

Environmental Noise and Disease – Basic Facts and Methods

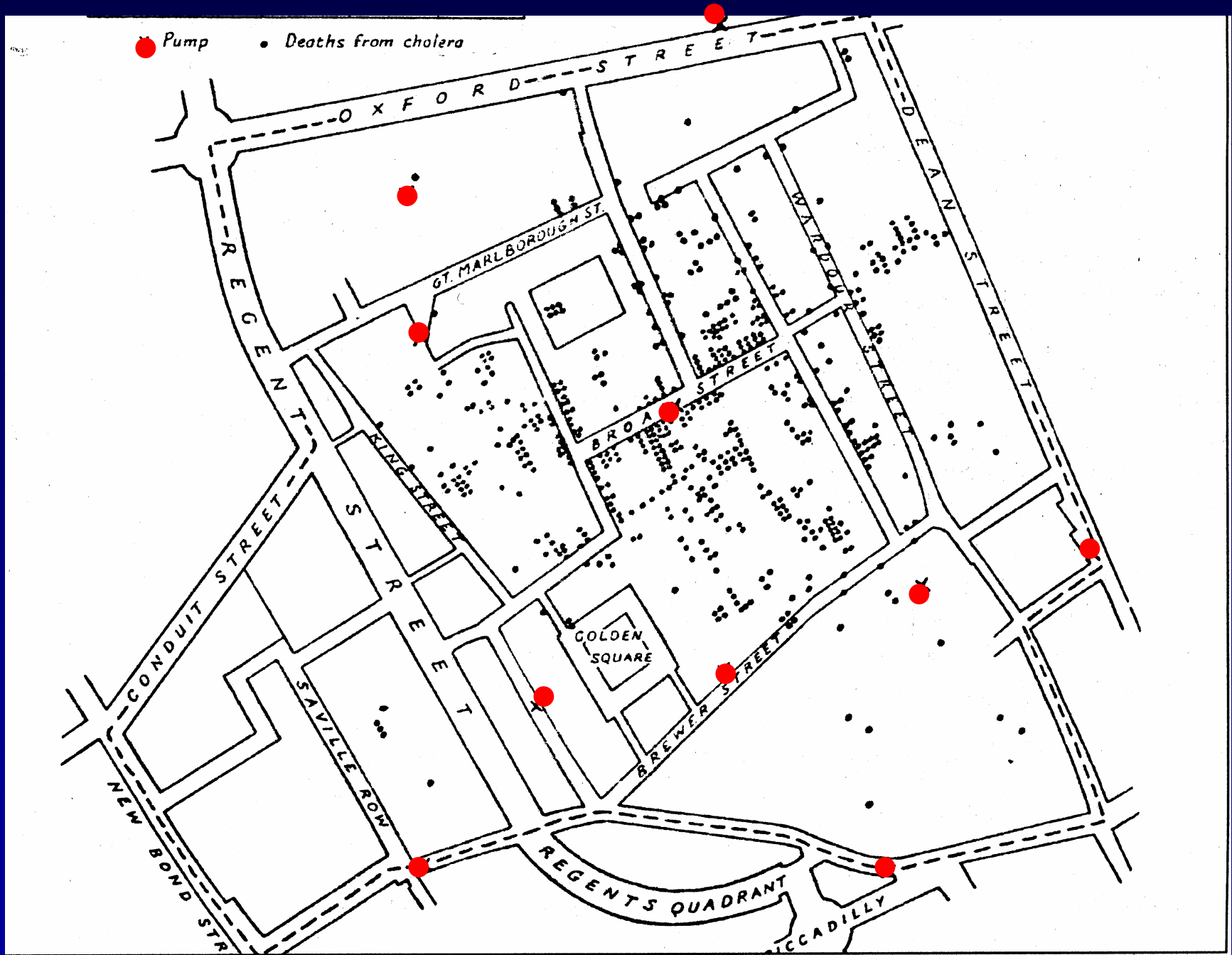
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Fields of Epidemiology

- ❖ Investigate Distribution of Diseases in the Population
- ❖ Determine Factors which Cause Disease
(= Risk Factors)
- ❖ Estimate Trends in Disease Occurrence
(Time, Region)
- ❖ Describe Health of Populations Using Routine Data
- ❖ Investigate Preventive Methods

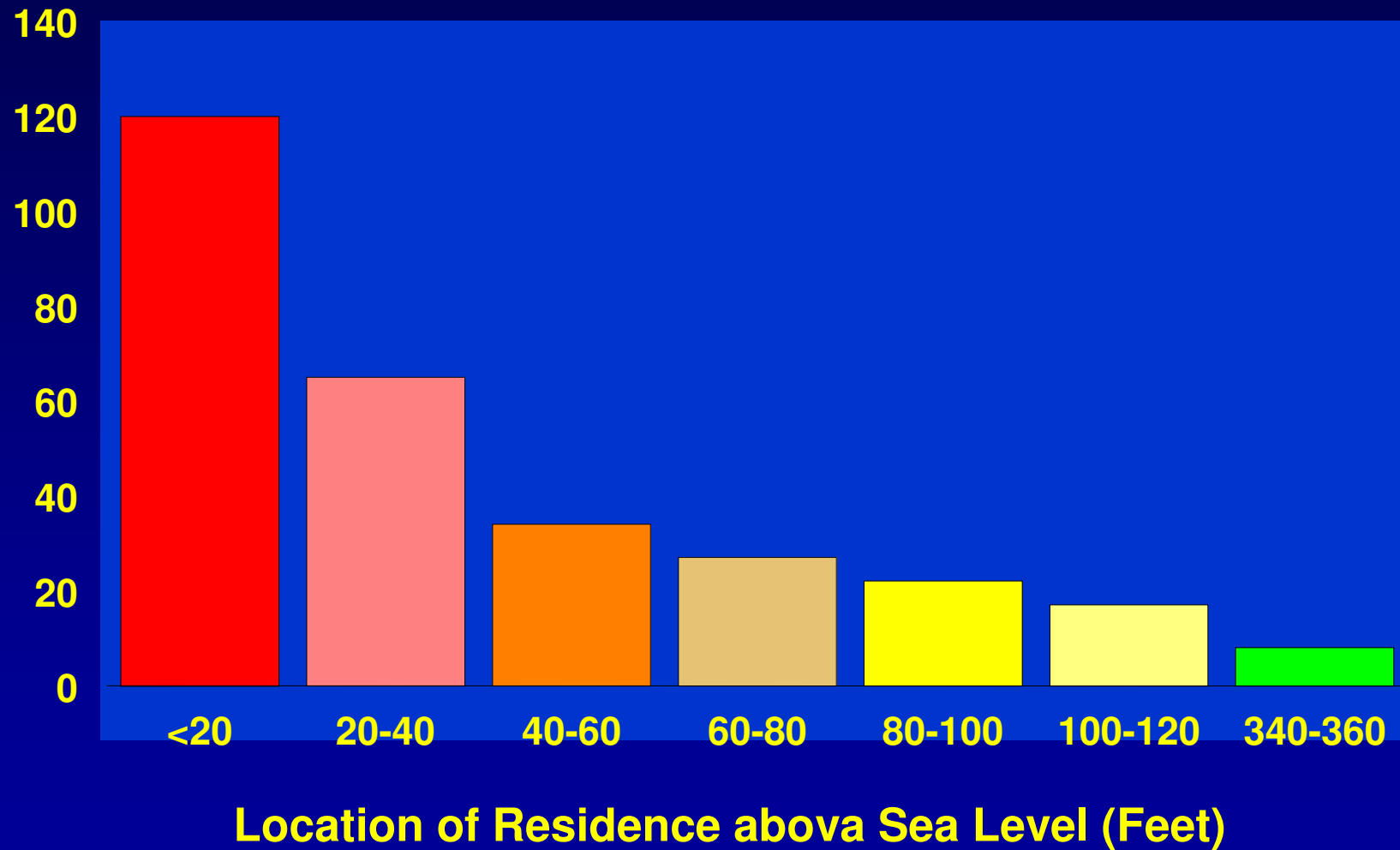
Diseases Linked to Environmental Noise

- ❖ Hearing Loss
- ❖ Sleep Disturbances
- ❖ Depression
- ❖ High Blood Pressure
- ❖ Heart Attacks (Myocardial Infarction)

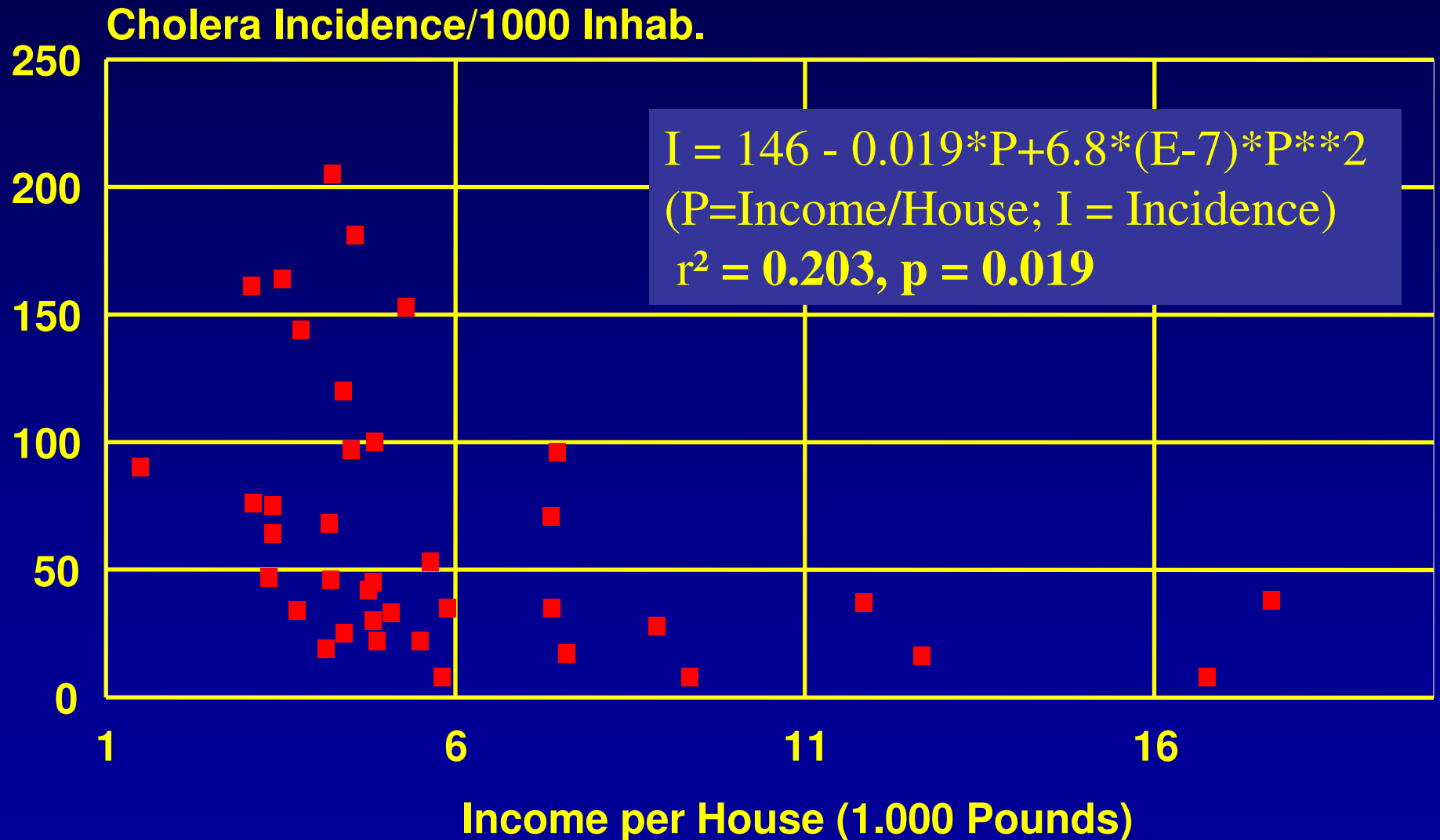


An epidemiological milestone: the Broad Street pump was identified by John Snow as the source of a cholera outbreak

Deaths due to Cholera per 10.000 (1848/49) London and Location of Residences above Sea Level



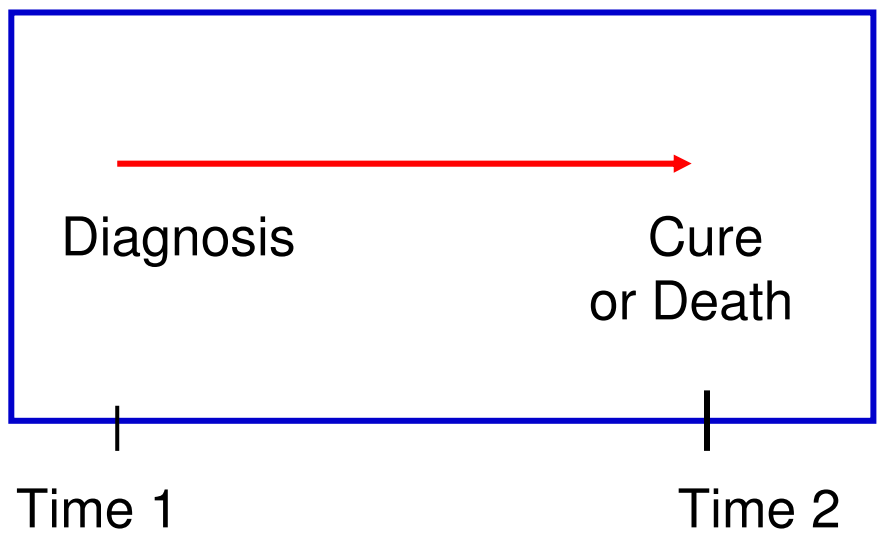
John Snow: Incidence of Cholera in London and Average Household Income in 38 Boroughs



- The cause of Cholera was polluted water.
Cholera has one major risk factor – Vibrio Cholerae.
Cholera certainly was due to environmental problems.
- Nowadays there are many environmental problems and diseases mostly have more than one single cause.

In the vicinity of a large airport physicians claim that their patients are suffering from high blood pressure – presumably due to air traffic noise.

How would **YOU** investigate this problem ?



Prevalence:

of diseased persons at specific point of time

Prevalence rate:

prevalence/number of all persons in specific region

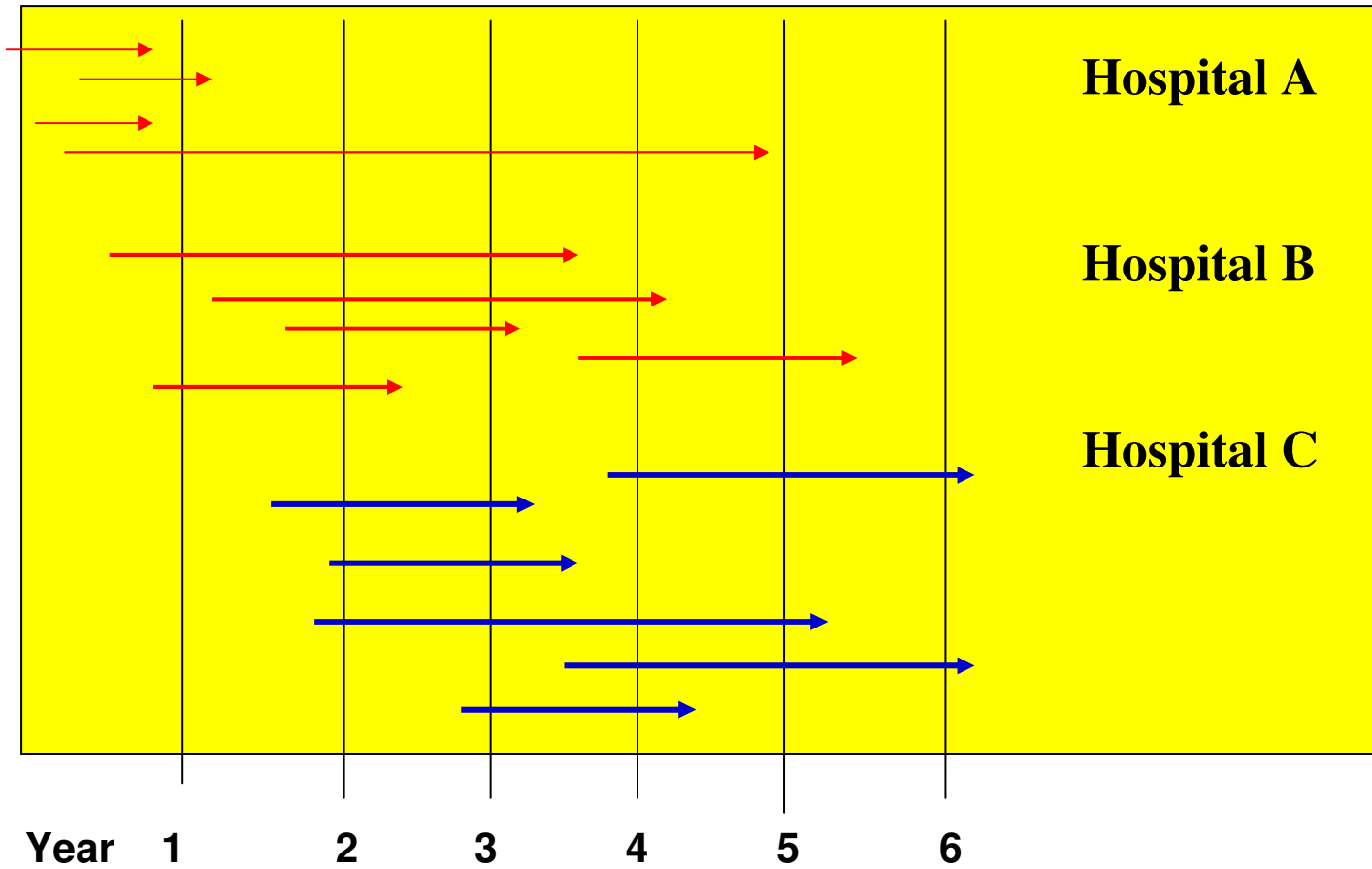
Incidence:

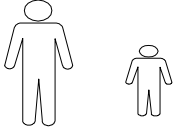

of persons falling ill during specified time period

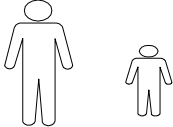

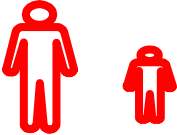

Incidence rate:

incidence/number of persons in specified region
during specified time period

Population-Frame



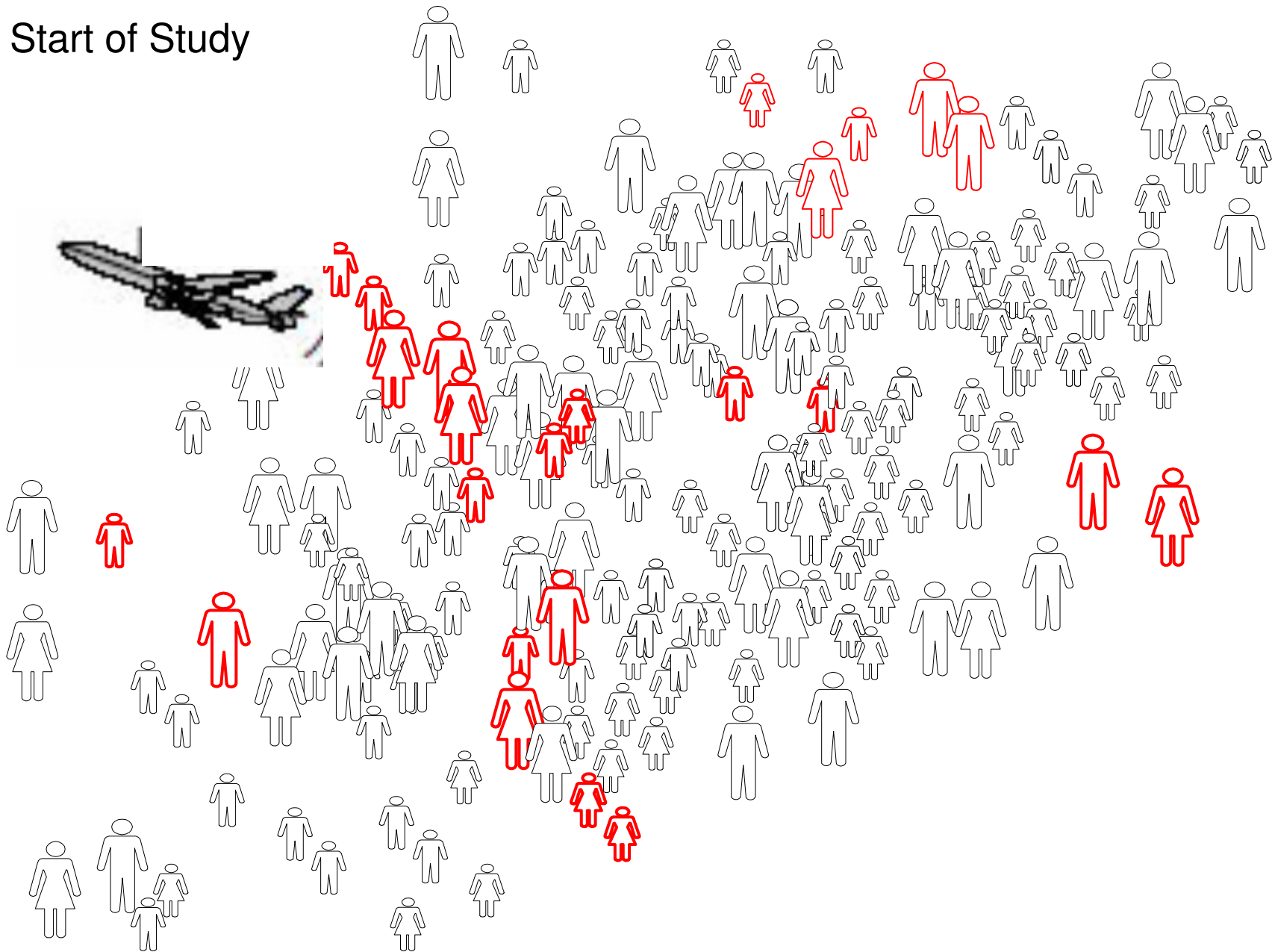
Population	Male	Female
...not noise sensitive		

Population	Male	Female
...not noise sensitive		
...noise sensitive		

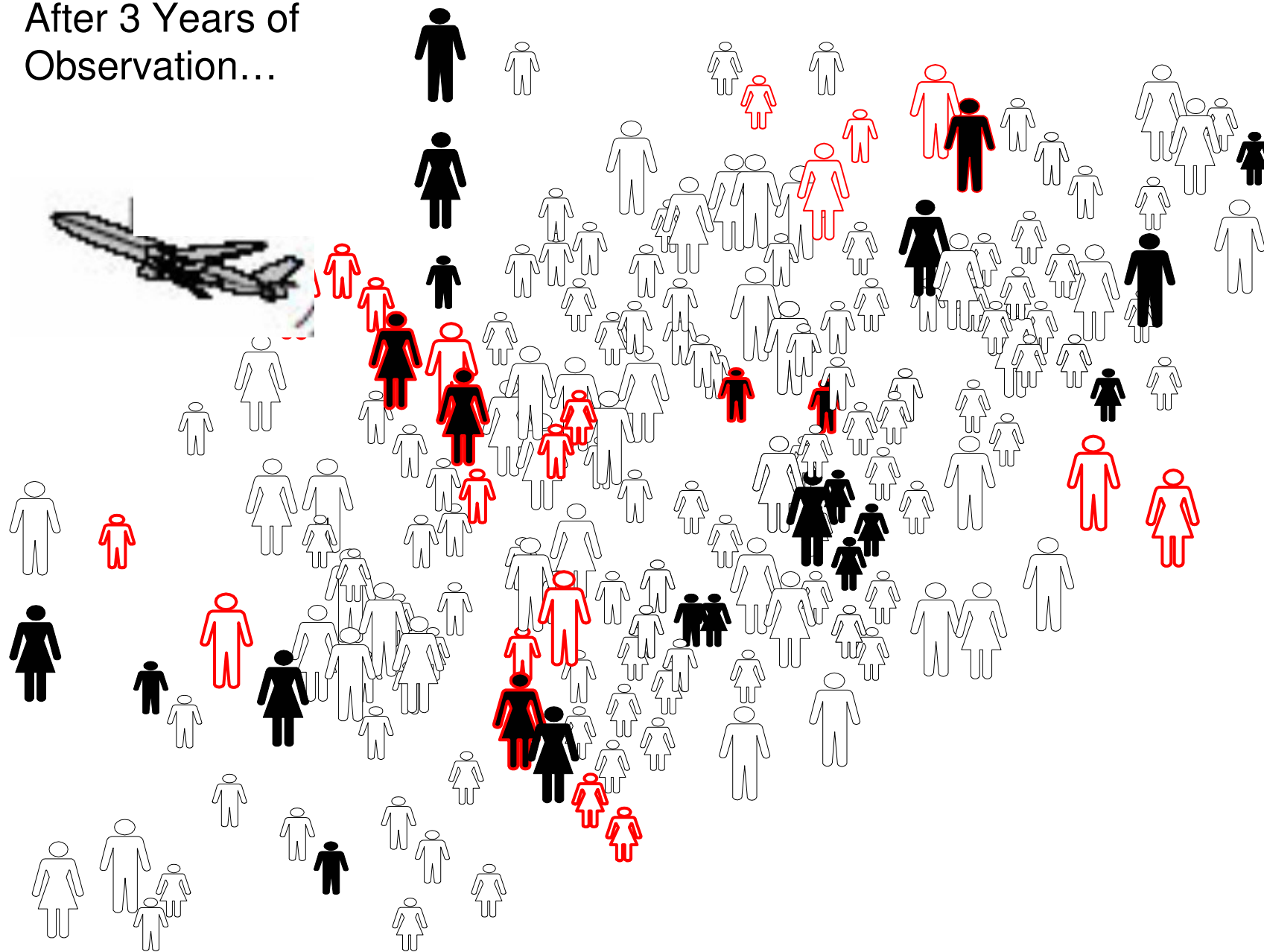


Population	Male	Female
...not noise sensitive		
...noise sensitive		
... not noise sensitivehypertensive		
...noise sensitivehypertensive		

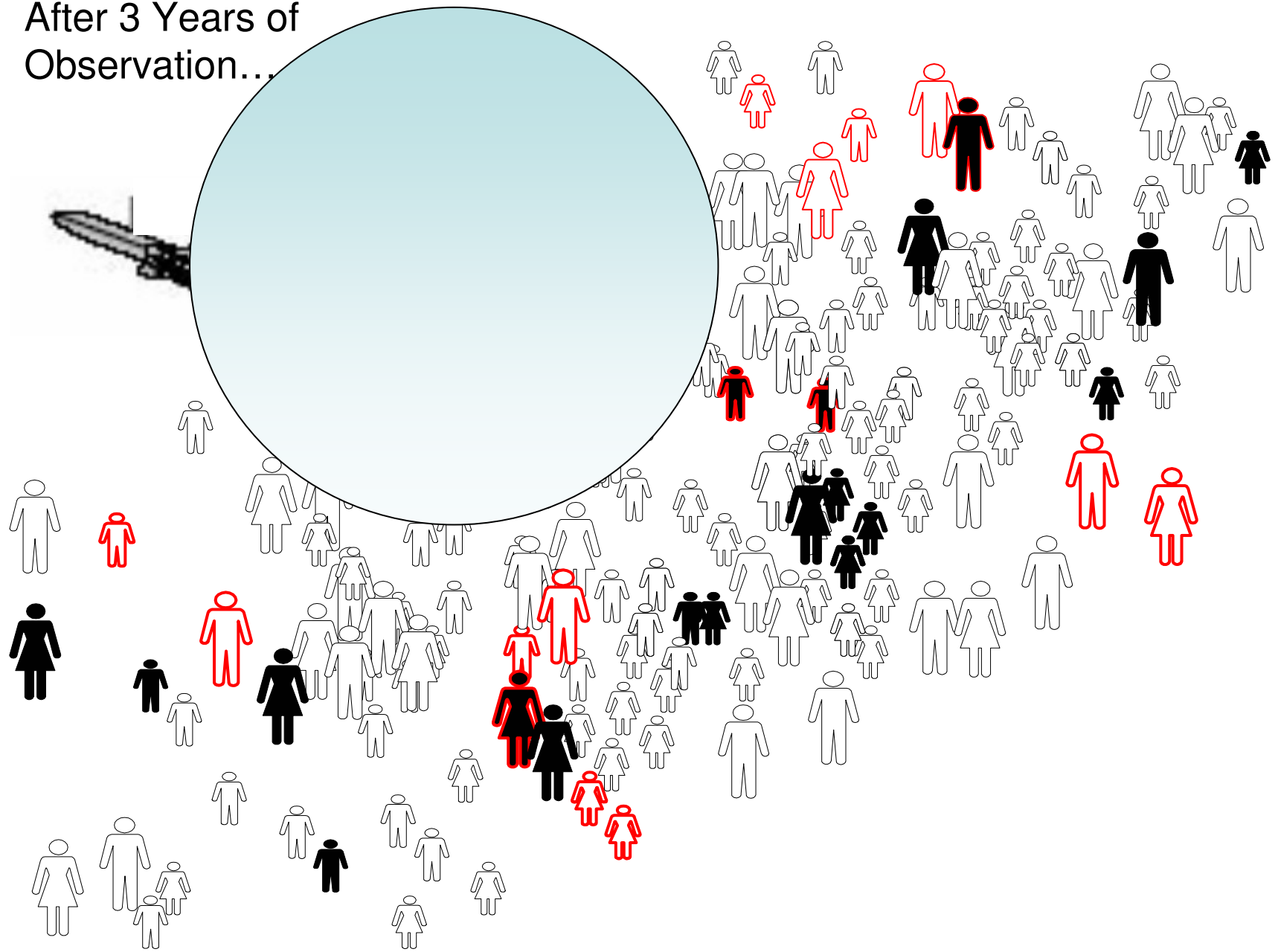
Start of Study



After 3 Years of Observation...



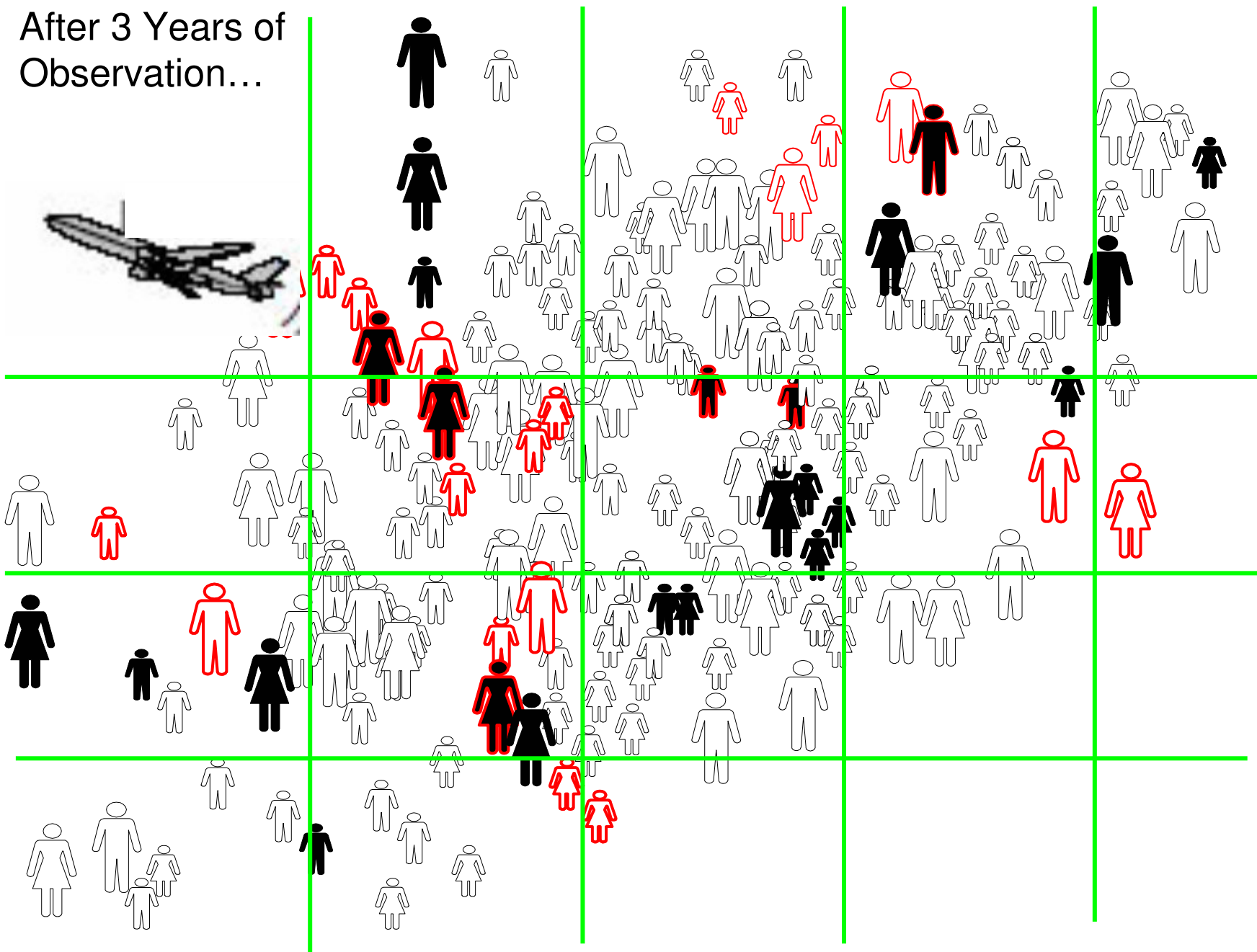
After 3 Years of
Observation...



What is wrong with this design ?

Could you investigate the whole population ?

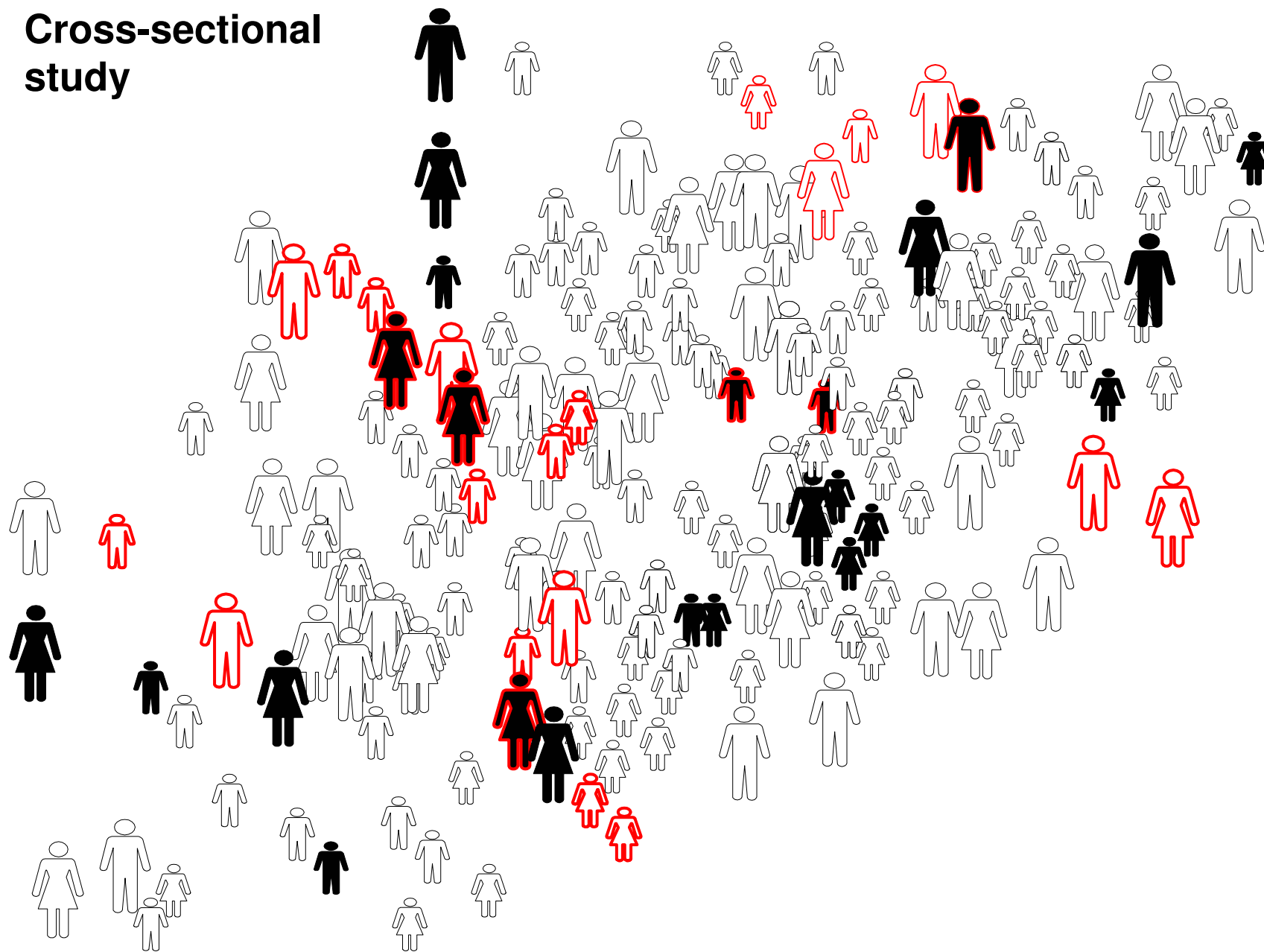
After 3 Years of Observation...



Methods of investigation

- ❖ **Cross-sectional study**
= one-time examination of a population
- ❖ **Cohort study**
= observation of a population over time
- ❖ **Case-control study**

Cross-sectional study



Investigate

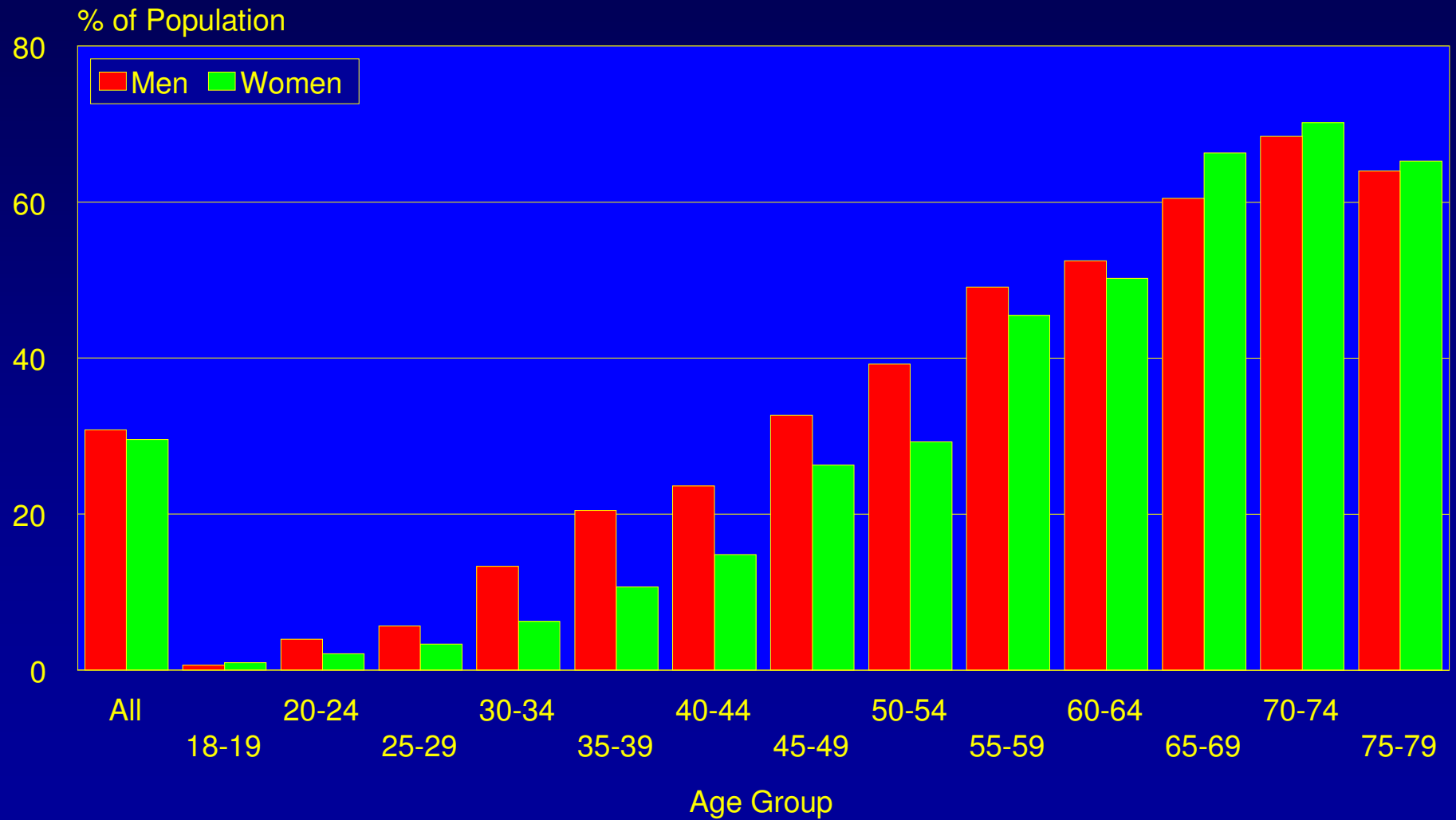
- ✓ Socio-demographic data
- ✓ Health behaviour
- ✓ Past and present diseases
- ✓ Use of therapeutic drugs
- ✓ Examination of physical risk factors
 - overweight
 - blood pressure
 - blood lipids
 - others

National Health Examination Survey 1998
- a representative examination and enquiry of
the German population

Organized by Robert Koch Institute and
Infratest Health Research

- **7.124 Men and women, 18-79 years old,**
Germans and German speaking foreigners
- **Random sample drawn from 120 sampling points**
in 113 cities and communities
- **Response rate: 61.4%**
(with short questionnaire 77.8%)
- **Standardized interviews and examinations**

High Blood Pressure (>94 /158 mm Hg or on Antihypertensive Drugs)



Why is high blood pressure important for public health?

1. It is of high prevalence in the general population
2. Its causes are known
 - Obesity
 - Salt intake
 - Lack of physical activity
 - Alcohol consumption
3. It leads to major diseases:
 - >> heart attack (myocardial infarction)
 - >> insufficiency of the heart muscle
 - >> stroke
 - >> kidney failure
 - >> peripheral arterial disease
 - >> cerebrovascular disease >> dementia
4. It is preventable

Major cause of high blood pressure:

Overweight

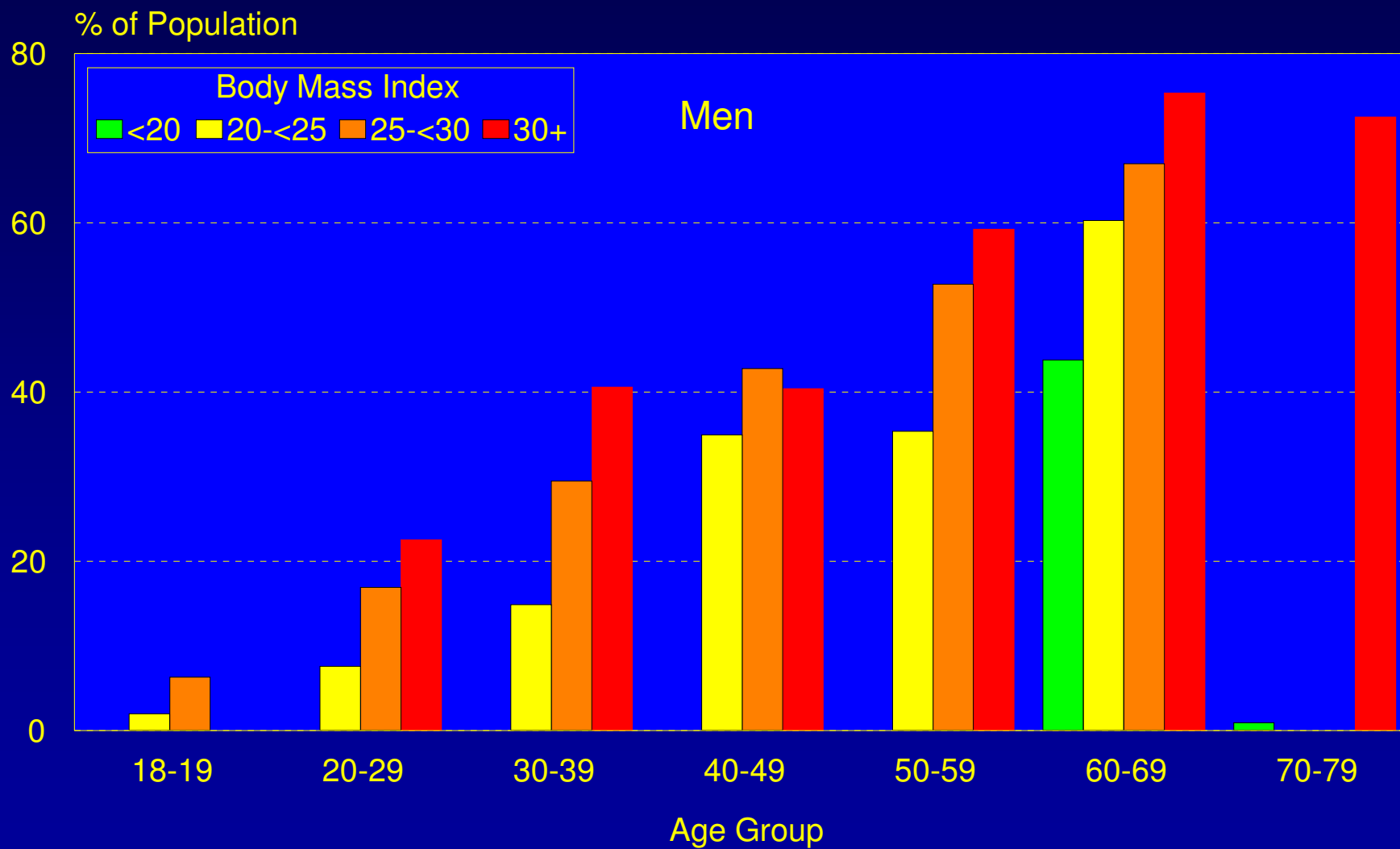
Determination by Body Mass Index (BMI):

$$\text{BMI} = \text{Body weight (kg)} / \text{Height (m)}^2$$

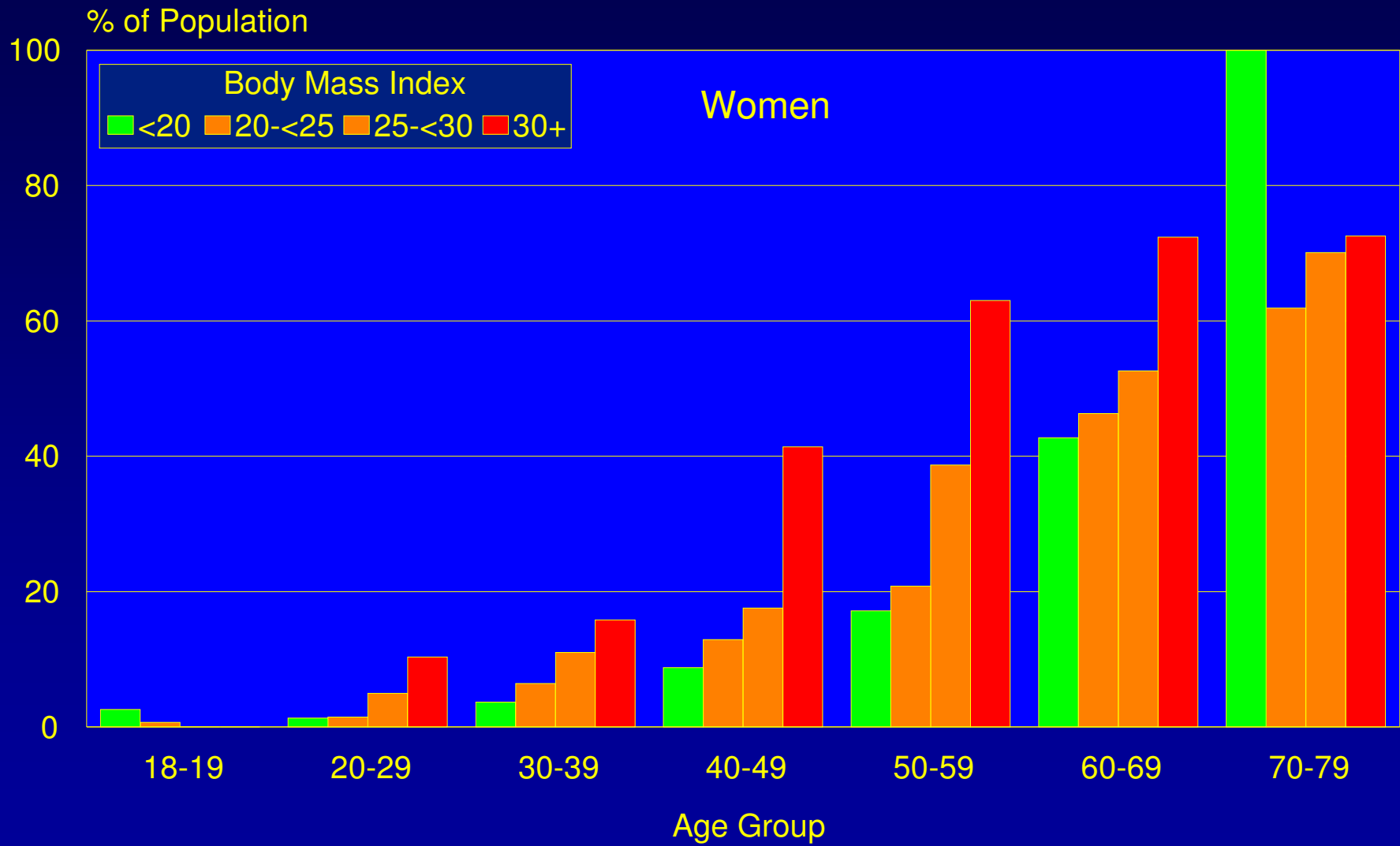
Cutpoints for BMI:

„Normal“:	20-<25
Overweight:	25-<30
Obesity :	30 +

High Blood Pressure and Body Mass Index



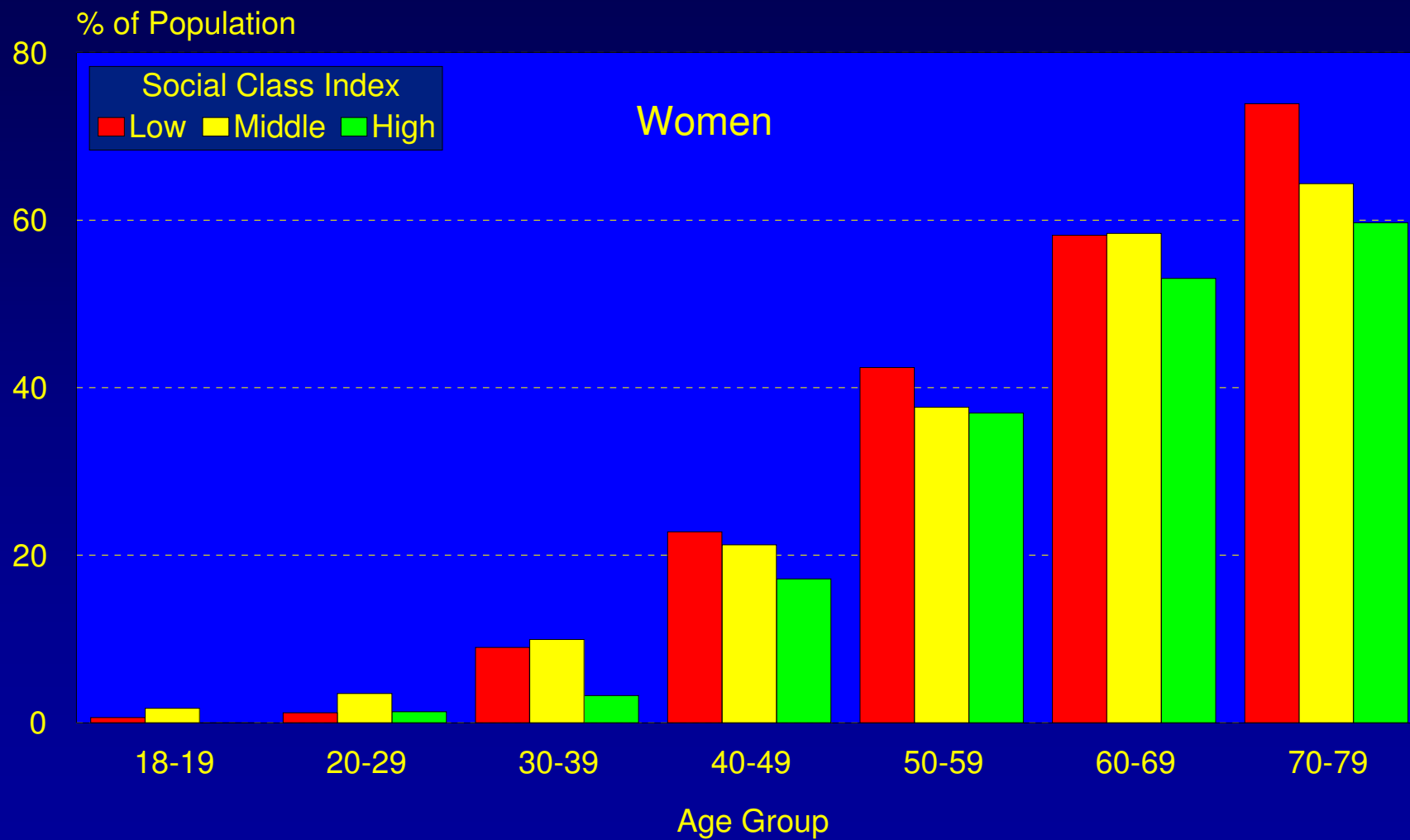
High Blood Pressure and Body Mass Index



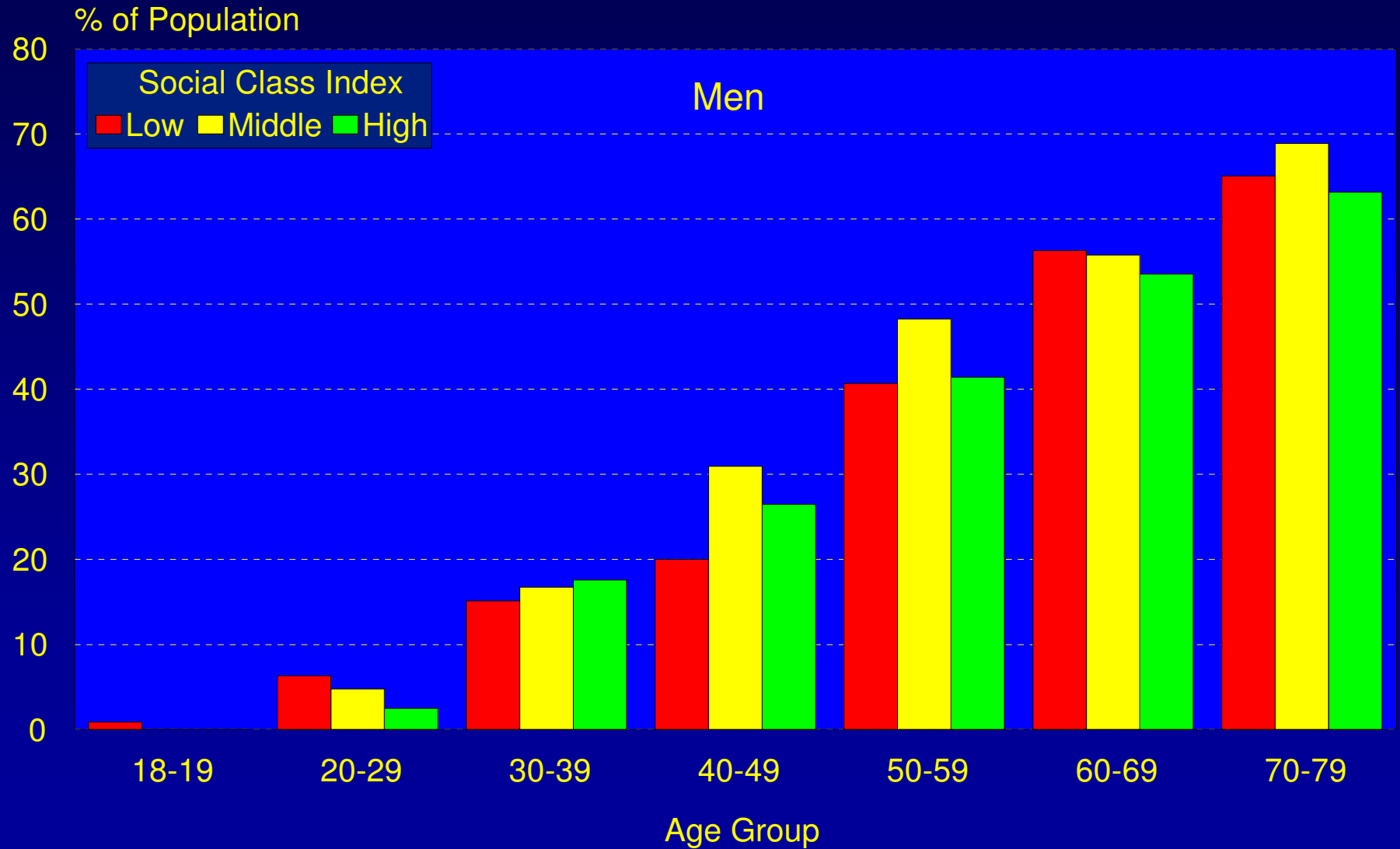
Major risk factor for high blood pressure
(as for many other risk factors and diseases):

Social class

High Blood Pressure and Social Class Index



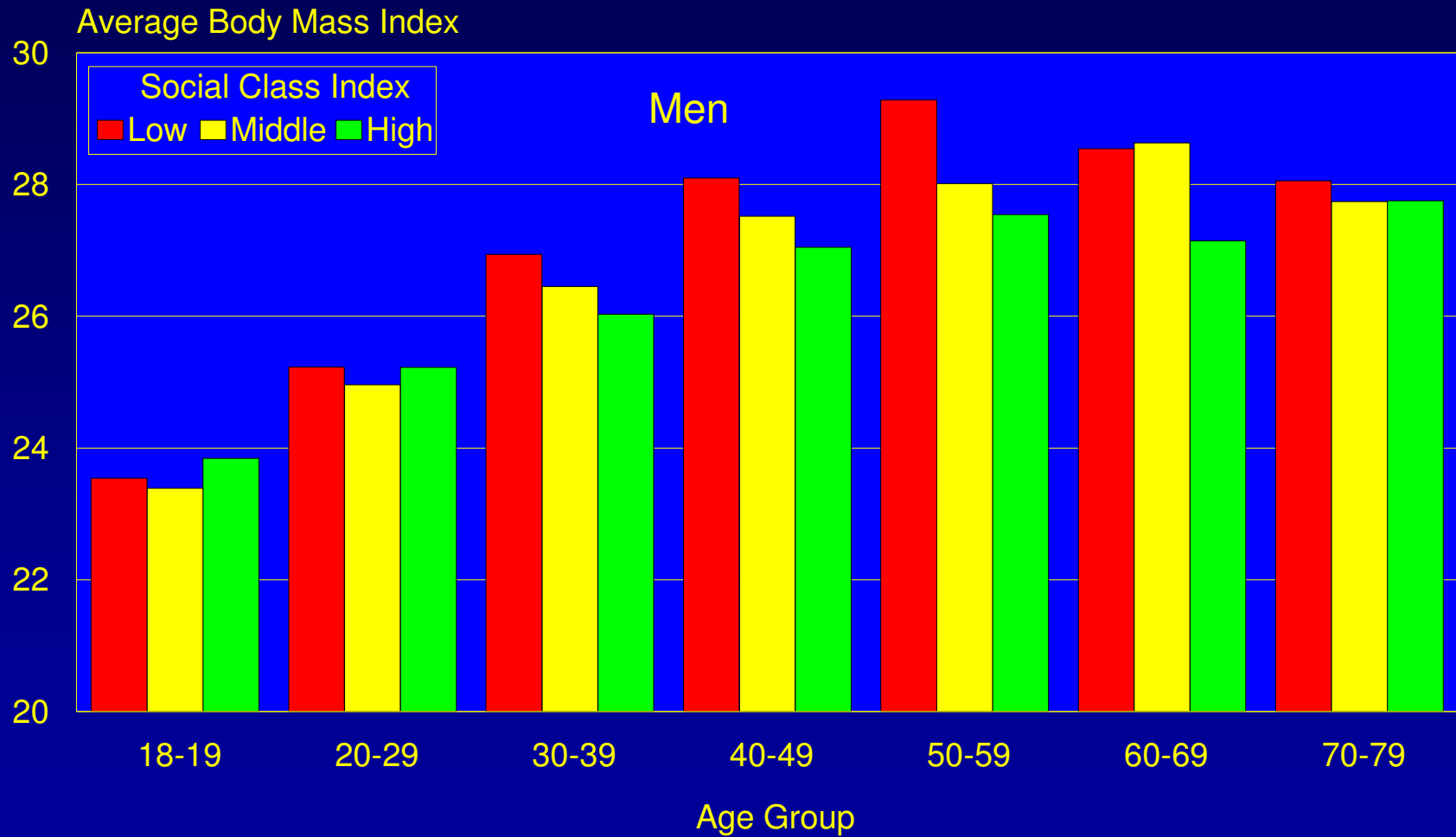
High Blood Pressure and Social Class Index



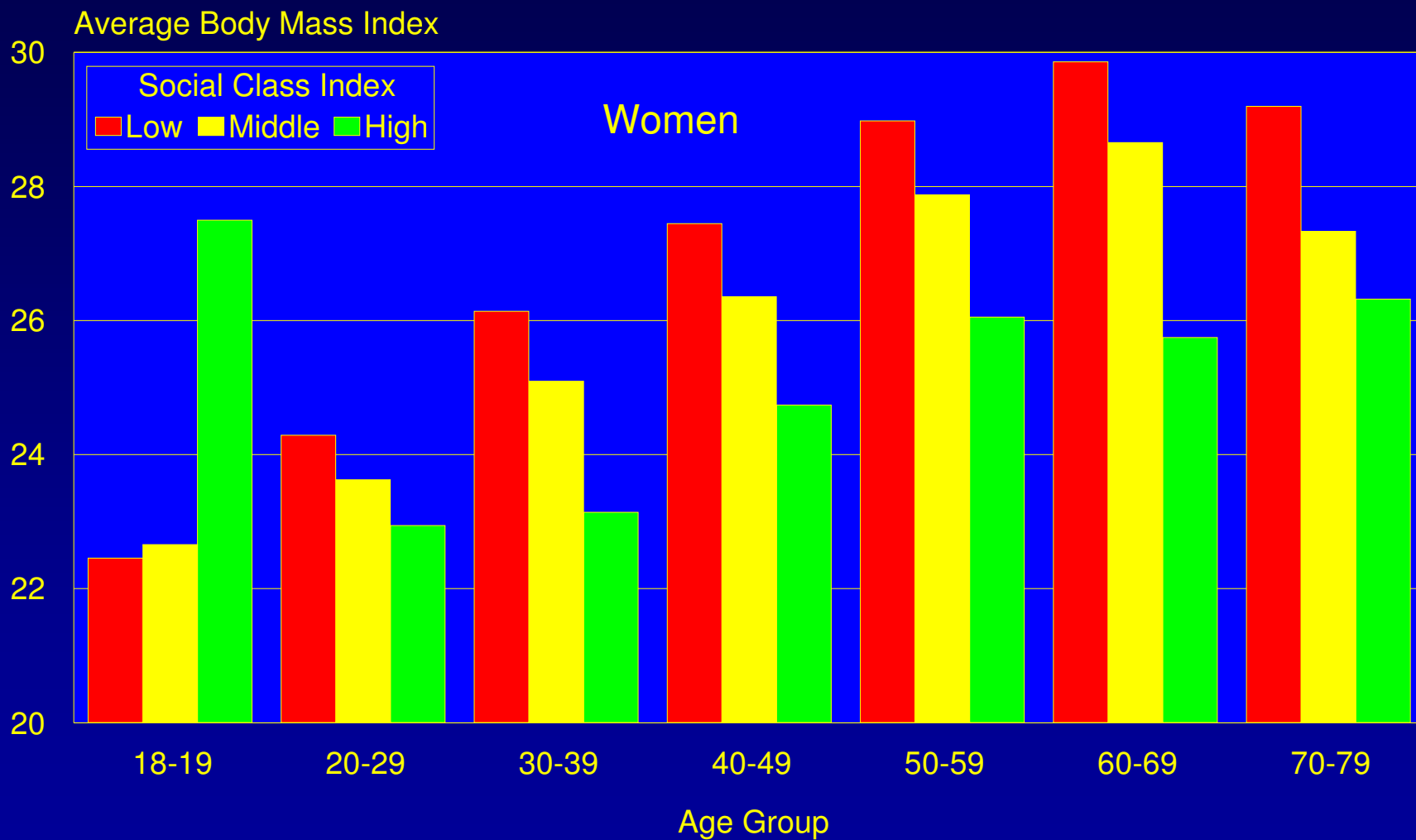
...but

social class is also a risk factor for overweight !

Average Body Mass Index and Social Class Index



Average Body Mass Index and Social Class Index



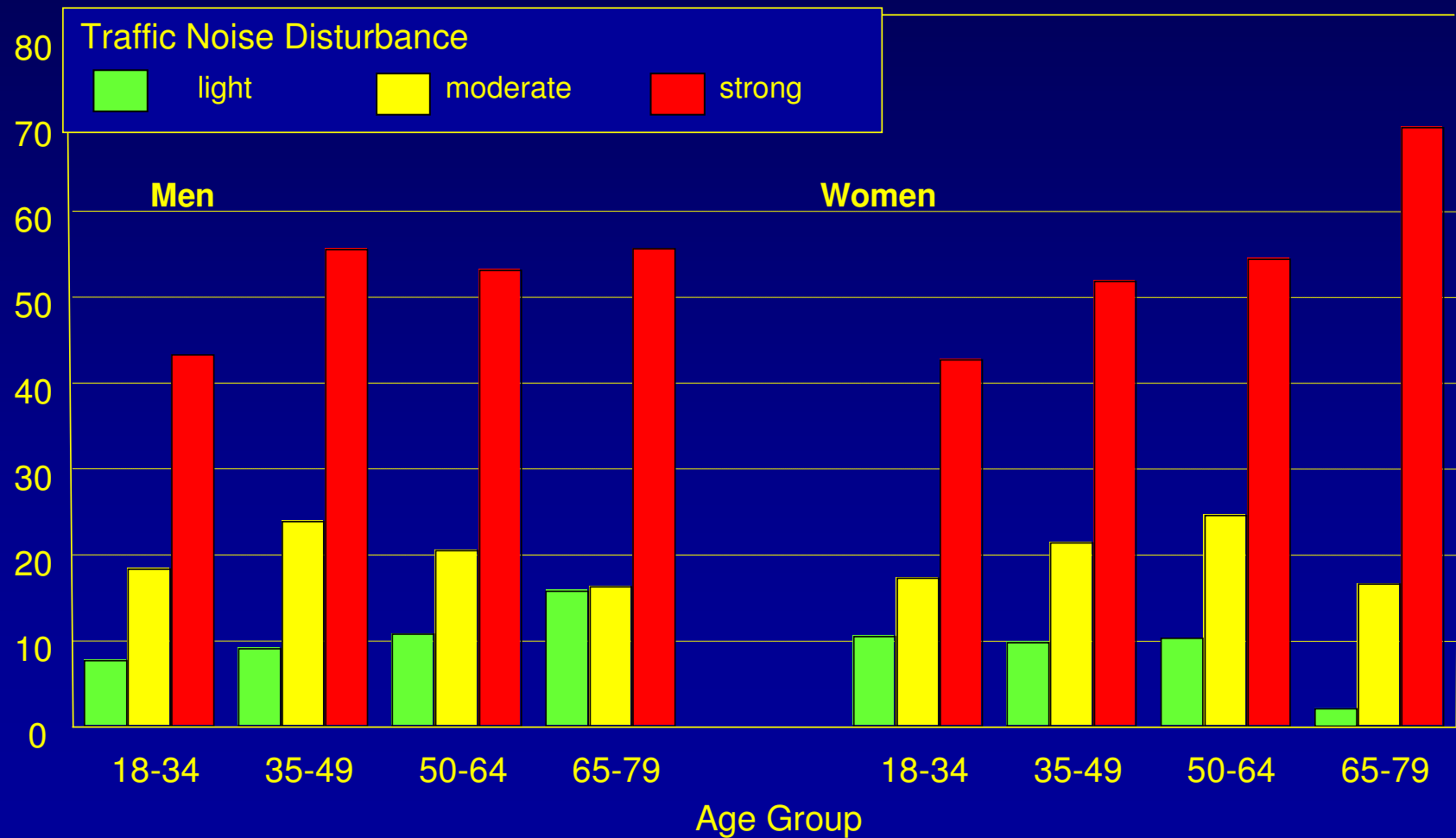
The questionnaire of the German National Health Examination Survey (1998) contained questions on:

- vicinity of residence to major roads
- heavy traffic noise
- noise due to air traffic
- noise due to factories
- neighbourhood noise
- sleep disturbances

Frequent Disturbance of Sleep by Traffic Noise (Road, Train, Air)

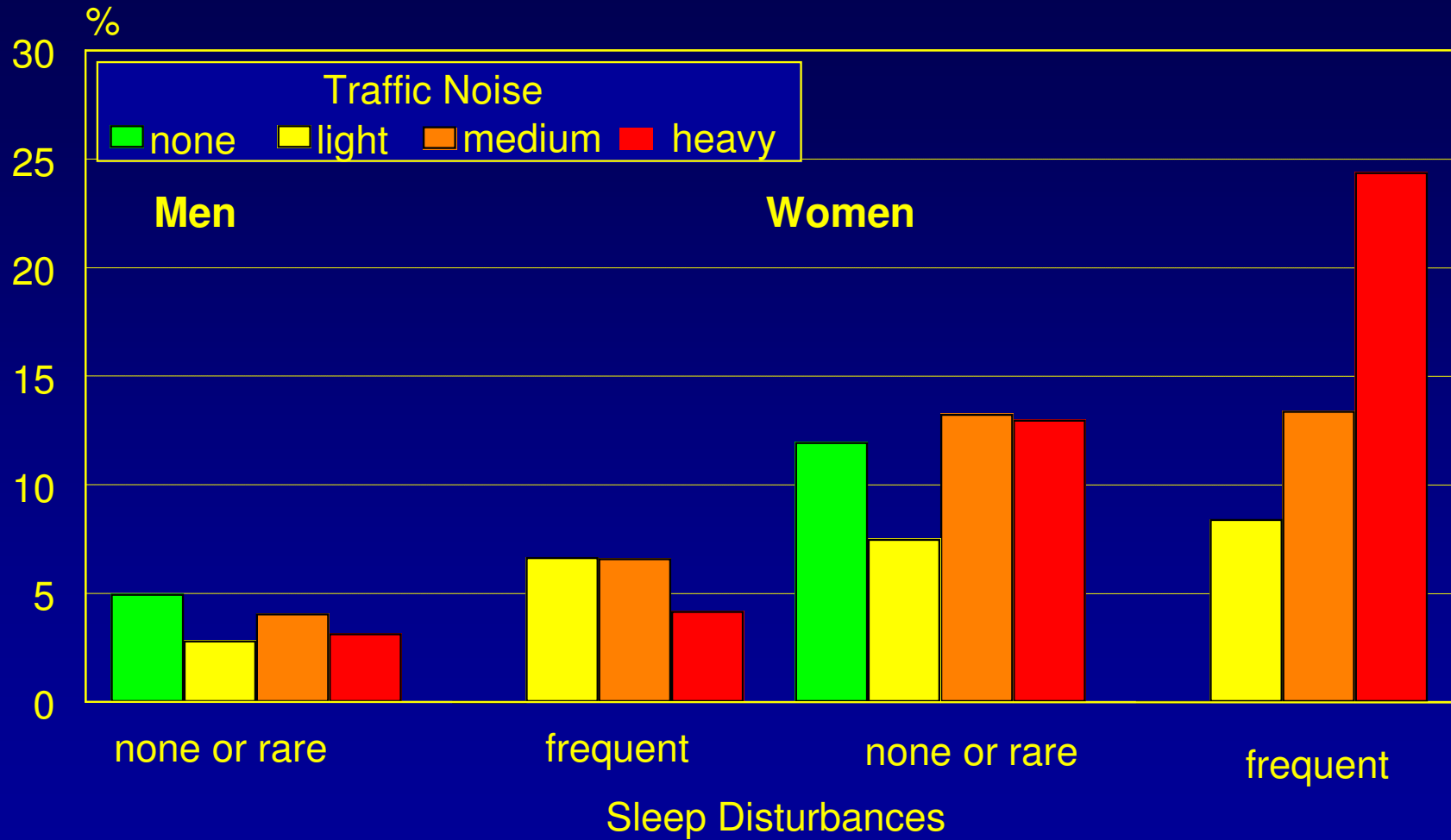
German National Health Examination Survey 1998

% sleep disturbance frequently

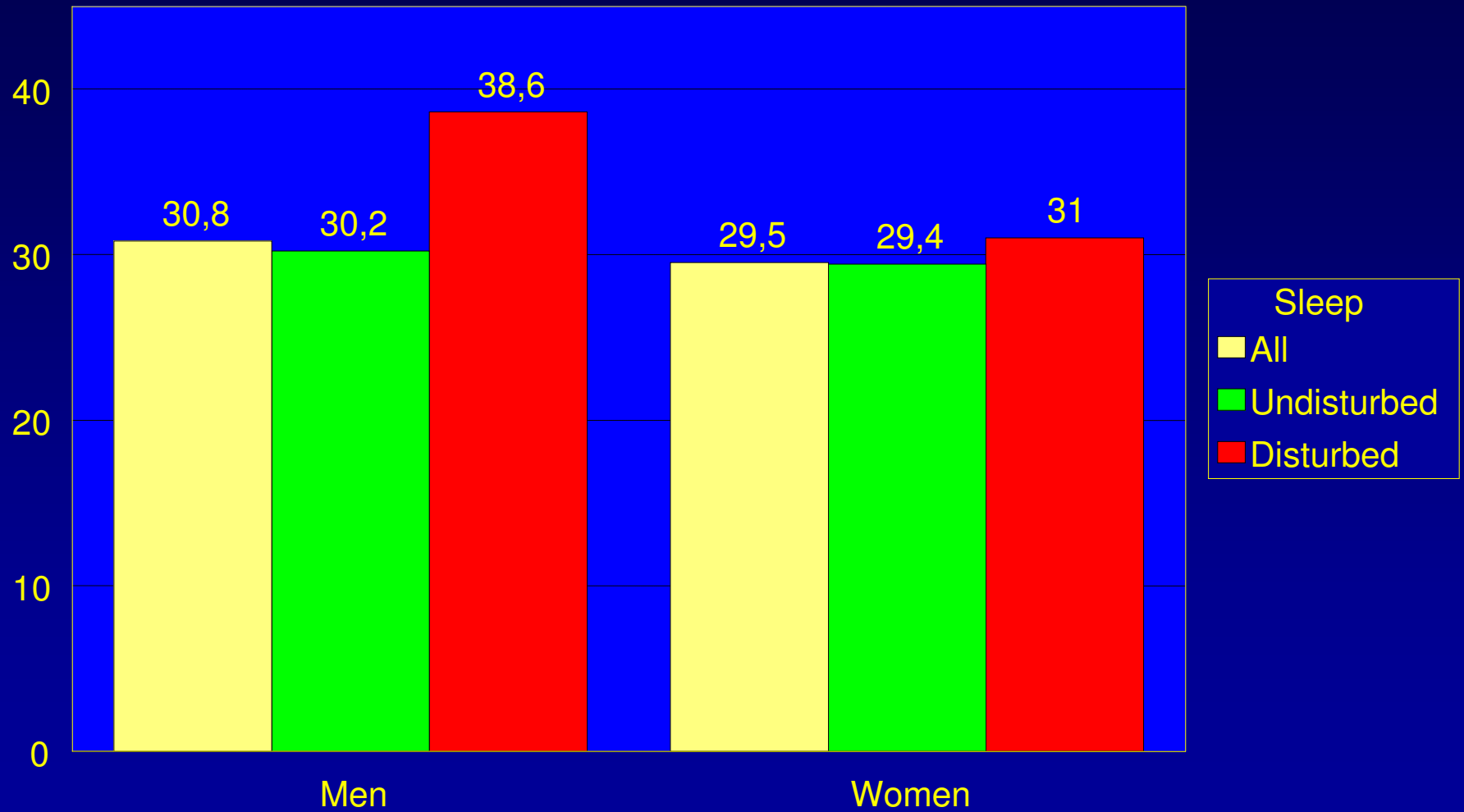


Use of Tranquillizers, Sedatives, Hypnotic Drugs

German National Health Examination Survey 1998



High Blood Pressure and Sleep Disturbance by Traffic Noise



Do these results prove that traffic noise causes high blood pressure ?

It is impossible to exclude the possibility that persons with higher income could move away from noisy residences.

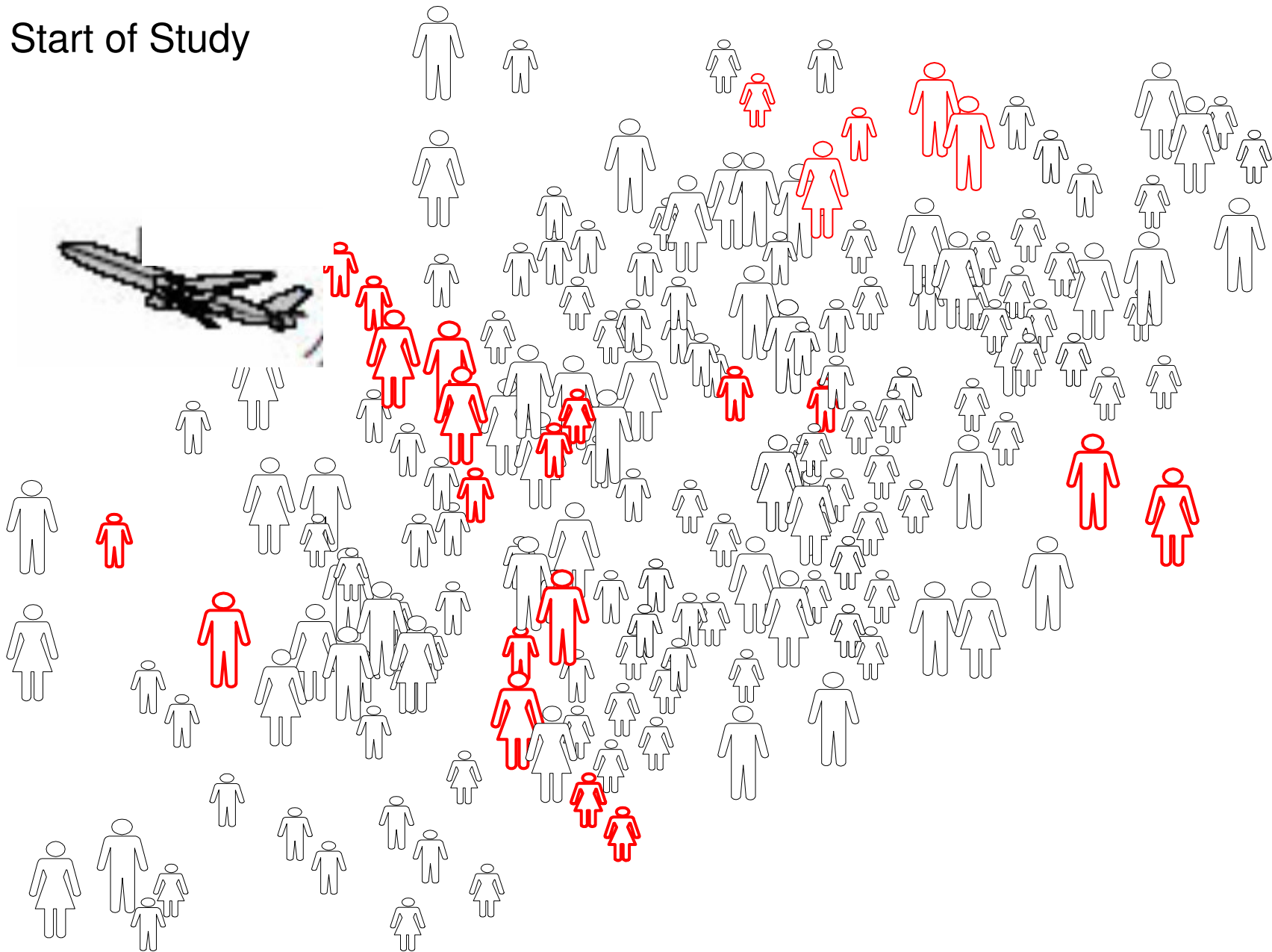
But: It can't be excluded that there is a link between traffic noise and high blood pressure

Solution: Cohort study or case-control study

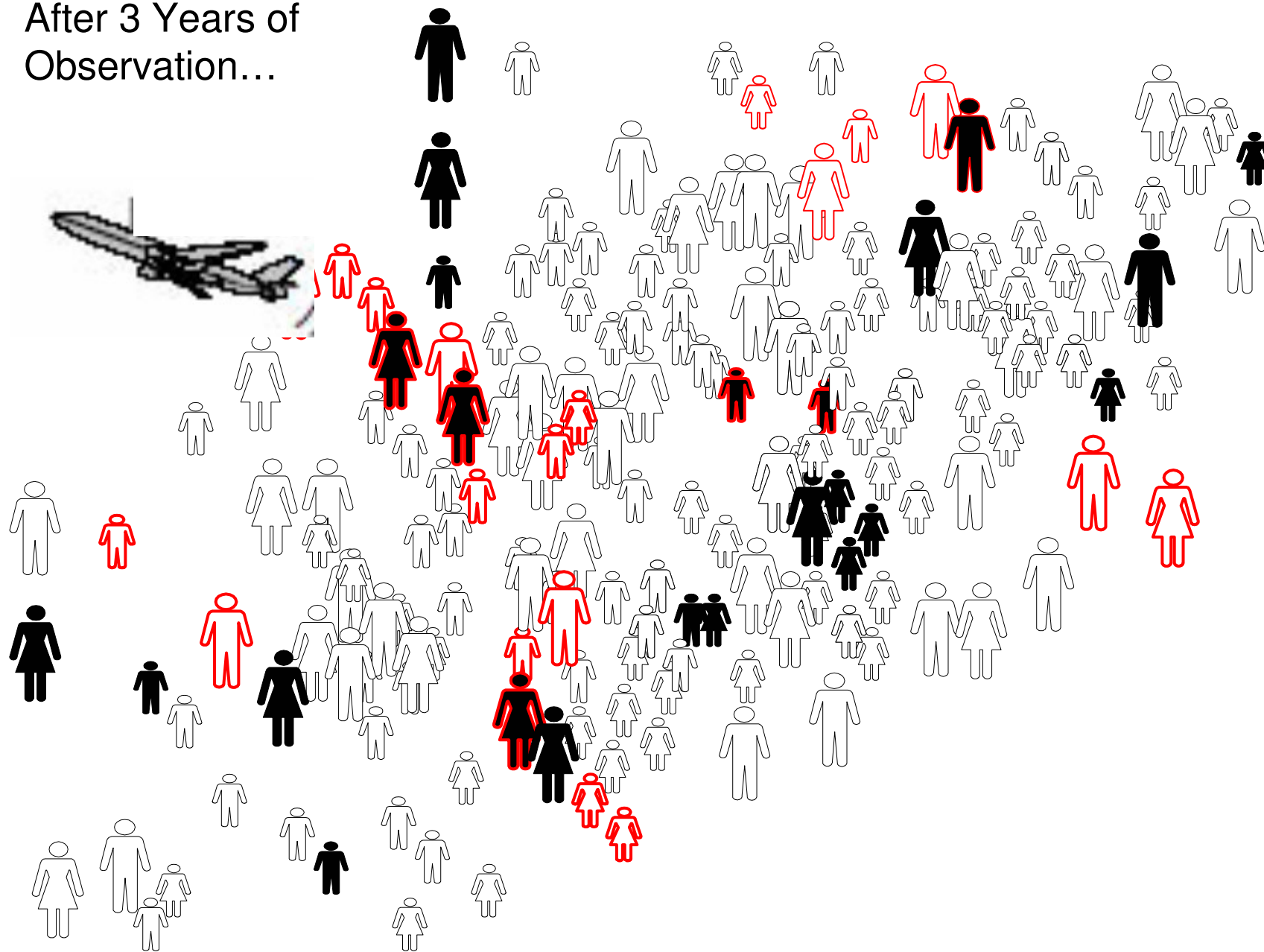
Cohort study principle:

- Examine a segment of the general population for factors that could lead to a specific disease.
- Observe this cohort for a specified time period and look for new occurrences (incidence) of the disease.
- Analyze data according to factors observed at baseline.
- If these factors are more frequent in newly diseased persons they are being called risk factors.

Start of Study



After 3 Years of
Observation...



Cohort study advantage:

...allows determination of causality

but...

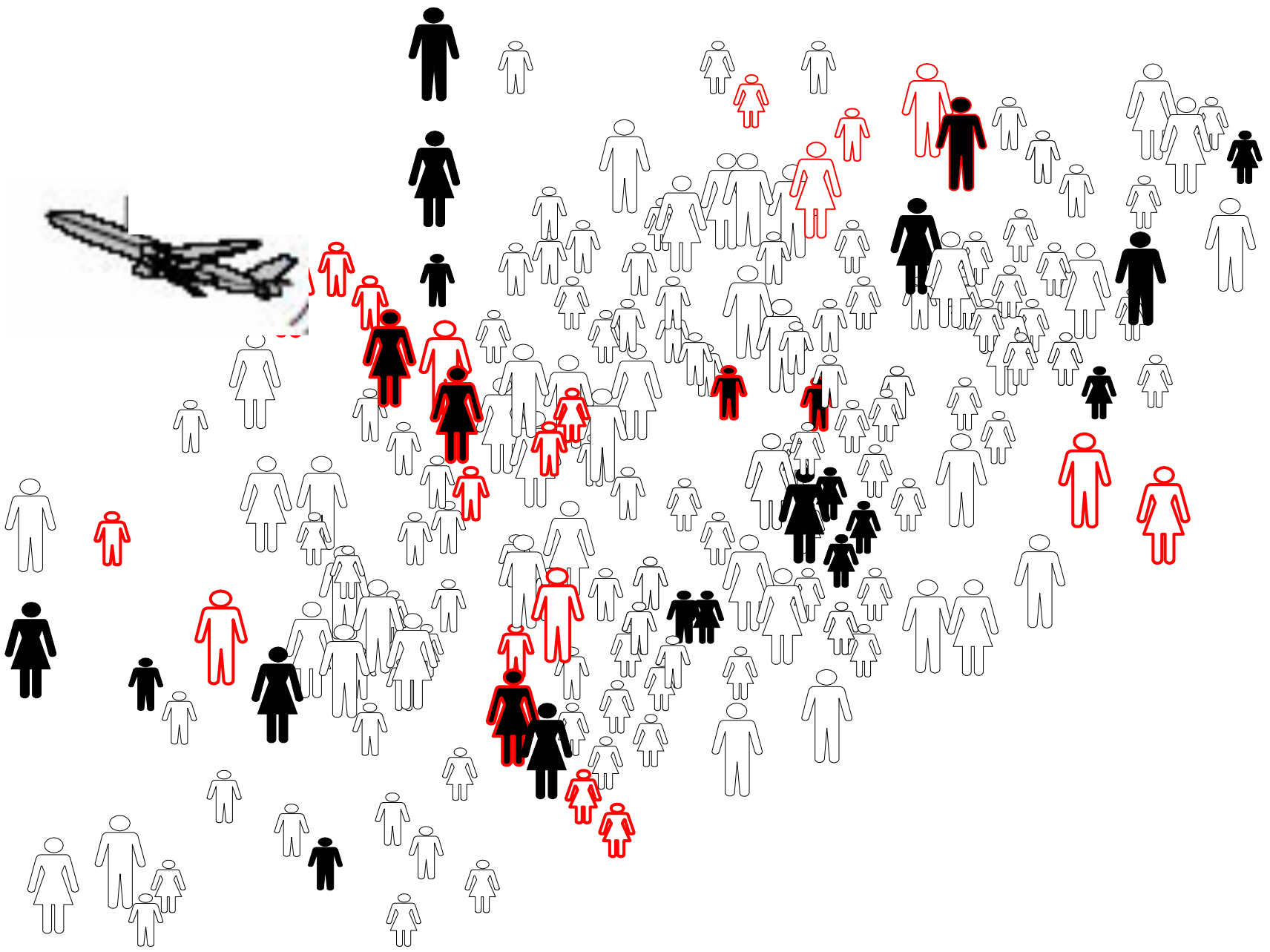
**you have to wait for a long time,
you need a large cohort**

Therefore...

cohort studies are unsuitable for rare diseases

Case-control study principle

Analyze a general population according to
potential risk factors in
healthy and diseased persons



Case-control study principle

Analyze a general population according to
potential risk factors in
healthy and diseased persons

Determine the frequency of risk factors in
healthy persons
persons with disease

If the frequency of risk factors is higher in diseased
persons, these risk factor could be causal.