



# Influence of Y Chromosome on Cancer Outcomes

**For Prelims:** [Colorectal Cancer](#), [DNA](#), [T cell](#), [Biomarker](#), Chromosomes.

**For Mains:** Impact of Y Chromosome on Cancer Outcomes.

## Why in News?

Recent studies have provided insights into the **influence of the Y chromosome on cancer outcomes**, highlighting the **greater vulnerability of males to certain types of cancer**.

- These studies shed light on the role of the Y chromosome in **colorectal and bladder cancer**, revealing key genetic mechanisms that contribute to tumour progression, **immune response**, and clinical prognosis.

## What is Colorectal and Bladder Cancer?

- **About Cancer:**
  - Cancer is a complex and broad term used to **describe a group of diseases characterised by the uncontrolled growth and spread of abnormal cells in the body**.
    - These abnormal cells, **known as cancer cells**, have the ability to invade and destroy healthy tissues and organs.
  - In a healthy body, **cells grow, divide, and die in a regulated manner**, allowing for the normal functioning of tissues and organs.
    - However, in the case of cancer, certain genetic mutations or **abnormalities disrupt this normal cell cycle**, causing cells to divide and grow uncontrollably.
    - These cells can form a mass of tissue called a tumor.
- **Colorectal Cancer:**
  - **Colorectal Cancer, also known as colon cancer or rectal cancer**, refers to cancer that **develops in the colon or rectum**, which are parts of the large intestine.
    - It is **one of the most common types of cancer worldwide**.
  - It typically **begins as small, noncancerous growths called polyps on the inner lining of the colon or rectum**. Over time, some of these polyps can develop into cancer.
- **Bladder Cancer:**
  - Bladder cancer refers to the **development of cancerous cells** in the tissues of the urinary bladder, the **organ responsible for storing urine**.

## What are the Major Findings of the Study?

- **Role of the Y Chromosome in Colorectal Cancer in Males:**
  - Studies investigated the sex differences in colorectal cancer using a **mouse model driven by a known oncogene called KRAS**.
    - They found that male mice had a higher frequency of metastasis (spread of cancer cells from the original site of a tumor to other parts of the body) and worse survival

than female mice, **mirroring the outcomes seen in humans.**

- They also identified an **upregulated gene on the Y chromosome that contributes to colorectal cancer in males** by driving tumour invasion and aiding immune escape.
  - **It leads to the activation of genes that promote cell migration, invasion, and angiogenesis** (the formation of new blood vessels), as well as the suppression of genes that stimulate immune response.

**Note:** KRAS is a gene that encodes a protein called **Kirsten Rat Sarcoma Viral Oncogene Homolog**. It is a **proto-oncogene**, meaning that it has the **potential to become a cancer-causing gene**.

▪ **Impact of Y Chromosome Loss on Bladder Cancer Outcomes:**

- In a separate investigation, the **impact of Y chromosome loss on bladder cancer outcomes was observed.**
  - Loss of the Y chromosome in cells happens as men age, enabling cancer cells to evade their immune system
- Loss of the Y chromosome was **found to be associated with poor diagnosis and more aggressive tumours.**
  - The condition **generated a more immunosuppressive tumour** microenvironment by altering the expression of genes involved in immune regulation.
  - For instance, **loss of the Y chromosome increased the expression of PD-L1**, a protein that **inhibits T cell activation and allows tumour cells to evade immune attack.**
- However, **Y chromosome loss was found to enhance the response to Anti-PD1 Checkpoint Blockade Therapy**, suggesting a potential treatment avenue for a subset of bladder cancers.
  - This suggests that loss of the **Y chromosome may be a biomarker for selecting patients** who may benefit from this treatment.

## What is a Chromosome?

- **About:** A chromosome is a thread-like structure of **nucleic acids and protein** found in the nucleus of most living cells, **carrying genetic information in the form of genes.**
  - Chromosomes are **essential for cell division, growth and development, and inheritance.**
  - In humans, **each cell normally contains 23 pairs of chromosomes, for a total of 46.**
- **Structure:** Chromosomes are composed of **DNA molecules** that are tightly wound around proteins called **histones.**
  - This combination of DNA and proteins helps to compact and organise the genetic material.
- **Types:** There are two main types of chromosomes: autosomes and sex chromosomes.
  - **Autosomes:** Autosomes are non-sex chromosomes.
    - In humans, there are 22 pairs of autosomes, numbered from 1 to 22.
    - Autosomes contain genes responsible for determining various traits and characteristics, excluding those related to sex determination.
  - **Sex chromosomes:** Sex chromosomes determine the sex of an individual and are **represented by the letters X and Y.**
    - In humans, **females have two X chromosomes (XX), while males have one X and one Y chromosome (XY).**

## UPSC Civil Services Examination, Previous Year Question (PYQ)

**Q. Which one of the following statements best describes the role of B cells and T cells in the human body?(2022)**

- (a) They protect the environmental allergens. body
- (b) They alleviate the body's pain and inflammation.
- (c) They act as immunosuppressants in the body.
- (d) They protect the body from diseases caused by pathogens.

**Ans: (d)**

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