

# Epidemiologists Count!

# Epidemiologists Count!

- “Shoe leather” epidemiology
- Measures of disease “occurrence” in the setting of interest
  - Population
  - Physician practice
  - Clinic
  - Hospital
- Prevalence
- Incidence

# Epidemiology

- Basic premise
  - most diseases do *not* occur at random in a population
- Descriptive Epidemiology
  - Finding patterns of disease at the population level
- Analytical Epidemiology
  - examination of specific hypotheses that are generated by descriptive studies and/or basic science findings

# Descriptive Epidemiology

## Occurrence Epidemiology

### ■ Prevalence

- a snapshot of the population at one point in time
- the population burden

### ■ Incidence


- occurrence of new cases over a specified period of time
- “risk” of disease

# Why is prevalence important?

- Can provide “baseline” data to enable investigation of
  - disease clusters
  - impact of environmental changes
- Can help to identify regional differences
  - Generating hypotheses
- Can assist agencies in targeting programs for those in need
- Can provide information to forecast healthcare and social needs/costs
- Critical in setting the stage for studies of incidence and risk factors

# How do we measure prevalence?

- We need to identify a population of interest
- Select a sample of subjects who are representative of the population of interest (Canadians over the age of 18, Quebecers, Military Veterans, etc)
- In that sample determine who has and who does not *have* the disease at a specific point in time (“prevalence day”) or in a small time interval (over a month) and compute the proportion (prevalence) with the disease
- E.g. 5% of the population over the age of 65 suffer from Alzheimer’s disease - common
- E.g. 90 in 100,000 of the population over the age of 18 suffer from multiple sclerosis –relatively rare



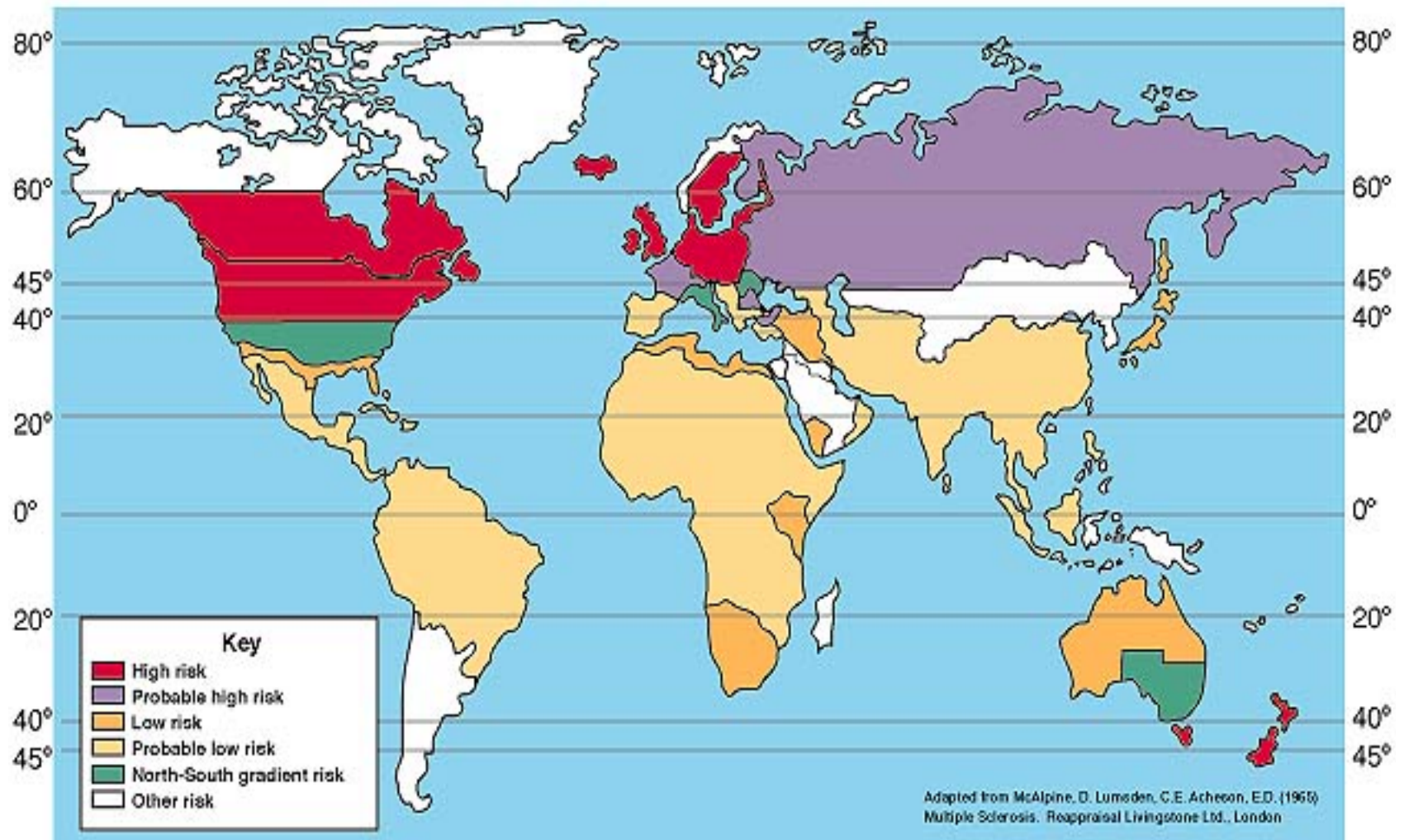
# What do we know about the prevalence of MS?

- Evidence of a unique geographic distribution worldwide
- Low/Medium/High prevalence *zones*
- South to North Gradient in U.S., Europe and in Australia

# “Zones” of MS Prevalence

- *Low* <5 /100,000
  - Asia, Africa, South America
- *Medium* 5-30/100,000
  - Australia, Southern US, Northern Scandinavia, Mediterranean, South Africa, Caribbean, South America
- *High* >30/100,000
  - Most of Europe, Israel, Canada, Northern US, New Zealand, Southeastern Australia

## World Distribution of Multiple Sclerosis



# The prevalence of MS in Canada

- “High” prevalence zone
- Systematic review of MS prevalence in Canada recently undertaken (Alex Poppe, 2006)
- Careful protocol to identify and select (based on methodological quality) all studies of MS prevalence published since 1985

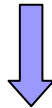
228 studies identified



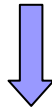
21 studies retained



6 published before 1985 excluded



15 studies retained



6 excluded

-4 only as poster/abstract/presentation

-1 same data published twice

-1 insufficient data for inclusion



Finally 9 studies made the cut and were included

# Results

- All 9 were judged to be of “Good” or “Very Good” quality
- Only 1/9 was a national study but identification of MS was based on self report of MS (a single question)
- 4 studies conducted in province-wide (2/4 in Newfoundland/Labrador)
- 4 studies conducted in cities/counties
- 7 of 9 identified cases via MS clinic charts, MS society lists, hospital charts etc
- 1 used health registration billing data

Table 1a: Studies Included in Systematic Review

Author	Year	Region	Number of cases	Population or Denominator	Crude Prevalence (per 100 000) (CI)
Sweeney	1986	British Columbia	2596	2 782 422	93.3
Pryse-phillips	1986	Newfoundland & Labrador	320	567 879	56.4 <u>(50-63)</u>
Hader	1988	London, Ontario	263	260 050	101.1
Hader	1988	Middlesex County, Ontario	61	63 895	95.4
Warren	1992	Barrhead County, Alberta	19	9 720	196 <u>(118-305)</u>
Warren	1993	Westlock County, Alberta	23	11 510	200 <u>(127-300)</u>
Klein	1994	Crowsnest, Alberta	15	6 912	217 <u>(121.5-358)</u>
Klein	1994	Cardston, Alberta	7	7 916	88 <u>(36-182)</u>
Svenson*	1994	Alberta	5548	2 560 000	216.7
Sloka	2005	Newfoundland & Labrador	493	521 986	94.4 <u>(90.2-98.7)</u>
Beck*	2005	Canada (10 provinces)	332	116 109	240 <u>(210-280)</u>

Table 2: Crude Prevalence by Latitude and Longitude

Location	Latitude (degrees)		Longitude (degrees)		Adjusted Prevalence (per 100 000)		Study #	
Newfoundland Labrador	46-52N 52-61N	52N*	52-59W 56-67W	56W*	55.2	94.4	2	8
Quebec	54N		72W		180 (90-260)		9	
London, Ontario	43N		81W		94		3	
Middlesex County, Ontario	43N		81W		91		3	
Ontario	50N*		86W*		230		9	
Crowsnest Pass, Alberta	49N**		113W**		217		6	
Cardston, Alberta	49N**		113W**		88			
Barrhead County, Alberta	54N		114W		196		4	
Westlock, Alberta	54N		114W		200		5	
Alberta	55N*		115W*		216.7 386 (377-394)		7 9	
British Columbia	55N		125W		93.3 240		1 9	

\*estimated geographical centre of territory

\*\*geographical coordinates not provided in paper

Table 1b: Canadian Community Health Survey Study

Author (year)	Region	Case ascertainment	Prevalence (CI)	Numerator	Denominator
Beck (2005)	Canada BC Prairies Quebec Ontario Atlantic Territories excluded	Canadian Community Health Survey (CCHS)  – phone survey conducted b/w Sep 2000 and Oct 2001	<b>Canada: 240 (210-280)</b>  <b>B.C. : 240 (160-320)</b> <b>Prairies: 340 (240-340)</b> <b>Ontario: 230 (150-300)</b> <b>Quebec: 180 (90-260)</b> <b>Atlantic: 350 (230-470)</b>	332  No regional numerators given	116 109  Regional % given:  B.C. : 16 487 (14.2) Prairies: 27 634 (23.8) Ontario: 35 529 (30.6) Quebec: 20 551(17.7) Atlantic: 16 023 (13.8)

# Limitations of Prevalence Data

- Prevalence figures are influenced by factors other than “risk” of disease
  - disease ascertainment, treatment, quality of medical care
  - “prevalence  $\sim$  incidence x duration of disease”
- A poor measure of risk
- But prevalence is much easier to study than incidence and - results of prevalence studies have generated a number of hypotheses

# For instance

- Climate
- Diet
- Sanitary conditions
- Infectious agents
- Ultraviolet light
- Race
- Genetic factors

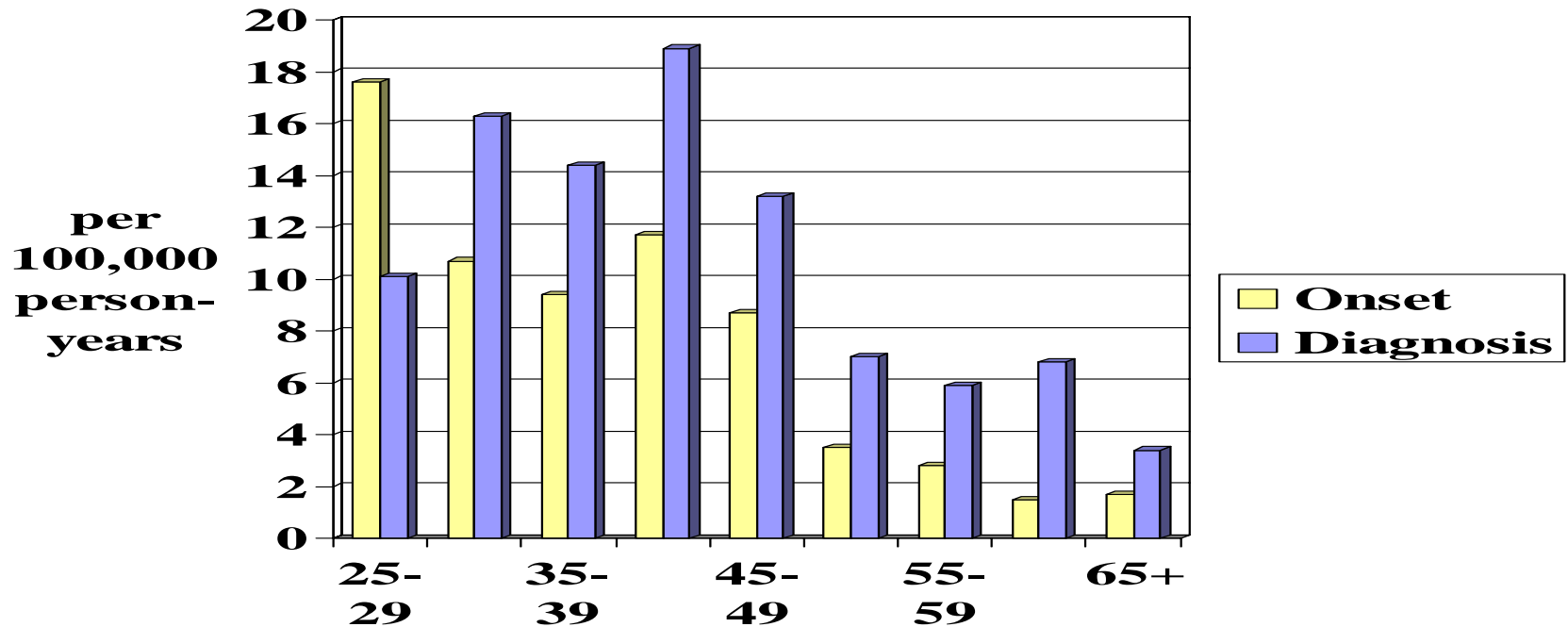
# Incidence

A true measure of *risk*

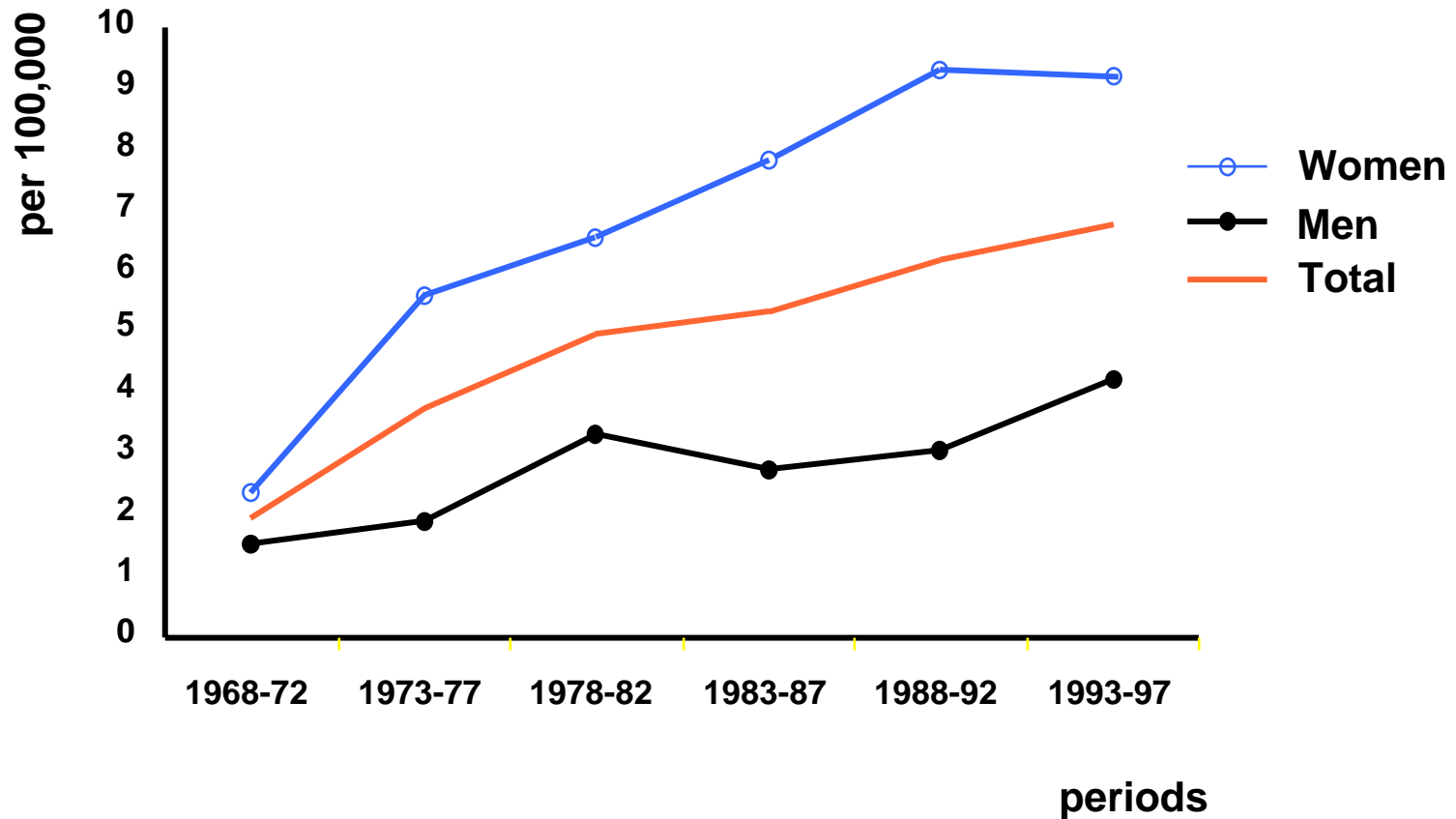
- Optimal design to determine risk
- Identifies the *rate* of “developing” disease rather than “having” disease
  - I.e. 2 per 100,000 per year
- Incidence studies far more difficult to conduct than prevalence studies
  - A large sample of *disease-free* individuals is needed
  - Extensive follow-up over many years
  - Ascertainment of disease *onset* not merely diagnosis

# Incidence of MS (by age)

## Nurse's Health Study

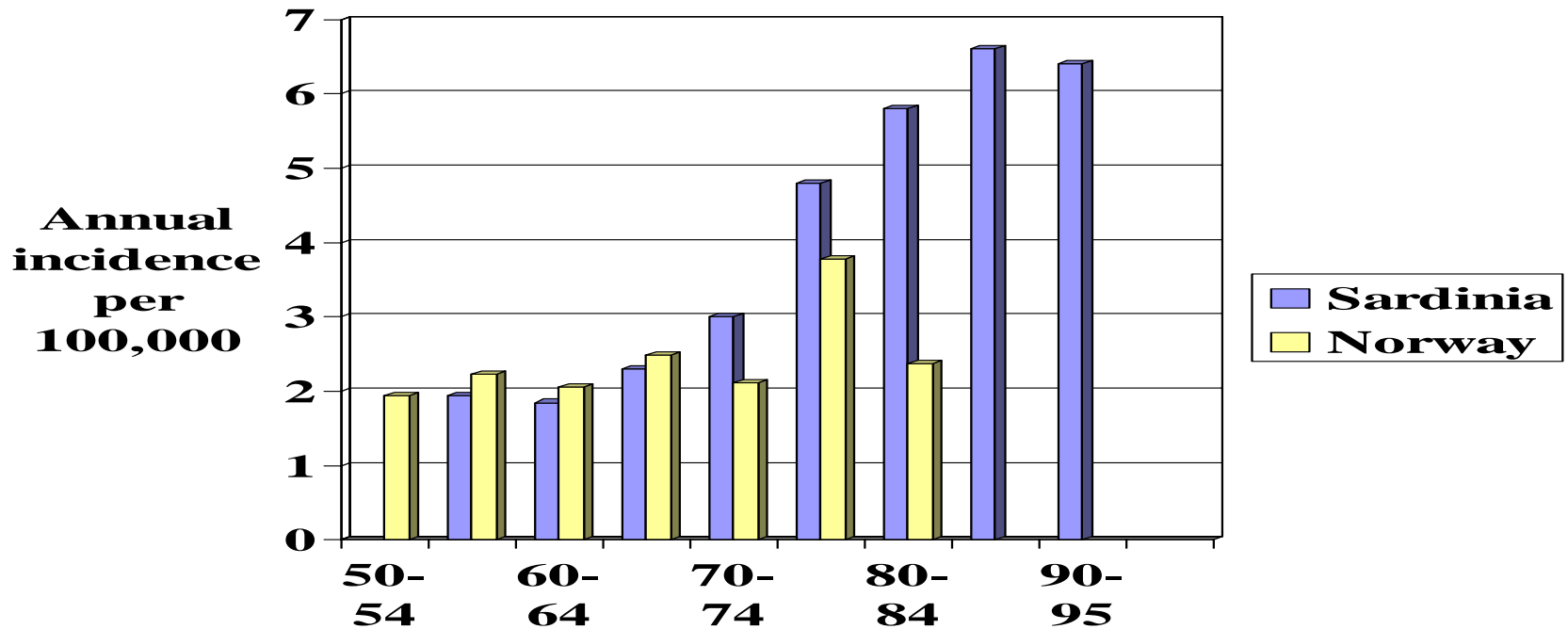



## Temporal trend of MS incidence rates in the province of Sassari, in the decades 1968 to 1997



# Changing Incidence

## 1950-1995





Is this real? – look for alternative explanations and examine their impact

- Improvements in diagnosis
  - ascertainment bias
- Improvement in survival
  - survival bias
- True increase in incidence
  - change in the environment



# Migrant Studies

- Population migrations provide a tool for the study of the respective role of host (genetic) and environmental factors in the development of disease

# Genetic Etiology

- If the disease has a *purely* genetic etiology, there should be little change in the risk of developing a disease when moving from one location to another

# Environmental Etiology

- If the disease has a *purely* environmental etiology, the risk of disease in the migrants would be expected to change relative to the risk in the native country depending upon when the environmental agent is thought to act (i.e. depending upon the timing/age of the migration)

# Findings from Migrant Studies

- Migration from countries in the 'high risk' zone to those in the 'low risk' zone
  - adult migrants retain the risk
  - child migrants develop MS at a rate closer to that of individuals born in the host country
- Migrant from countries in the 'low risk' zone to those in the 'high risk' zone
  - racial confounder
  - children of migrants closer to host country risk

# Current Philosophy

- Multiple sclerosis has a multifactorial etiology
  - one or more environmental insults to a genetically susceptible individual at the *right* time

**Genetic  
Susceptibility**

**Exposure A**

**Exposure B**

**Exposure C**

**Trigger**

**Clinically  
Evident  
Disease**



**Critical  
age<sub>1</sub>**

**Critical  
age<sub>2</sub>  
(10-15 years)**

**Critical  
age<sub>3</sub>**



# MS Epidemiology

- Historically those favoring the genetic hypothesis and those favoring an environmental hypothesis have considered these as *alternative* hypotheses
  - it is clear that they are not mutually exclusive and large scale population based studies combining a strong genetic and strong environmental view are essential



# Conclusion

- Epidemiologic research has played a pivotal role in mapping the occurrence of MS world wide and as a result suggesting many etiological hypotheses to examine
- Given recent suggestions of increasing incidence, re-examination of prevalence and incidence data is timely
- Collaborative population based studies incorporating both genetic and environmental aspects of the the disease are needed