that when light enters from a lighter medium (air) into a denser medium (water), some of it is reflected by the surface and the rest is refracted. In a waterfall, light suffers numerous such reflections and refractions.

The light refracted by a layer on top would also contribute to reflection at the next layer of drops. As a result, most of the light is reflected by the waterfall.

This leads to whiteness. Mist, paper, water vapour, colloidal solutions, clouds, talcum powder, snow, white paint, and sugar also appear white because of the same reason.

(There are no white pigments in white paint. White paint has transparent oxides of zinc, lead, and titanium suspended in a transparent solution.)

When all colours are reflected from the surface of an object, it appears white. SLNC/UNSPLASH

To see a waterfall white, light should not be directional, i.e. it should be coming from all directions. If it is directional, one would see colours as in a rainbow.

(S. Mukund, Chennai)

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Analysing local environmental footprints

What is the importance of evaluating household environmental footprints? Which are the three footprints analysed in this study? Do these footprints associated with luxury consumption show an increase as one analyses households that are richer and affluent? What should policymakers do?

EXPLAINER

Soumyajit Bhar

While climate change is a global concern, issues such as water scarcity and air pollution are often localised or regionalised. For example, excessive water use in one region may not directly affect water scarcity elsewhere. Focusing on local environmental issues is crucial; and herein comes the importance of understanding household environmental footprints.

How are household environmental footprints distributed in India?

A recent study titled 'Water, air pollution and carbon footprints of conspicuous/luxury consumption in India', of which the author is one of the contributors, highlights the environmental impact of affluent individuals, particularly those who engage in consumption beyond basic needs. This study specifically examines the CO2, water, and particulate matter (PM2.5) footprints associated with luxury consumption choices among households in India across different economic classes. The analysis contrasts these luxury consumption footprints with those associated with non-luxury consumption. The luxury consumption basket includes various categories such as dining out, vacations, furniture, social events etc.

How were environmental impacts assessed in this study?

Methodologically, the study employed an input/output analysis of the entire economy to map or link different components of household consumption to the resources or materials involved in their production. This approach enabled the capture and aggregation of the (indirect or embedded) environmental impacts associated with each stage of production. For example, the water footprint was utilised to quantify water usage throughout various stages of production of different goods and services, as well as direct water usage by households. The PM2.5 footprint encompassed both embedded emissions and direct emissions from household activities such as the use of fuelwood, kerosene, and vehicular fuels. Similarly, the CO2 footprint was used to capture both embedded and direct CO2 emissions associated with household consumption.

GETTY IMAGES

What were the key findings?

The study reveals that all three environmental footprints increase as households move from poorer to richer economic classes. Specifically, the footprints of the richest 10% of households are approximately double the overall average across the population. A notable surge in footprints is observed from the ninth to the 10th decile, with the air pollution footprint experiencing the highest increase at 68% in the 10th decile compared to the ninth. Conversely, the rise in the water footprint is the lowest at 39%, while CO2 emissions stand at 55%. This suggests that Indian consumers, particularly those in the top decile, are still in the 'take-off' stage, with only the wealthiest segment exhibiting substantial increases in consumption-related environmental footprints. The heightened footprints in the 10th decile are primarily attributed to increased expenditure on luxury consumption items.

What are the key contributors?

The study identifies eating out/restaurants as a significant contributor to the rise in environmental footprints, particularly in the top decile households, across all three footprints. Additionally, the consumption of fruits and nuts is highlighted as a factor driving the increase in water footprint in the 10th decile. Luxury consumption items such as personal goods, jewellery, and eating out contribute to the rise in CO2 and air pollution footprints. Notably, the presence of fuels like firewood in the consumption baskets of poorer households is emphasised, showcasing contrasting impacts of modern energy transitions. While transitioning from biomass to LPG reduces direct footprints, the lifestyle choices associated with affluence lead to a rise in PM2.5 footprints (and subsequently, the CO2 footprint).

The average per capita CO2 footprint of the top decile in India, at 6.7 tonnes per capita per year, is noted to be higher than the global average of 4.7 tonnes in 2010 and the annual average of 1.9 tonnes CO2eq/cap required to achieve the Paris agreement target of 1.5°C. While still below the levels of the average citizen in the U.S. or U.K., this disparity underscores the need for urgent attention from policymakers. Given the influence of elite lifestyles on broader societal aspirations, policymakers should prioritise efforts to nudge consumption levels of affluent households downwards to align with sustainability goals.

What are the implications?

The study emphasises that while sustainability efforts often focus on global climate change, global environmental footprints do not necessarily align with local and regional scale footprints. However, local and regional environmental issues exacerbated by luxury consumption disproportionately affect marginalised communities. For instance, water scarcity and air pollution disproportionately impact marginalised groups, further marginalising them, while affluent sections can afford protective measures such as air-conditioned cars and air purifiers. This underscores the importance of multi-footprint analysis in addressing environmental justice concerns and ensuring equitable sustainability efforts.

Soumyajit Bhar is Assistant Professor at the School of Liberal Studies of BML Munjal University, Gurugram.

THE GIST

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FAME-II 'violations' could put e2W firms in the blacklist

S. Ronendra Singh
NEW DELHI

Three electric two-wheeler companies – Hero Electric, Okinawa and Benling India – can be de-registered or blacklisted from future government schemes if they do not pay back the money they owe to the government under the Faster Adaption of Manufacturing of Electric Vehicles (FAME)-II scheme, sources have said.

The companies earned ₹300 crore in violation of FAME-II scheme norms. The government has demanded this amount be paid back as per norms.

In April last year, the MHI had fined Hero Electric ₹133.8 crore, Okinawa Autotech ₹116.85 crore, and Benling India ₹48.42 crore for violating the FAME-II guidelines.

"The next step is debarment from all schemes of the Ministry (MHI). That has also been done for Benling and Hero Electric. It didn't happen for Okinawa because they were in court at the time. The next step is blacklisting from all schemes under the GoI. That has not happened so far because the Ministry of Finance gives the approval for debarment from all the Ministries' schemes/ policies for any company," a senior government official told *businessline*.

"The whole matter is under the scrutiny of the Delhi High Court. We would not like to comment on any matter that is sub-judice," Amit Kumar, Chief Executive Officer, Benling India, told *businessline*.

(The writer is with The Hindu businessline)

FAME -II Scheme

Government has approved Phase-II of FAME Scheme with an outlay of Rs. 10,000 Crore for a period of 3 years commencing from 1st April 2019.

Out of total budgetary support, about 86 percent of fund has been allocated for Demand Incentive so as to create demand for xEVs in the country.

This phase aims to generate demand by way of supporting 7000 e-Buses, 5 lakh e-3 Wheelers, 55000 e-4 Wheeler Passenger Cars (including Strong Hybrid) and 10 lakh e-2 Wheelers.

Only advanced battery and registered vehicles will be incentivized under the scheme.

With greater emphasis on providing affordable & environment friendly public transportation options for the masses, scheme will be applicable mainly to vehicles used for public transport or those registered for commercial purposes in e-3W, e-4W and e-bus segments.

However, privately owned registered e-2Ws are also covered under the scheme as a mass segment.

Death knell for whales

Crew members board Japan's new whaling mothership, the *Kangei Maru*, in Shimonoseki city. The 9,300-tonne ship set sail on its maiden hunting voyage on Tuesday, heralding a new era for the controversial practice defended by the government as a part of national culture. AFP

Kangei Maru

- The new Kangei Maru set off from Shimonoseki, the first new ship of its kind to sail from Japan in over 70 years. The ship can process and store whale meat on board.
- Kangei Maru replaces a previous lead vessel, Nisshin Maru, which was retired last year.
- This is a new ship for a new era, symbolic of the new period of resumed commercial whaling,”

Japan was a member of the International Whaling Commission (IWC) before its moratorium on commercial whaling in 1985

International Whaling Commission (IWC)

The IWC was established in 1946 as the global body responsible for management of whaling and conservation of whales.

Today the IWC has 88 member countries.

The mandate has not changed but many new conservation concerns exist and the IWC work programme now also includes bycatch & entanglement, ship strikes, ocean noise, pollution and debris, and sustainable whale watching

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