

26<sup>th</sup> lecture:

# Cancer Epidemiology

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Objectives:

- Students should be able to:
  - Appreciate the historical perspective of cancer control
  - Explain the Global impact of cancer
  - Identify the most prevalent cancers world wide
  - Identify the leading causes of cancer deaths
  - Understand the cancer control continuum and explain its implication to public health
  - Explain important factors and trends affecting cancer control and directions for future research



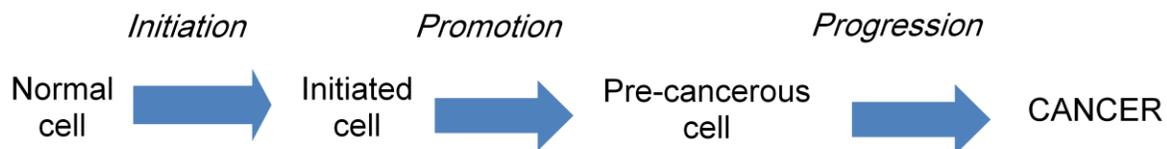
## What is cancer?

- Definition:

"Cancer is a generic term for a group of more than 100 diseases that can affect any part of the body." Other terms used are malignant tumors and neoplasm. (WHO)

Basically we have normal cells. Then something happens to these cells affecting its proliferation so precancerous cells arise then they progress to cancer. This is at the molecular level.

## Biologic Basis for Cancer Control



## Cancer history

Human cancer is probably as old as the human race.

It is obvious that cancer did not suddenly start appearing after modernization or industrial revolution.

### Ancient Egypt (3000 BC-1500 BC) 1

- The oldest known description of human cancer is found in 7 Egyptian papyri (ورق البردي "يستخدم من قِبَل الفراعنة") written between 3000-1500 BC.
- Two of them, known as the "Edwin Smith" and "George Ebers" papyri, contain details of conditions that are consistent with modern descriptions of cancer.

### Hippocrates (460-370 B.C) 1

- He is the first person to clearly recognize difference between **benign and malignant** tumors
- His writings include description of cancers involving **various body sites**

### Hippocrates (460-370 B.C) 2

- Hippocrates noticed that **blood vessels** around a malignant tumor looked like the **claws of crab**.
- He named the disease **karkinos** (the Greek name for crab) to describe tumors. In English this term translates to **carcinoma or carcinoma**.

## Global Burden of Disease

- Total of 58 million deaths worldwide in 2005, cancer accounts for 7.6 million (or 13%) of all deaths
- Main types:
  - lung (1.3 million deaths/year);
  - Stomach (almost 1 million deaths/year);
  - Liver (662,000 deaths/year);

- Colon (655,000 deaths/year) and
- Breast (502,000 deaths/year).

**Cancer incidence for the regions of the world, 2002 estimates**

	New cases of number	% of total
Africa	649,800	6
Asia	4,876,900	45
Europe	2,820,800	26
Latin America & the Caribbean	833,000	8
Northern America	1,570,500	14
Oceania	111,500	1
Developed Countries	5,016,100	46
Developing Countries	5,827,500	54
World	10,862,500	100

High

**This was mentioned in the notes, wasn't mentioned by the doctor**

Each year 10.9 million people worldwide are diagnosed with cancer, because of the size of its population most of these people (45%) are in Asia

"Trends in Cancer Incidence and Mortality"....IARC...compile data from cancer registries around the world

Clues into etiology difference between Hungary vs. Thailand

quality of data

quality of medical care and diagnosis

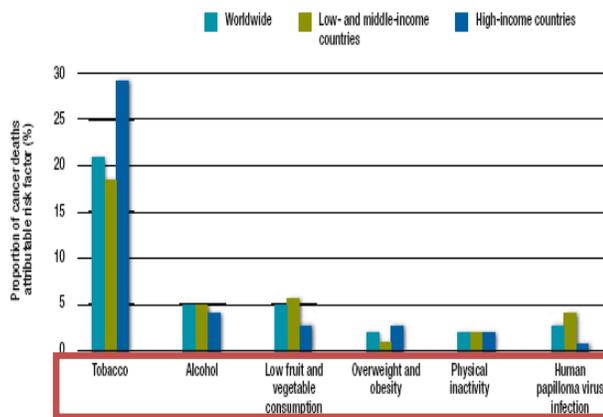
age distribution (cancer is a disease of old age)

lifestyle (etiological)

population composition ( ethnicity/race)

**Developing countries have higher incidence of cancer compared to developed countries**

**Figure 1.** Contribution of selected risk factors to all cancer deaths, worldwide, in high-income countries, and in low- and middle-income countries

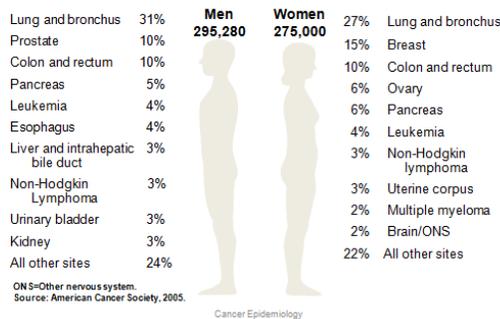


Source: based on data from Danaei et al., 2005.

The most important risk factors for cancer globally are:

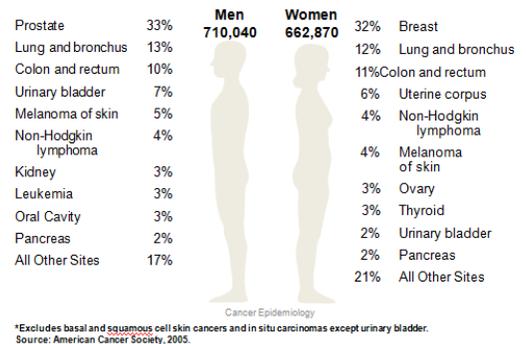
- 1- Tobacco
- 2- Alcohol
- 3- Low fruit and vegetables consumption
- 4- Physical activity
- 5- HPV (Human papilloma virus)

**Estimated Cancer Deaths**



It is said the prostate cancer equals all cancers in males combined; same applies to breast cancer in females.

**Estimated New Cancer Cases**



Regional and Local data (GCC)

#1 is breast cancer in females  
 In males non hodgkin lymphoma

Figure 1.6 ▼  
 Most common cancers among nationals of the GCC States, 1998-2007.

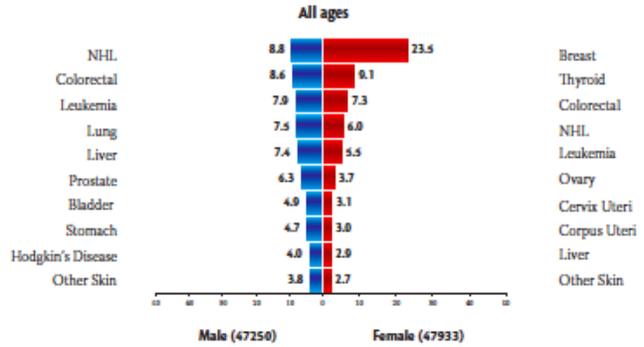


Figure 1.4 ▼  
 Average annual Age Specific Incidence Rates of all Cancers in the GCC States, 1998-2007: Male.

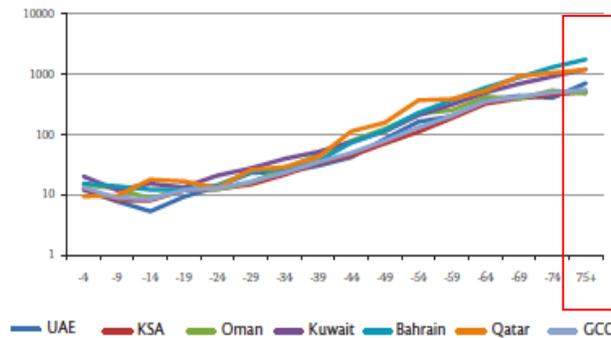


Figure 1.5 ▲  
 Average annual Age Specific Incidence Rates of all Cancers in the GCC States, 1998-2007: Female.

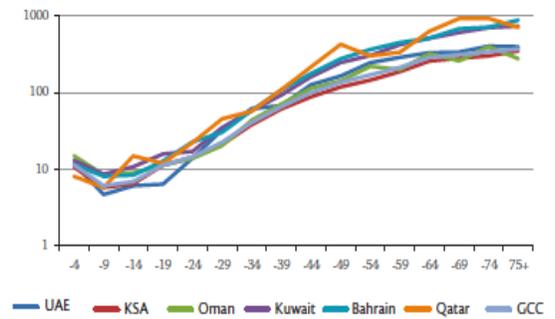
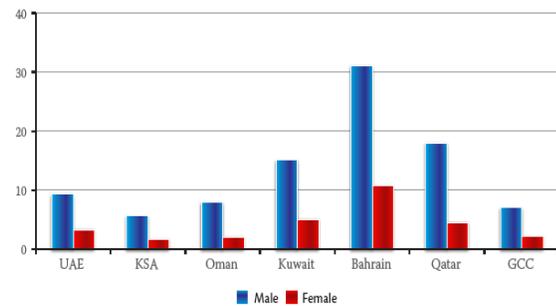
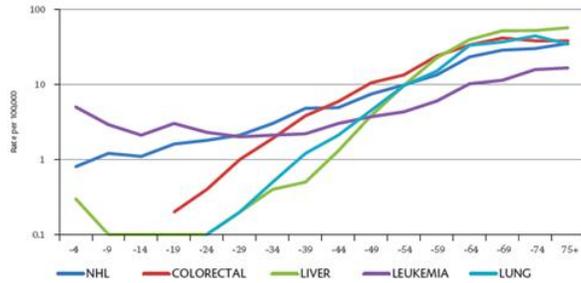


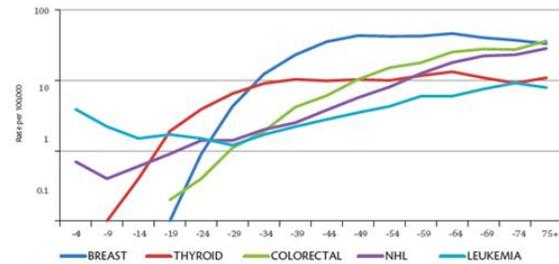
Figure 1.37 ▼  
 Age Standardized Incidence Rate (ASIR) of Lung cancer in the GCC States, 1998-2007.



\*The age of developing cancer in the GCC is approximately 49 in males. However, it is much younger in females.



Average annual Age Specific Incidence Rates of Most Common Cancers in Saudi Arabia, 1998-2007: Male.



Average annual Age Specific Incidence Rates of Most Common Cancers in Saudi Arabia, 1998-2007: Female.

## Cancer Epidemiology Concepts

### Methods of Cancer Epidemiology

- **Descriptive Studies**
  - Incidence, mortality, survival
  - Time Trends
  - Geographic Patterns
  - Patterns by Age, Gender, SES, Ethnicity
- **Analytic Studies**
  - Cross-sectional
  - Case-control
  - Cohort

### Rates:

- Incidence
- Prevalence
- Specific
- Crude
- Adjusted/Standardized
- SMR/SIR

#### This was mentioned in the notes, wasn't mentioned by the doctor

- Incidence: # of new cancers occurring in a particular amount of time...per 100000 or per  $1 \times 10^6$
- Prevalence: # of cases that exist at a given time
- Specific: age, gender, race
- Crude: not adjusted: look at stuff from Epi I regarding adjusted...
- Adjusted/Standardized: usually for US, use US population
- SMR/SIR: standard mortality ratios/standard incidence ratios...SMR=200...2 fold increase of disease compared to the standard population.

**Sources:**

- US SEER Registry System (SEER): Surveillance, Epidemiology, and End Results: <http://seer.cancer.gov/>
  - IARC International Registries
  - State/Hospital Registries
  - Etiologic Clues
    - “Alert” Clinician
    - Experimental Studies
- \*See the last page

**Known Risk Factors for Cancer**

- Smoking
- Dietary factors
- Obesity
- Exercise
- Occupation
- Genetic susceptibility
- Infectious agents
- Reproductive factors
- Socioeconomic status
- Environmental pollution
- Ultraviolet light
- Radiation
- Prescription Drugs
- Electromagnetic fields

**Cancer Epidemiology****Identified Associations**

- Tobacco & Lung Cancer
- Asbestos & Lung Cancer
- Leather Industry & Nasal Cancer
- Dyes & Bladder Cancer
- Ionizing Radiation & Many Cancers
- DES & Vaginal Adenocarcinoma
- EBV & Burkitt’s Lymphoma
- HPV & Cervical Cancer

**Prevention & Control****Comprehensive Approach**

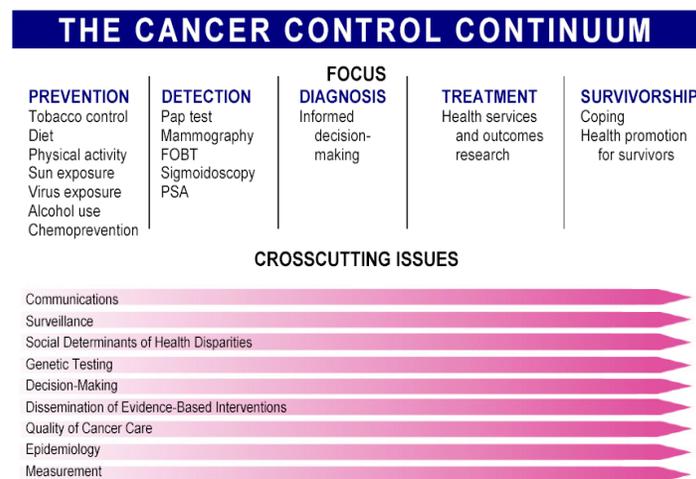
- Integrated coordinated approach is needed to reduce cancer incidence, morbidity, disability and mortality through promotion, prevention, early detection, management, rehabilitation, palliative care
- This involved combined work of public, private as well as civil society agencies

### Primary Prevention (Risk Factor Control)

- **Cancer education & legislation**
- **Tobacco / alcohol** prevention and cessation
- **Diet:** high fiber, low fat, fruits & vegetables
- **Weight** control
- **STI** prevention and control
- Monitoring exposure to **sunlight / radiation** (sun blocks)
- **RF** control (within/outside workplace)
- Lowest **estrogen** dose, upon prescription

### Secondary Prevention

- **Cancer registration** (hospital-based, population-based)
- **Early detection / screening:** best during pre-invasive (in-situ) or pre-malignant stages. Examples: cervical, breast, prostate, colon, oral, skin, testis, etc
- **Management:** multi-modal: surgical, chemotherapy, radiotherapy, pain therapy



### Lung Cancer

- Risk factors
  - Cigarette smoking, environmental exposures, tuberculosis
- Detection/Prevention
  - Reduce exposure to tobacco smoke

### Breast Cancer

- Risk Factors

- Age, family history, biopsy, breast density, early menstruation, obesity after menopause, recent use of oral contraceptives, hormone therapy, late or no children, alcohol, breast feeding, exercise
- Early Detection
  - Mammography and clinical breast exam every year after age 40 (ACS)

### Prostate Cancer

- Risk factors
  - Age, ethnicity, family history, dietary fat?, weight?
- Early detection/prevention >50yrs old
  - PSA blood test/yr
  - Digital rectal exam/yr

### Colorectal Cancer

- Risk factors
  - Age, family history, smoking , alcohol, obesity, exercise, high fat diet/red meat
- Early Detection/Prevention
  - 4 modalities recommended for people age 50 and older
    - Fecal occult blood test (FOBT) every year
    - Flexible sigmoidoscopy every 5 years
    - Colonoscopy every 10 years
    - Double-contrast barium enema every 5 years

## References

- Adami HO, Hunter D, Trichopoulos D. Textbook of cancer epidemiology. 2<sup>nd</sup> edition. Oxford: Oxford University Press, 2008.
- Dennis LK, Lynch CF, Smith EM. Cancer. In: Wallace/Maxcy-Rosenau-Last Public Health & Preventive Medicine. 15<sup>th</sup> edition. New York: McGraw, 2009.
- Brownson RC, Joshi C. Cancer. In: Chronic disease epidemiology and control. 3<sup>rd</sup> edition. Washington DC: American public health association, 2010.
- Boffetta P, La Vecchia C. Neoplasms. In: Detels R, Beaglehole R, Lansang MA, Gulligord M. Oxford textbook of public health. 5<sup>th</sup> edition. Oxford: Oxford University Press.
- International agency for research on cancer. <http://www.iarc.fr/>
- Centers for disease control and prevention. [www.cdc.gov](http://www.cdc.gov)
- GCC and KSA national cancer registry. <http://bportal.kfshrc.edu.sa/wps/portal/bportal/KFCC>
- American cancer society. <http://www.cancer.org/>

- This was mentioned in the notes, wasn't mentioned by the doctor
- The Surveillance, Epidemiology, and End Results (SEER) Program of the [National Cancer Institute \(NCI\)](#) is an authoritative source of information on cancer incidence and survival in the United States. SEER currently collects and publishes cancer incidence and survival data from population-based cancer registries covering approximately 26 percent of the US population. SEER coverage includes 23 percent of African Americans, 40 percent of Hispanics, 42 percent of American Indians and Alaska Natives, 53 percent of Asians, and 70 percent of Hawaiian/Pacific Islanders. (Details are provided in the table: [Number of Persons by Race and Hispanic Ethnicity for SEER Participants](#).) The [SEER Program registries](#) routinely collect data on patient demographics, primary tumor site, tumor morphology and stage at diagnosis, first course of treatment, and follow-up for vital status. The SEER Program is the only comprehensive source of population-based information in the United States that includes stage of cancer at the time of diagnosis and patient survival data.
- SEER began collecting data on cancer cases on January 1, 1973, in the states of [Connecticut](#), [Iowa](#), [New Mexico](#), [Utah](#), and [Hawaii](#) and the metropolitan areas of [Detroit](#) and [San Francisco-Oakland](#). In 1974-1975, the metropolitan area of [Atlanta](#) and the 13-county [Seattle-Puget Sound](#) area were added. In 1978, 10 predominantly black [rural counties in Georgia](#) were added, followed in 1980 by the addition of American Indians residing in [Arizona](#). Three additional geographic areas participated in the SEER program prior to 1990: New Orleans, Louisiana (1974-1977, rejoined 2001); New Jersey (1979- 1989, rejoined 2001); and Puerto Rico (1973-1989). The National Cancer Institute also funds a cancer registry that, with technical assistance from SEER, collects information on cancer cases among Alaska Native populations residing in [Alaska](#). In 1992, the SEER Program was expanded to increase coverage of minority populations, especially Hispanics, by adding [Los Angeles County](#) and four counties in the [San Jose-Monterey area](#) south of San Francisco. In 2001, the SEER Program [expanded coverage](#) to include [Kentucky](#) and the remaining counties in California ([Greater California](#)); in addition, [New Jersey](#) and [Louisiana](#) once again became participants. For the expansion registries (Kentucky, Greater California, New Jersey, and Louisiana), NCI funds are combined with funding from the [Centers for Disease Control and Prevention \(CDC\)](#) through the [National Program of Cancer Registries](#) and with funding from the states.
- NCI staff work with the [North American Association of Central Cancer Registries \(NAACCR\)](#) to guide all state registries to achieve data content and compatibility acceptable for pooling data and improving national estimates. The SEER team is developing computer applications to unify cancer registration systems and to analyze and disseminate population-based data. Use of surveillance data for research is being improved through Web-based access to the data and analytic tools, and linking with other national data sources. For example, a new Web-based tool for public health

officials and policy makers, [State Cancer Profiles](#), provides a user-friendly interface for finding cancer statistics for specific states and counties. This Web site is a joint project between NCI and CDC and is part of the [Cancer Control PLANET](#) Web site which provides links to comprehensive cancer control resources for public health professionals.

- The SEER Program is considered the standard for quality among cancer registries around the world. Quality control has been an integral part of SEER since its inception. Every year, studies are conducted in SEER areas to evaluate the quality and completeness of the data being reported.
- The International Agency for Research on Cancer (IARC) is part of the [World Health Organization](#).

IARC's mission is to coordinate and conduct research on the causes of human cancer, the mechanisms of carcinogenesis, and to develop scientific strategies for cancer control. The Agency is involved in both epidemiological and laboratory research and disseminates scientific information through publications, meetings, courses, and fellowships.