

Gene Activity Map of the Prefrontal Cortex

Prelims: Current events of national and international importance | Health

Why in News?

Recently, scientists have created a detailed molecular map of gene activity in the brain's prefrontal cortex.

Gene Activity Map of the Prefrontal Cortex

Key Findings of the Brain Study			SHANKAR IAS PARLIAMENT
 Prefrontal cortex	Parameter	Findings	
	 Brain region	Prefrontal cortex	
	 Brain cells studied	More than 6.3 million	
	 Donors	1,494 deceased individuals	
	 Age range	Infancy to 108 years	
	 Cell material studied	Nuclei of brain cells	
	 Genetic diversity	Donors had different genetic ancestries	
	 Diseases represented	Alzheimer's, Parkinson's, Lewy body dementia, vascular dementia, schizophrenia, bipolar disorder etc.	
	 Major output	Detailed map of gene activity at cellular level	

- **Objective** - To understand normal brain development, ageing and disorders such as **Alzheimer's, Parkinson's, schizophrenia and dementia**.
- **Conducted under** - **PsychAD research consortium** with support from the **U.S. National Institute on Aging (NIA)**.

Prefrontal Cortex

- The **prefrontal cortex** is situated in the anterior region **of the brain's outer layer**, directly behind the forehead.
- **Major functions**
 - Planning
 - Decision-making
 - Regulation of emotions
 - Behavioural adaptation
 - Higher cognitive functions
- Notably, the prefrontal cortex is **especially susceptible to age-related changes and plays a significant role in various** psychiatric and neurodegenerative disorders.

Gene Activity

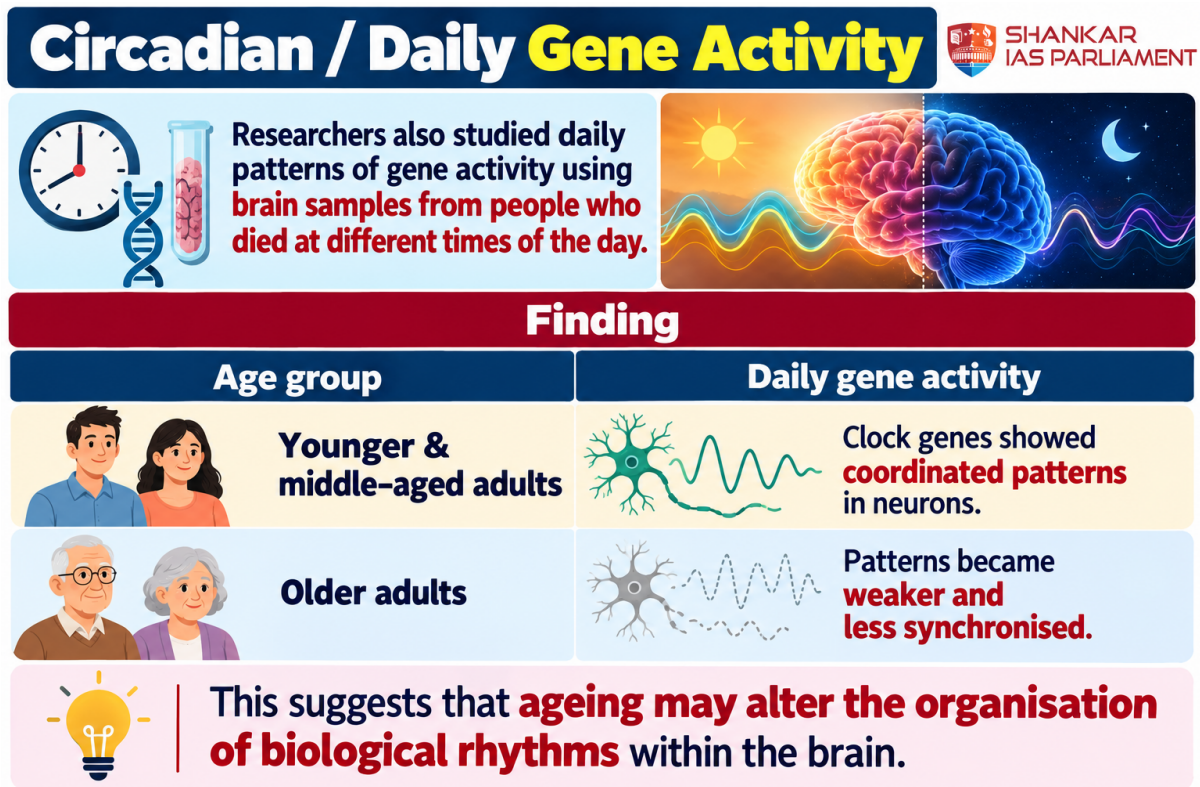
- Gene activity, also known as **gene expression**, refers to the process by which cells utilize genetic information to synthesize functional molecules, primarily proteins.
- In this study, researchers analyzed gene activity across various brain cell types to elucidate the following relationships:
- **Gene activity influences cell function, which in turn affects brain development and ageing, ultimately contributing to disease processes.**

- **Key Findings**
- **Similarities among Brain Disorders** - Significant similarities in gene expression profiles were identified among the following disorders:
 - **Alzheimer's disease**
 - **Lewy body disease**
 - **Vascular dementia**
 - **Parkinson's disease**
- The following biological processes were commonly affected:
 - Nerve-cell development
 - Neuronal communication
 - Blood-vessel biology
- **Microglia** - Researchers identified shared molecular pathways in microglia between **Alzheimer's disease and Parkinson's disease**.

***Microglia** are the resident immune cells of the central nervous system.*

- **Transition from infancy to adulthood** - Significant molecular changes occur in the prefrontal cortex during this period.
- **Throughout most of adulthood** - There is relative molecular stability across various cell types.
- In later life, renewed molecular changes are observed, particularly in immune and support cells.
- **Transition point** - The study identifies approximately 24 years of age as the point at which a molecular shift occurs, marking the onset of the stability phase.
- **Cognitive Resilience in Alzheimer's**
 - Certain individuals maintain relatively preserved cognitive function even in the presence of significant Alzheimer's pathology.

- Researchers have identified differences in energy-related cellular processes within the brains of these individuals.
- These findings may offer insights into the following areas:
 - Protective mechanisms, cognitive resilience, and potential therapeutic targets.
- However, further research is necessary to elucidate these mechanisms.
- **Inherited Genetic Risk** - Researchers established connections between the following elements:
 - Inherited genetic risk, particular genes, and specific cell types.
- The study mapped genetic influences that affect the activity of over **14,000 genes**.



- **Significance** - These findings may facilitate the identification of the following:
 - Genes associated with disease
 - Cell populations that are particularly vulnerable
 - Relevant molecular pathways
 - Potential targets for therapeutic intervention

Reference

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