Epidemiology of Chronic Disease

Prof. Ashraf Zaghloul

Definition

Chronic diseases are defined **broadly** as conditions that last **1** year or more and ***require ongoing medical attention*** or ***limit activities of daily living or both***

Epidemiology of Chronic Disease

Originally, epidemiology focused on a single pathogen, a single cause of disease.

The epidemiologist's challenge was to isolate a single bacteria, virus, or parasite.

Types of Disease

There are **4** main types of disease:

1- Infectious diseases,
2- Deficiency diseases,
3- Hereditary diseases (including both genetic and non-genetic hereditary diseases), and
4- Physiological diseases.

Types of Disease

Diseases can also be classified in other ways, such as

Communicable versus **N**on-**C**ommunicable **D**iseases

(NCD)

Types of Disease

Acute versus Chronic

حاد مزمن

Role of epidemiology in chronic disease

1- (SCREENING)

Creating new procedures to use while researching or analyzing data related to a variety of different chronic diseases.

2- (RESEARCH)

Implementing new research methods. Testing samples or analyzing testing results.

Role of epidemiology in chronic disease

3- (Health Education)

Behavioural change of the community towards the risk factors of the chronic disease.

4- (Prevention)

Utilizing the pharmaceutical products for prevention (vaccines, sera, medications, etc;.)

Causation in Epidemiology

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What do we mean by a cause? السبب

It is tempting to think that a **cause** is a single condition or event that inevitably leads to a particular effect or outcome;

i.e. there is a one-to-one relationship such that wherever or whenever the cause occurs the effect will follow.

What do we mean by a cause? السبب

Things are not so simple and everyday causal phenomena are ***rather more complicated*** than they might seem at first

What do we mean by a cause? السبب

Although we use analytic epidemiology to search for causes of disease, this is not a straightforward matter.

Not all associations between exposures and disease are causal relations

William Farr

(30 November 1807 – 14 April 1883)

was a British epidemiologist, regarded as one of the founders of medical statistics.

*William Farr promoted the idea that some diseases, especially chronic diseases, have a **multifactorial etiology***

What do we mean by a cause? السبب

Because the **Agent-Host-Environment Model** does not work well for some non-infectious diseases (Chronic Disease), several other models have been proposed.

Newer models are based on the multi-factorial nature of causation in many diseases.

What do we mean by a cause? السبب

The accepted models of disease causation ALL require the precise interaction of factors and conditions before a disease will occur.

Rothman's Component Cause and Causal Pie Model

Jack Rothman, American sociologist.

(Rothman's Model 1976).

What do we mean by a cause? السبب

For simplicity, we will define a **cause** of disease as a **factor** (*characteristic, behavior, event, etc.*) that influences the occurrence of disease.

An increase in the factor leads to an increase in disease.

Reduction in the factor leads to a reduction in disease.

Definition

A cause is

‘an event, condition or characteristic [or a combination of these factors] that plays an essential role in producing an occurrence of the disease’.

Classification of Causal Relationships

A sufficient cause كاف is a cause (factor, or more usually a combination of several factors) the effect (disease, health event) will always occur.

A component cause مكون is a factor that contributes towards disease causation but is not sufficient to cause disease on its own.

Classification of Causal Relationships

A necessary cause ضروري the factor (cause) must be present for the effect (disease, health event) to occur; however, a necessary cause may be present without the disease occurring.

(Example the specific infectious agent).

Classification of Causal Relationships

Risk factor:

If the factor is present, the **probability** that the effect will occur is increased.

Directly causal association:

The factor exerts its effect in the absence of intermediary factors (intervening variables).

Classification of Causal Relationships

Indirectly causal association: The factor exerts its effect through intermediary factors.

Noncausal association: The relationship between two variables is statistically significant, but no causal relationship exists because the ***temporal relationship is incorrect*** (the presumed cause comes after, rather than before, the effect of interest) or because ***another factor is responsible for the presumed cause and the presumed effect***.

Example

Quitting smoking is associated with an increased incidence of lung cancer

However, it is unlikely that quitting causes lung cancer or that continuing to smoke would be protective.

What is much more likely is that smokers having early, undetectable or undiagnosed lung cancer start to feel sick because of their growing malignant disease.

This sick feeling prompts them to stop smoking and thus, temporarily, they feel a little better. When cancer is diagnosed shortly thereafter, it appears that there is a causal association, but this is false.

The cancer started before the quitting was even considered

The temporality of the association precludes يمنع causation

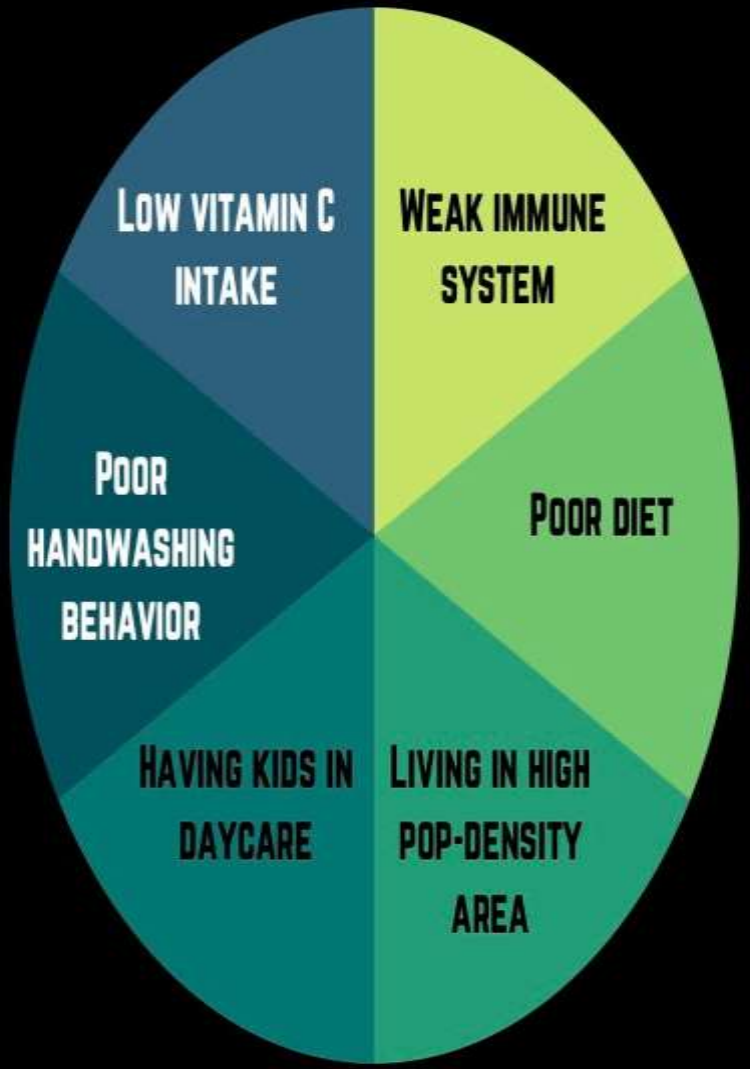
If a statistically significant association is found between two variables, but some other factor is responsible for both the presumed cause and the presumed effect, the association is **NOT** causal.

Causal Pie

Illustrates the factors that act to cause disease as pieces of a pie, **the whole pie making up the sufficient cause for a disease**

A disease may have more than one sufficient cause, with each sufficient cause being composed of several factors

Example: A Common Cold Causal Pie



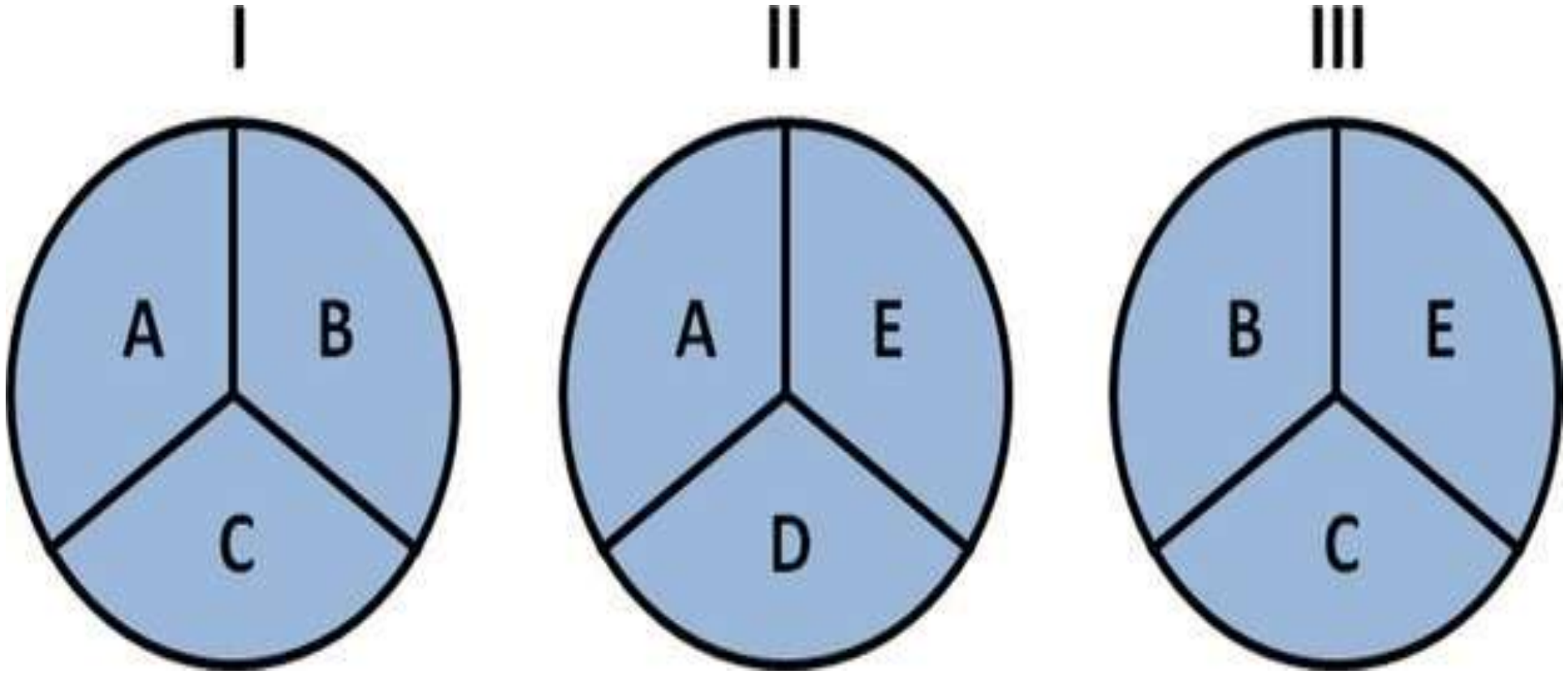
Causal Pie

The factors represented by the pieces of the pie in this model are called **component causes**

They include intrinsic host factors, as well as the agent and the environmental factors of the agent-host-environment model.

A single component cause is **rarely** a sufficient cause by itself

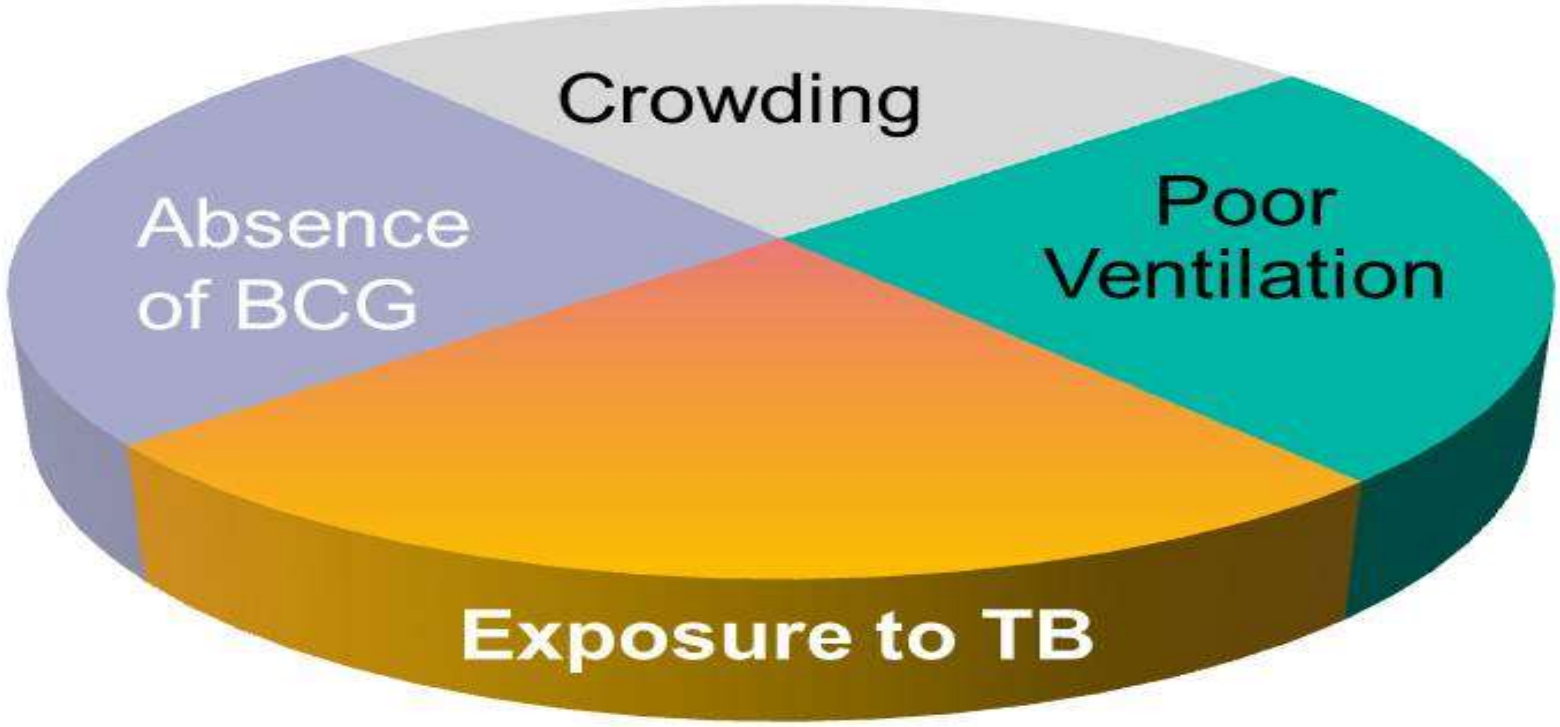
A Hypothetical Disease



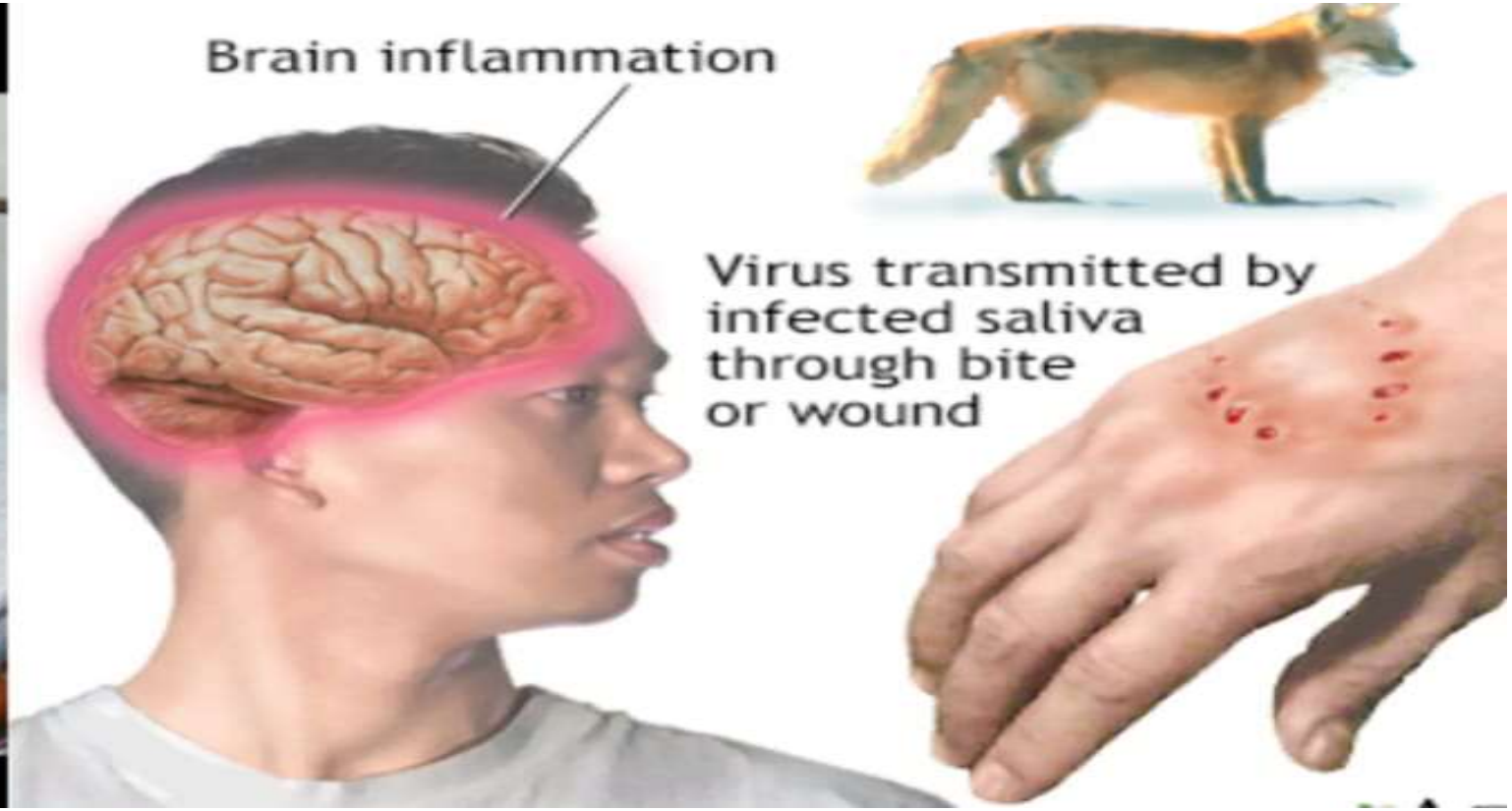
Example: Death from a head on car collision

A= car hits another vehicle
B= poor road design
C= high speed
D= slippery road
E = tired driver
F = low visibility
G= poor light
H= faulty breaks
I = inexperienced driver
J = unrestrained driver

Exposure to *Mycobacterium tuberculosis* is **necessary** for **tuberculosis** to develop, but it is not sufficient, because not everyone infected develops disease.



On the other hand, exposure to a large innoculum of **rabies virus** is a **sufficient** cause in a **susceptible person**, since clinical rabies and death will almost inevitably occur.



Example

Even exposure to a highly infectious agent such as **measles virus** does not invariably result in measles disease—the host must be **susceptible**; other host factors may also play a role

At the other extreme, an agent which rarely causes disease in healthy persons may be pathogenic when other conditions are right. ***Pneumocystis carinii*** is one such organism, harmlessly colonizing some healthy persons.

BUT causing potentially lethal pneumonia *in persons whose immune systems have been weakened by human immunodeficiency virus* (HIV).

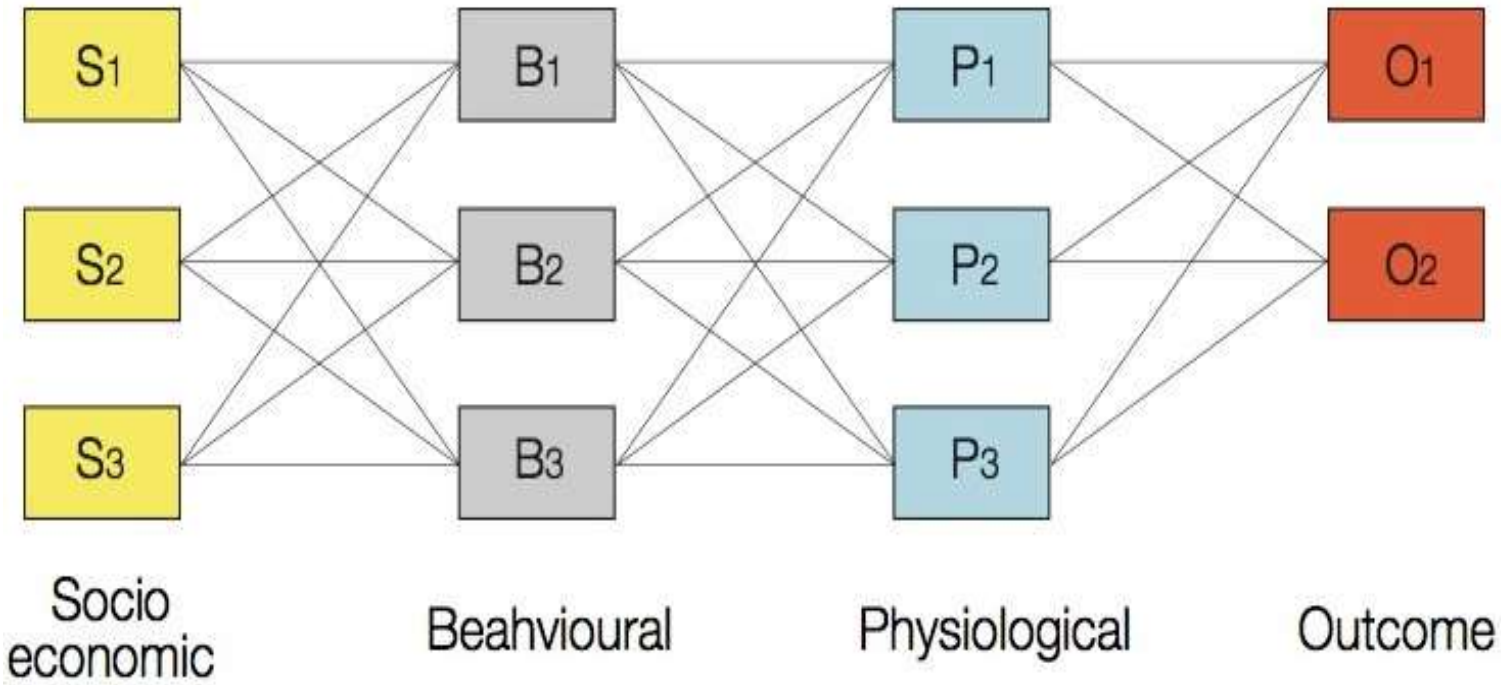
Presence of *Pneumocystis carinii* organisms is therefore a necessary but not sufficient cause of pneumocystis pneumonia.

Murray's Hierarchical Web of causes

Christopher Murray has deviced an alternative, hierarchical model of causation that encompasses

- **socio-economic** (distal) causes,
- **behavioural** causes and finally
- **physiological/biological** (proximal) causes

Murray's hierarchical web of causes



Murray CJL & Lopez AD *Epidemiology* 10: 594 (1999)

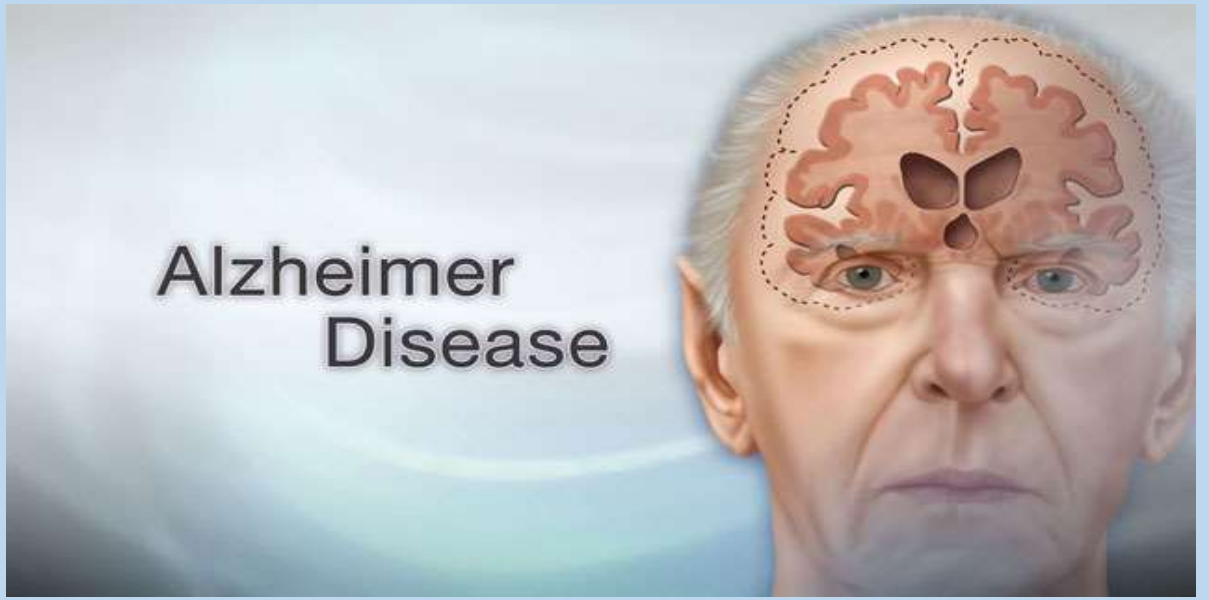
Example

Web causation for **heart disease** would include:

- Stress (type A personality) (Physiological)
- Obesity (Behaviour)
- Urban / wealthy (Social)
- Hypertension (lifestyle, social, behaviour)

Global Burden of Disease عبء المرض (GBD)

Prof. Christopher Murray, is the architect and co-author of the original Global Burden of Disease عبء المرض (GBD) framework, *a systematic effort to quantify the comparative magnitude of health loss due to diseases, injuries, and risk factors by age, sex, and geography over time.*



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How do you measure the burden of disease?

The overall burden of disease is assessed using the **disability-adjusted life year (DALY)**, a time-based measure that combines ***years of life lost*** due to premature mortality (YLLs) and years of life lost due to ***time lived in states of less than full health***, or years of healthy life *lost due to disability* (YLDs).

DALY = YLL + YLD

Example

Ischaemic Heart Disease

Country X	Country Y
15 DALY	40 DALY

Ischaemic Heart Disease

Country X	Country Y
5 DALY	5 DALY

What are the leading causes of the global burden of disease?

At a global level, in 2017 more than **60 percent** of the burden of disease results from **non-communicable diseases (NCDs)**, with **28 percent** from communicable, maternal, neonatal and nutritional diseases, and just over **10 percent** from injuries

Top 10 global causes of disability-adjusted life years (DALYs) in 2019

- Ischaemic heart disease.
- Stroke.
- Chronic obstructive pulmonary disease.
- Lower respiratory infections.
- Neonatal conditions.
- Trachea, bronchus, lung cancers.
- Alzheimer disease and other dementias.
- Diarrhoeal diseases.

What is the leading cause of disease burden by 2030?

Untreated mental health problems account for 13% of the total global burden of disease.

It is projected that by 2030 **mental health problems (particularly depression)** will be the leading cause of mortality and morbidity globally.

Multifactorial etiology in chronic disease epidemiology

Prevention and control of noninfectious diseases and conditions is often much more complicated than that of infectious diseases

Complexities of Prevention Programs

- The interaction between behavior, environment, genetic, and social risk factors often make prevention efforts complex and sometimes infeasible
- Prevention programs need to be specifically tailored to given societies and cultures
- Despite the complexities of primary prevention, it provides the greatest potential for minimizing public suffering and health-care costs

Disease Prevention and Control

Priorities in disease prevention and control may be determined by the following questions:

1- Which disease, disorder, or condition has the greatest impact on illness, disability, injury, lost work time or school time, unnecessarily using up health resources, rehabilitation costs, causing family disruption, economic impact, and costs?

2- Are special populations or groups of people suffering from exposures to diseases, agents, risk factors, or hazards?

Disease Prevention and Control

3- Which susceptible populations are most likely to respond to prevention, intervention, and control measures?

4- Which risk factors, diseases, agents, or hazards are most likely to respond to control measures?

Disease Prevention and Control

5- Are there diseases, disabilities, injuries, disorders, or conditions that need to be investigated, that are being overlooked, or are not being responded to by other organizations or agencies?

6- Of the many risk factors, diseases, agents or hazards, which would yield the greatest improved health status, social impact, and economic benefit to the target population?

Disease Prevention and Control

7- Of the many risk factors, diseases, agents, or hazards, which are of national, regional, state, or local concern and of major priority for an epidemiological investigation?

REMEMBER

In practice, when considering causes of disease we mostly find ourselves dealing with component causes.

We do not have to eliminate all components of a particular cause in order to prevent disease due to that cause.

If any one of them is identified and removed, then we will prevent cases of disease due to sufficient causes that contained in the component.

Thank You