

# Cancer Biology

## Lecture No. 3

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## Lecture No 3.

# Epidemiology of Cancer

## Lecture's Structure:

Definition of Epidemiology

Cancer is a global problem

Epidemiology identifies causes of cancer

Epidemiological Data for some types of cancer

Role Of Various Factors In The Development  
Of Cancer

Risk Factors

# Epidemiology of Cancer

**Epidemiology** is the study of the patterns, causes, and effects of health and disease conditions in defined populations.

It is the cornerstone of public health, and informs policy decisions by identifying risk factors for disease and targets for preventive medicine.

# Epidemiology of Cancer

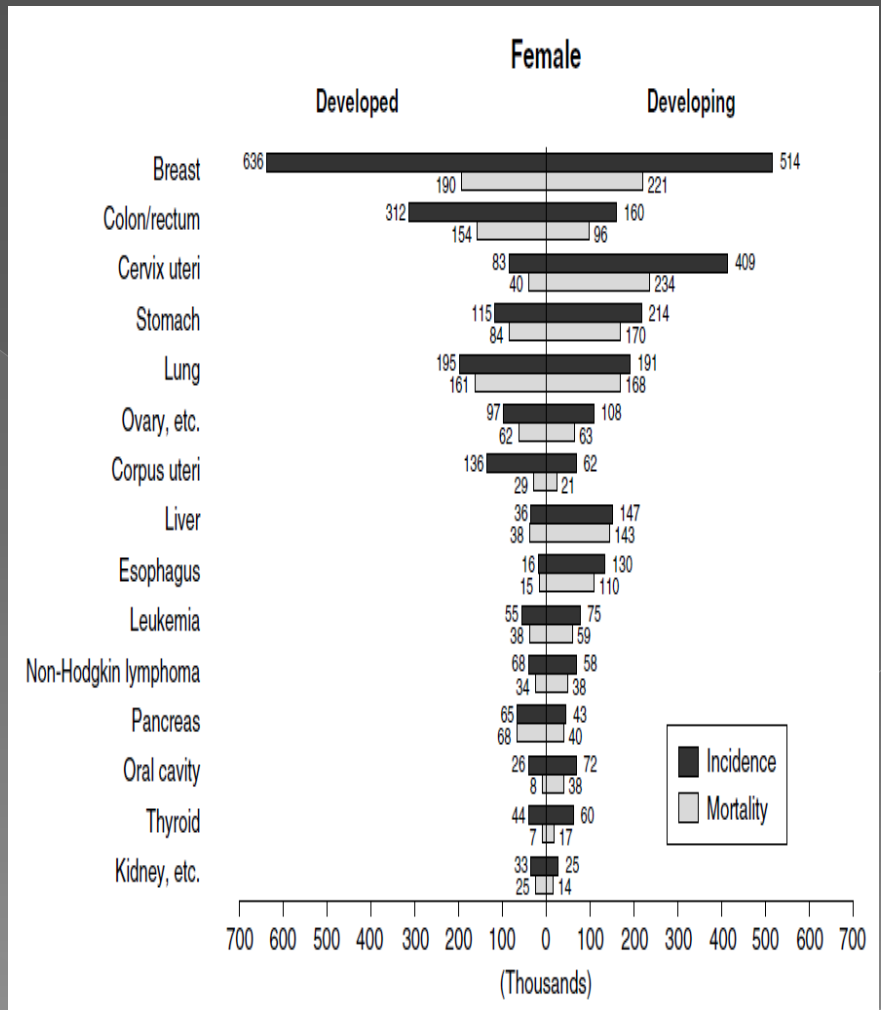
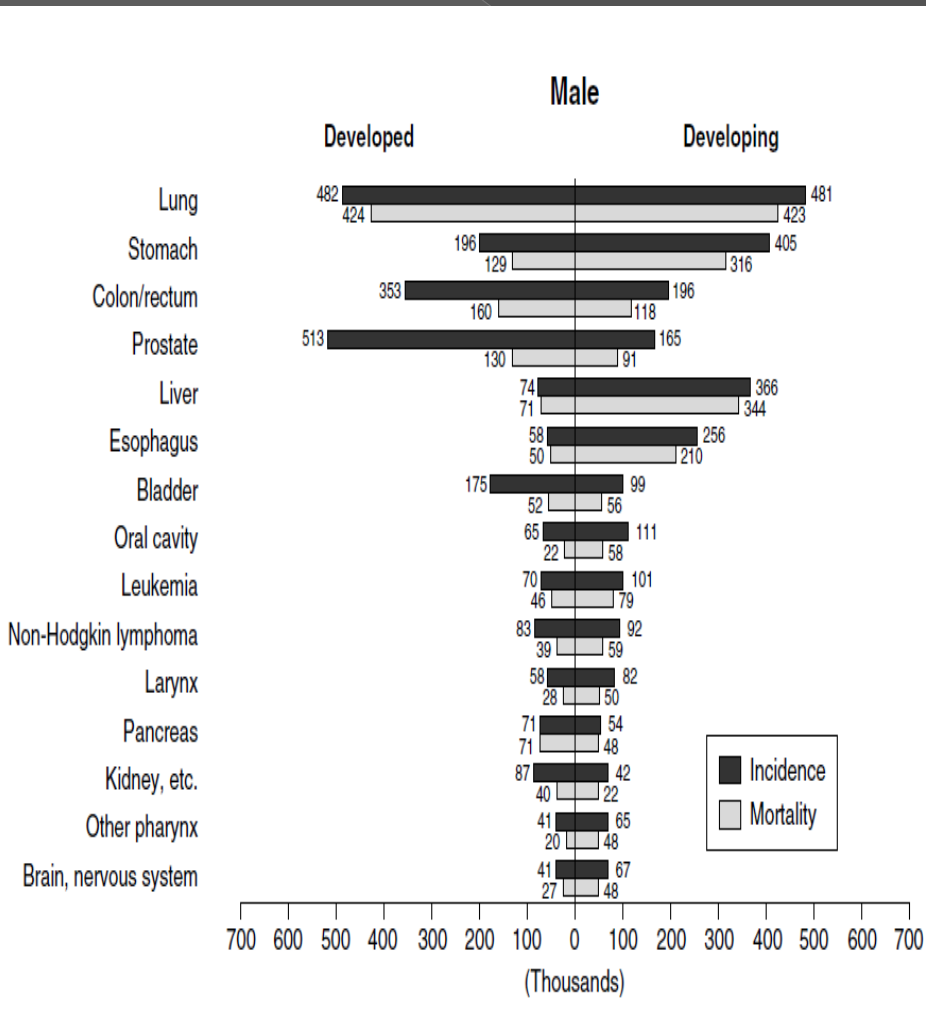
## Cancer Is a Global Problem

The incidence and mortality rates for various cancers are similar, though not identical, among developed countries.

In the developing world, as countries become more westernized and their populations achieve longer life expectancy, cancer rates are increasing.

# Epidemiology of Cancer

## Cancer Is a Global Problem



# Epidemiology of Cancer

## Epidemiology identifies the etiology of cancer

Regional differences in the distribution of various cancers in different regions of the world reflect differing etiologic factors.

### **Examples:**

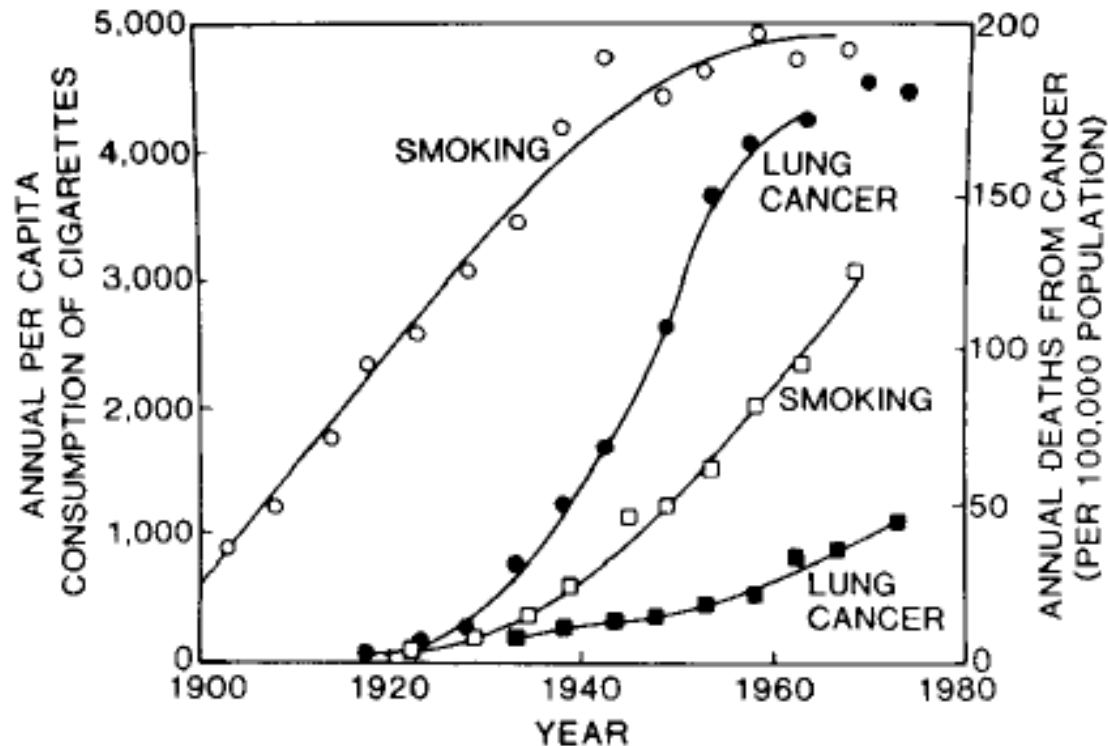
Schistosomiasis infections and bladder cancer in parts of Africa.

Hepatitis B infections in liver cancer in China

# Epidemiology of Cancer

Epidemiological data for some types of cancer

## Lung Cancer and Cigarette Smoking



# Epidemiology of Cancer

## Epidemiological data for some types of cancer

### Breast Cancer

Over 210,000 new cases of invasive breast cancer and over 40,000 deaths.

Although breast cancer is more common in developed Western societies, incidence rates are increasing in the developing world.



# Epidemiology of Cancer

## Epidemiological data for some types of cancer

### Breast Cancer risk factors

Duration of exposure to female hormones

Dietary and low physical activity factors (obesity; high-fat diet).

Ionizing radiation during breast development.

Chronic use of hormone replacement therapy.

Genetic inheritance (family history) of breast cancer such as *brca1*, *brca2*, or *p53* germline mutations.

# Epidemiology of Cancer

## Epidemiological data for some types of cancer

### Colorectal Cancer

Although cancers of the colon and rectum are relatively rare in developing countries, they are the second-most frequent malignancies in the developed world.

This discrepancy appears to be largely due to the conditions of an affluent lifestyle, because the major risk factors are a diet abundant in fat, refined carbohydrates, and animal protein and low in fiber, combined with physical inactivity.

# Epidemiology of Cancer

## Role Of Various Factors In The Development Of Cancer

Incidence rates of migrants changes to match the new location (food intake habits and life styles).

Environmental and lifestyle factors play the predominant role in cancer causation.

Thus a high percentage of cancers are preventable, or at least “delayable.”

# Epidemiology of Cancer

## Role Of Various Factors In The Development Of Cancer

*Table 3–5. Estimated Percentage of Total Cancer Deaths Attributable to Established Causes of Cancer*

| Risk Factor                                  | Percentage |
|--|------------|
| Tobacco                                      | 30         |
| Adult diet and obesity                       | 30         |
| Sedentary lifestyle                          | 5          |
| Occupational factors                         | 5          |
| Family history of cancer                     | 5          |
| Viruses and other biologic agents            | 5          |
| Perinatal factors and growth                 | 5          |
| Reproductive factors                         | 3          |
| Alcohol                                      | 3          |
| Socioeconomic status                         | 3          |
| Environmental pollution                      | 2          |
| Ionizing and ultraviolet radiation           | 2          |
| Prescription drugs and medical procedures    | 1          |
| Salt, other food additives, and contaminants | 1          |

# Epidemiology of Cancer

## Risk factors

Cigarette Smoking (Lung Cancer)

Alcohol (oral and esophageal cancers, liver cancers)

Note: Alcohol appears to be synergistic with tobacco in causing cancers of the mouth, pharynx, larynx, and esophagus, but not that of the lung.

## Mechanisms

(1) a carcinogenic effect of other chemicals such as N-nitrosamines in alcoholic Beverages.

(2) a solvent action that facilitates absorption of carcinogens found in tobacco smoke.

(3) a carcinogenic effect due to acetaldehyde, a major metabolite of ethanol.

# Epidemiology of Cancer

## Risk factors

### Diet

Second leading risk factor after tobacco.

Correlation of obesity with the increased incidence of various cancers such as esophagus, colorectum, breast, endometrium, and kidney.

Differences in cancer rates among various countries

*Table 3–7.* Dietary Risk Factors, Dietary Protective Factors, and Other Major Risk Factors for Common Cancers

| Cancer                             | Dietary and Diet-Related Risk Factors   | Dietary Protective Factors  | Other Major Risk Factors                |
|------------------------------------|---|---|---|
| Oral cavity, pharynx and esophagus | Alcohol<br>Very hot drinks<br>Obesity (adenocarcinoma of the oesophagus)<br>Chinese-style salted fish (nasopharyngeal cancer) | Probably fruit and vegetables                                     | Smoking                                 |
| Stomach                            | Probably high intake of salt-preserved foods and salt   | Probably fruit and vegetables                                     | Infection by <i>Helicobacter pylori</i> |
| Colorectum                         | Obesity<br>Possible red and processed meat  | Probably fruit and vegetables and other plant foods rich in fiber | Sedentary lifestyle                     |
| Liver                              | High alcohol intake<br>Foods contaminated with aflatoxins   | None established  | Hepatitis viruses                       |
| Pancreas                           | None established  | None established  | Smoking                                 |
| Larynx                             | Alcohol   | None established  | Smoking                                 |
| Lung                               | None established  | Possibly fruit & vegetables                                       | Smoking                                 |
| Breast                             | Obesity after menopause<br>Alcohol  | None established  | Reproductive and hormonal factors       |
| Endometrium                        | Obesity   | None established  | Low parity                              |
| Cervix                             | None established  | None established  | Human papillomavirus                    |
| Prostate                           | None established  | None established  | None established                        |
| Kidney                             | Obesity   | None established  | None established                        |

From Key et al.,<sup>68</sup> with permission.

# Epidemiology of Cancer

## Risk factors

### **Sexual Development, Reproductive Patterns, and Sexual Behavior**

The duration of hormonal exposure appears to play a role in the susceptibility to breast cancer in women.

These factors include early age of menarche, delayed age of first pregnancy, and delayed menopause, suggesting longer duration of exposure to hormonal stimulation as an etiologic agent in breast cancer.



# Epidemiology of Cancer

## Risk factors

### Industrial Chemicals and Occupational Cancers

Industrial levels of 4-aminobiphenyl have a higher incidence of bladder cancer

Occupational exposure to asbestos fibers results in a higher incidence of lung cancer, mesotheliomas, gastrointestinal tract cancers, and laryngeal cancers.

Leukemia in workers exposed to benzene

# Epidemiology of Cancer

## Risk factors

**Herbicides**

**Air and Water Pollutants**

**Radiation**

sunlight as a cause of skin Cancer

Evidences:

1. Skin cancer occurs primarily on exposed areas.
2. Skin cancer is relatively rare in dark skinned races in whom skin pigment filters out UV radiation.
3. Skin cancer frequency and the intensity of solar radiation are related.
4. Skin cancer can be induced in laboratory animals by repeated exposure to UV radiation.
5. The inability to repair DNA damaged by UV radiation is associated with skin cancer

# Epidemiology of Cancer

## Risk factors

**Ionizing Radiation** increased incidence of leukemia among radiologists was recognized.

**Chernobyl disaster**

# Epidemiology of Cancer

## Risk factors

### Infection

Cancer is not an infectious disease

Infection with certain viruses probably acts in concert with other carcinogenic agents or processes.

# Epidemiology of Cancer

## Risk factors

### GENETIC FACTORS IN CANCER

**Somatic mutations**

**Germline mutations**

Inherited Cancers (1% to 2%, of total cancers)

The probability that an individual carrying the retinoblastoma gene will develop a tumor is about 95% and an average of three to four tumors occur in such a gene carrier.

Table 3–9. Inherited Cancer Syndromes Caused by a Single Genetic Defect\*

| Syndrome                        | Gene           | Location      | Cancer Site and Cancer Type   |
|---------------------------------|----------------|---------------|---|
| Familial retinoblastoma         | <i>RB1</i>     | 13q14         | Retinoblastoma, osteosarcoma  |
| Multiple endocrine neoplasia II | <i>RET</i>     | 10q11         | Medullary thyroid carcinoma, pheochromocytoma   |
| Multiple endocrine neoplasia I  | <i>MEN1</i>    | 11q13         | Adrenal, pancreatic islet cells   |
| Neurofibromatosis type I        | <i>NF1</i>     | 17q11         | Neurofibromas, optic gliomas, pheochromocytoma  |
| Neurofibromatosis type II       | <i>NF2</i>     | 22q2          | Bilateral acoustic neuromas, meningiomas, cerebral astrocytomas                             |
| Bloom syndrome                  | <i>BLM</i>     | 15q26         | Leukemia, lymphoma  |
| Familial adenomatous polyposis  | <i>APC</i>     | 5q21          | Colorectal, thyroid   |
| Von Hippel-Lindau               | <i>VHL</i>     | 3p25          | Renal cell carcinoma, pheochromocytoma  |
| Familial Wilm's tumor           | <i>WT1</i>     | 11q           | Wilms tumor (kidney)  |
| Xeroderma pigmentosum           | <i>XP(A–D)</i> | 9q,3p,19q,15p | Basal cell carcinoma, squamous cell carcinoma, melanoma (skin)                              |
| Fanconi anemia                  | <i>FAC</i>     | 16q, 9q, 3p   | Acute leukemia  |
| Li-Fraumeni syndrome            | <i>p53</i>     | 17p13         | Breast and adrenocortical carcinomas, bone and soft-tissue sarcomas, brain tumors, leukemia |
| Cowden syndrome                 | <i>PTEN</i>    | 10q22         | Breast, thyroid   |
| Gorlin syndrome                 | <i>PTCH</i>    | 9q31          | Basal cell carcinoma  |
| X-linked proliferative disorder | <i>XLP</i>     | Xq25          | Lymphoma  |
| Peutz-Jeghers syndrome          | <i>LKB1</i>    | 19p           | Breast, colon   |
| Ataxi telangiectasia            | <i>ATM</i>     | 11q22         | Leukemia, lymphoma  |

*Table 3–10. High-risk Susceptibility Genes and Their Chromosomal Location\**

| Gene             | Location | Associated Tumors                        |
|------------------|----------|--|
| <i>BRCA1</i>     | 17q      | Breast, ovary, colon, prostate           |
| <i>BRCA2</i>     | 13q      | Breast, ovary, pancreas, prostate        |
| <i>p16 INK4A</i> | 9p       | Melanoma, pancreas                       |
| <i>CDK4</i>      | 6q       | Melanoma, other tumors (rarely)          |
| <i>hMLH1</i>     | 3p       | Colorectal, endometrial, ovarian cancer  |
| <i>hMSH2</i>     | 2p       | Colorectal, endometrial, ovarian cancer  |
| <i>hMSH6</i>     | 2p       | Colorectal, endometrial, ovarian cancer  |
| <i>PMS1</i>      | 2q       | Colorectal cancer, other tumors (rarely) |
| <i>PMS2</i>      | 7p       | Colorectal cancer, other tumors (rarely) |
| <i>HPC2</i>      | 17p      | Prostate (rarely)                        |

QUESTIONS