Get every one in the picture

Mortality measures and uses

Data analysis and report writing workshop for civil registration and vital statistics in the Asia Pacific

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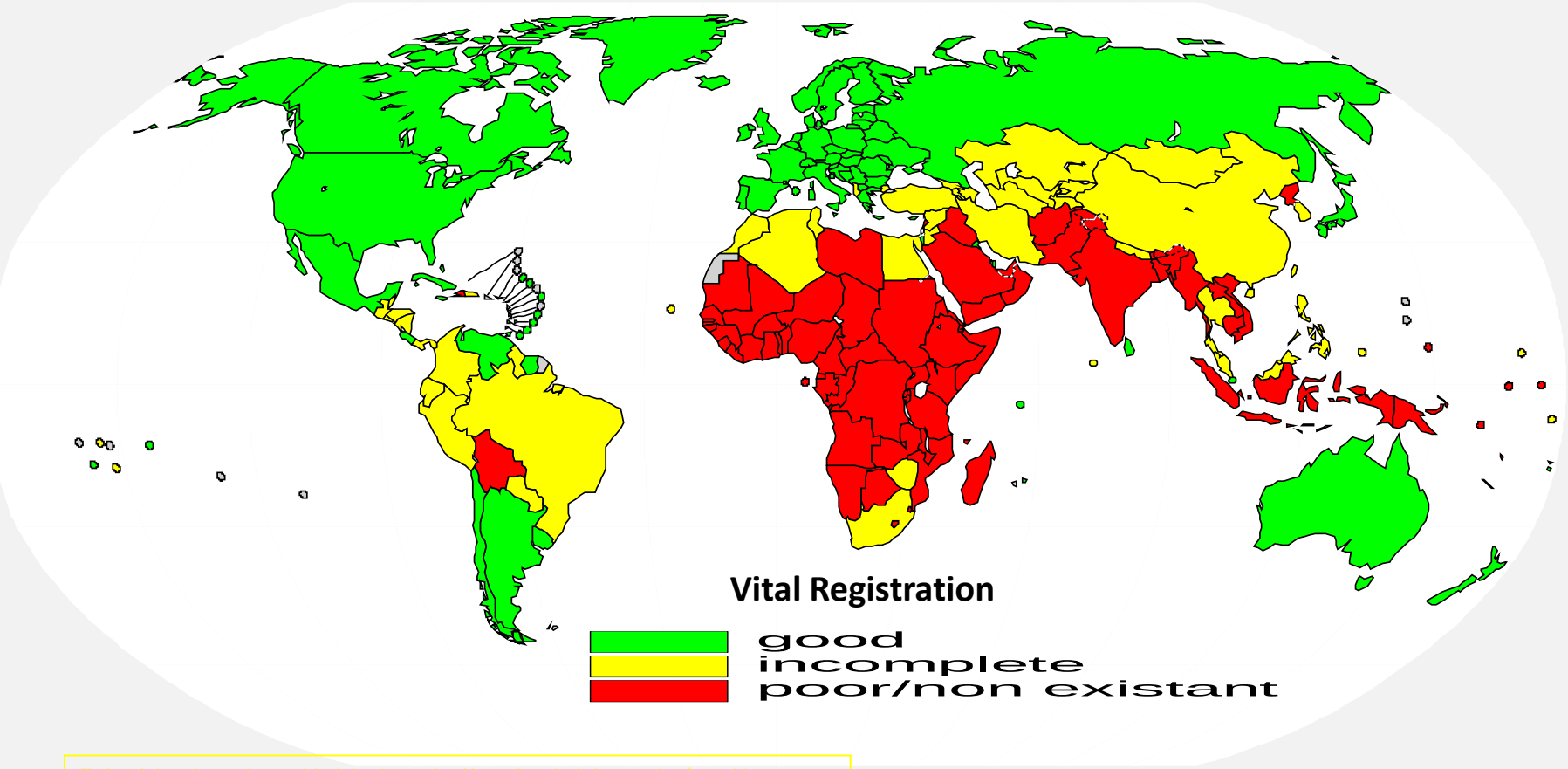
Data sources (general / cause specific)

- Vital registration systems
- Population censuses
  - Denominators, sometimes numerators (direct / indirect)
- Sample registration systems – India and China
- Demography and Health Surveys – child mortality estimates
- Population laboratories / epidemiological studies
- Hospital records / statistics
- Disease specific surveillance programs (MCH, cancers/HIV/TB)
- Police registers for injury deaths
- Others

Global availability of cause of death data from national vital registration systems around the year 2000



Challenges in interpreting data at population level

- Voluminous datasets
- Main challenge lies in

SUMMARIZING data

to

DESCRIBE population attributes

and

COMPARE across populations

Measures of mortality

- Absolute number of deaths
- Crude death rates
- Age specific death rates (perinatal/infant etc)
- Maternal mortality ratio
- Life expectancy; age-specific mortality risks
- Age-standardized death rates (total/cause-specific)
- Proportionate mortality ranks by cause, sex, age
- Years of Life Lost
- NCD mortality indicator
- Epidemiological measures – case fatality rates, relative risks, odds ratios

Age-specific death rates

- Age specific death rate (ASDR)

$$= \frac{deaths\ in\ calendar\ year\ at\ age\ x}{mid\ \ year\ \ population\ at\ age\ x}\ X\ 1000$$

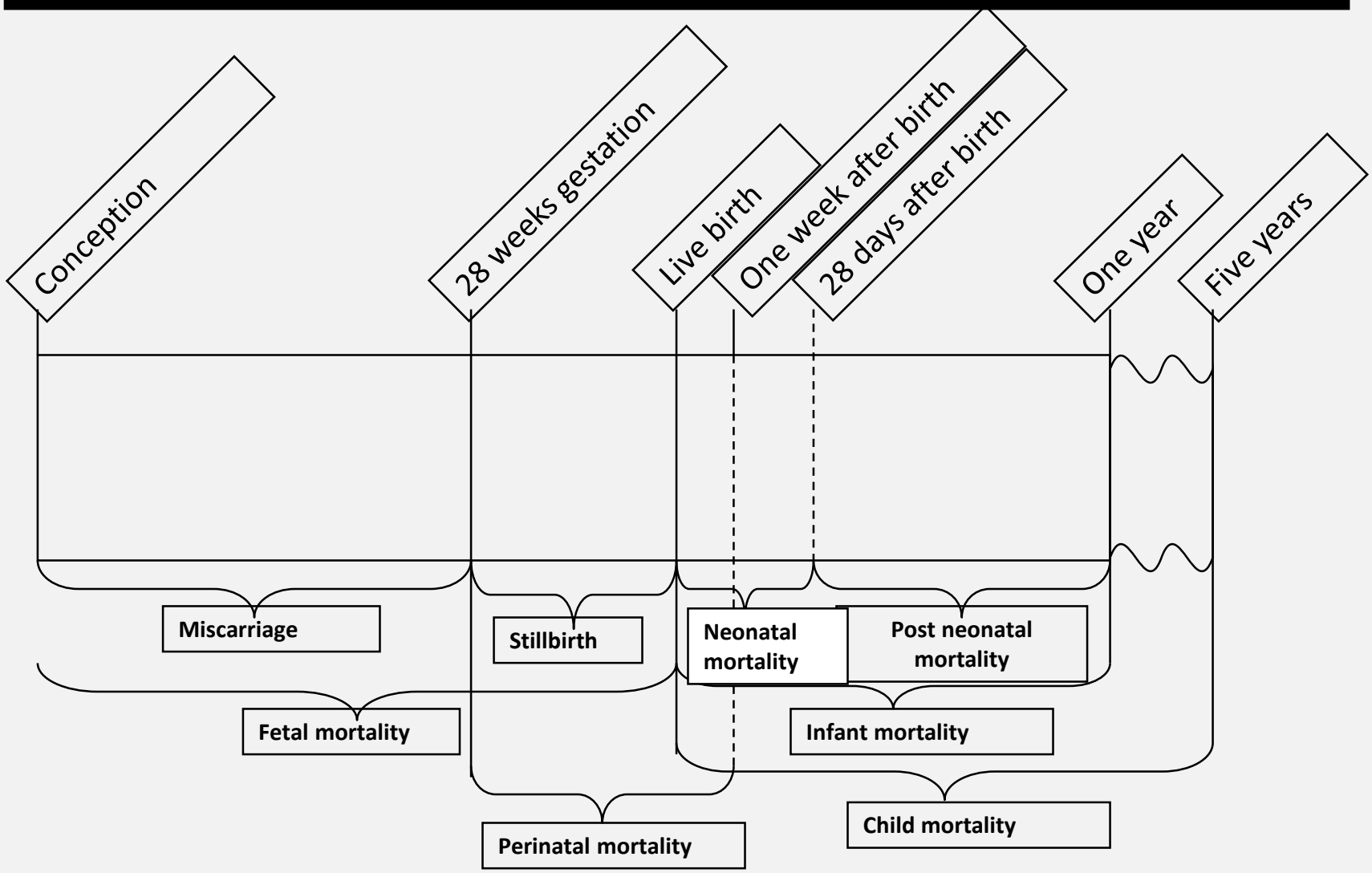
- ASDRs can be influenced by population age composition
- These effects can be removed by standardization

Maternal and child mortality rates

- Maternal mortality ratio
  - Number of maternal deaths per 100,000 live births
- Life time risk of maternal mortality

- Neonatal mortality rate
  - number of deaths of infants aged less than 1 month per 1,000 live births
- Post-neonatal mortality rate
  - number of deaths of infants aged 1 to 11 months per 1,000 surviving infants at age 1 month
- Infant mortality rate
  - number of deaths of infants aged less than 12 months per 1,000 live births
- Child mortality rate
  - number of deaths of children aged 12 to 59 months per 1,000 surviving children at age 12 months
- Under-five mortality rate
  - number of deaths of children aged 0 to 59 months per 1,000 live births

Mortality in early life



Life expectancies

- Calculated by converting observed age specific mortality rates using a '**life table**' to estimated probabilities of death (and survival) at different ages

- Commonly used life table outputs include
- Life expectancy at birth *(e^0)*
- child mortality (${}_5q_0$)– *probability of dying before age 5 years*
- Adult mortality (${}_{45}q_{15}$ *) probability of dying between 15 and 60 years*
- Life expectancy at age 60 years *e^{60}*
- Mortality risk in elders *(${}_{20}q_{60'}$) – risk of dying between 60 and 80 years*

Life table

Construction of an abridged life table												
MALES												
x	n	Population	Deaths	$_nM_x$	a	$_nq_x$	$_np_x$	l_x	$_nd_x$	$_nL_x$	T_x	e_x
0	1	640995	24322	0.038	0.1	0.037	0.963	100,000	3,669	96,698	6,769,301	**67.69**
1	4	2756945	5900	0.002	0.4	0.009	0.991	96,331	820	383,355	6,672,603	69.27
5	5	3487024	2796	0.001	0.5	0.004	0.996	95,511	382	476,597	6,289,248	65.85
10	5	3571968	2240	0.001	0.5	0.003	0.997	95,128	298	474,897	5,812,651	61.10
15	5	3692570	4737	0.001	0.5	0.006	0.994	94,831	606	472,637	5,337,754	56.29
20	5	3427945	5638	0.002	0.5	0.008	0.992	94,224	772	469,192	4,865,117	51.63
25	5	2977515	4761	0.002	0.5	0.008	0.992	93,453	744	465,402	4,395,925	47.04
30	5	2553306	4540	0.002	0.5	0.009	0.991	92,708	821	461,491	3,930,523	42.40
35	5	2454482	5627	0.002	0.5	0.011	0.989	91,888	1,047	456,821	3,469,032	37.75
40	5	2084293	6989	0.003	0.5	0.017	0.983	90,840	1,510	450,426	3,012,211	33.16
45	5	1711383	9055	0.005	0.5	0.026	0.974	89,330	2,332	440,819	2,561,785	28.68
50	5	1356885	11611	0.009	0.5	0.042	0.958	86,998	3,644	425,878	2,120,965	24.38
55	5	1016621	14171	0.014	0.5	0.067	0.933	83,353	5,614	402,732	1,695,088	20.34
60	5	864612	18902	0.022	0.5	0.104	0.896	77,739	8,057	368,554	1,292,356	**16.62**
65	5	794986	27456	0.035	0.5	0.159	0.841	69,682	11,077	320,719	923,802	13.26
70	5	518056	28550	0.055	0.5	0.242	0.758	58,606	14,193	257,544	603,083	10.29
75	5	254541	22291	0.088	0.5	0.359	0.641	44,412	15,954	182,176	345,539	7.78
80	5	98832	13729	0.139	0.5	0.516	0.484	28,458	14,671	105,613	163,363	5.74
85+	5	83602	19959	0.239		1	0.000	13,787	13,787	57,750	57,750	4.19
Total		34,346,564	233,276								(a) 5q0	0.04489
											(b) 45q15	0.18023

Proportional mortality - ranks

LEADING CAUSES OF DEATH AT ALL AGES	Males	Females
Ischaemic Heart Disease	13.3	9.1
Cerebrovascular Disease	11.8	14.0
Chronic Lower Respiratory Disease	8.8	4.3
Pneumonia	5.5	7.6
Diabetes Mellitus	4.7	5.0
Other Heart Diseases	2.2	2.2
Cancer of Colon, Rectum and Anus	2.0	1.3
Hypertensive Diseases	1.8	1.9
Trachea, Bronchus and Lung Cancer	1.3	1.4
Other Malignant Neoplasms	1.2	1.7
Falls	1.2	1.8
Breast Cancer		1.3
Symptoms and Ill-Defined Conditions	30.2	35.8
Other Specified Causes	16.0	12.6
TOTAL	100.0	100.0

Years of Life Lost (YLLs)

- A measure of time lost due to premature death
- A major component of the international Burden of Disease indicator – Disability Adjusted Life Years
- DALY = YLL + YLD
- In developing countries, YLLs account for 65-70% of DALYs, hence important to get the mortality component correct
- YLL calculated using Standard life expectancy
  - Where e_x is the expectation of life at each age x based on ideal standard, facilitates comparison of YLLs across populations and over time
- For Global Burden of Disease, the model life table used as standard (fem e^0 *82.5 years)*
- In this indicator, deaths at all ages contribute to life lost due to premature death, and all deaths at same age from different populations contribute equally to the total burden

WHO NCD mortality Indicator definition

- Unconditional probability of dying between ages 30 and 70 from 4 major NCDs – CVDs, cancers, diabetes, and chronic respiratory diseases
- This indicator excludes potential for confounding across countries due to death from competing causes or different population age-structures
- Allows within country comparison over time to monitor 25% reduction, without confounding as mentioned above
- Age interval chosen because
  - NCD mortality starts rising at age 30
  - Mortality below 70 years is premature death in all populations aged 30 years
  - Cause-specific attribution above age 70 is riddled with uncertainty

Computation

- Step 1: calculate 5 year age-sp death rate – $_5M_x$

$$_5M_x = \frac{Total\ deaths\ from\ four\ NCD\ causes\ between\ exact\ age\ x\ and\ exact\ age\ x+5}{Total\ population\ between\ exact\ age\ x\ and\ exact\ age\ x+5}$$

- Step 2: convert into probability of dying – $_5q_x$

$$_5q_x = \frac{_5M_x * 5}{1 + \ _5M_x * 2.5}$$

- Step 3: compound across target age interval

$$_{40}q_{30} = 1 - \prod_{x=30}^{65}(1 - \ _5q_x)$$

Uses of mortality data

- To assess population dynamics & change

At any time, Total Population size P_t is:

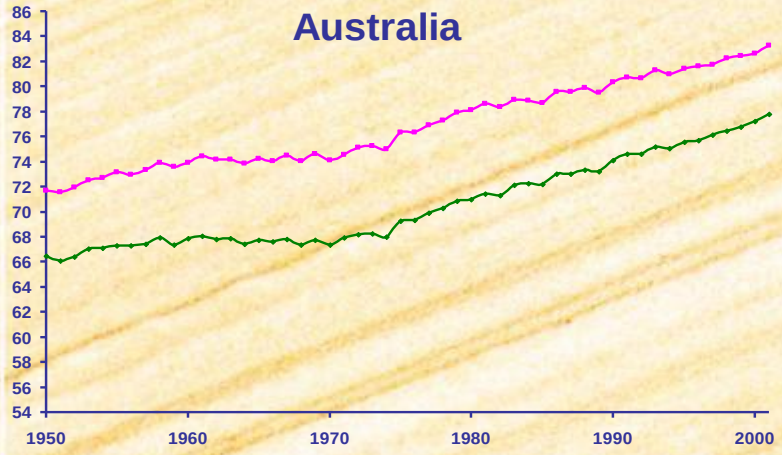
$$P_t = P_0 + \text{births} - \text{deaths} + \text{Immig} - \text{Emig}$$

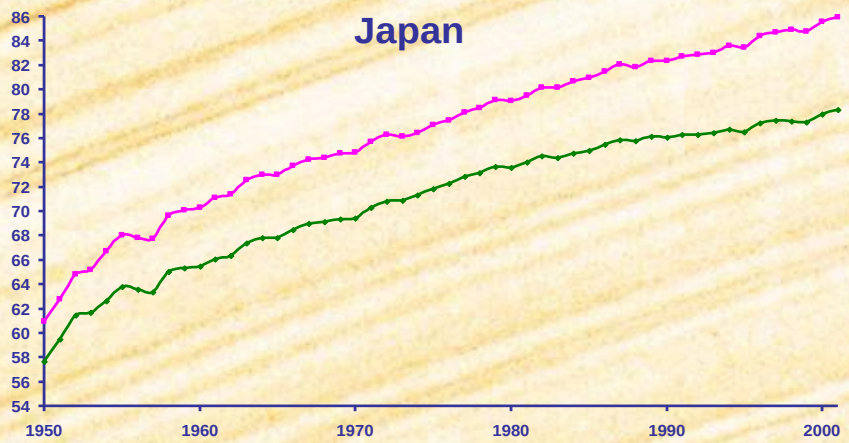
- Total mortality indicators (e.g. Life expectancy at birth; IMR) routinely used to IDENTIFY trends & differentials in socio-economic development

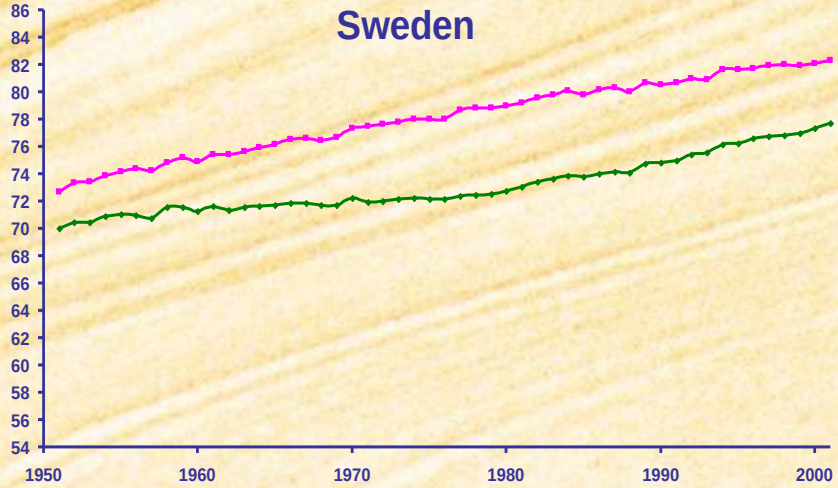
  (e.g. international; sub national; ethnic)

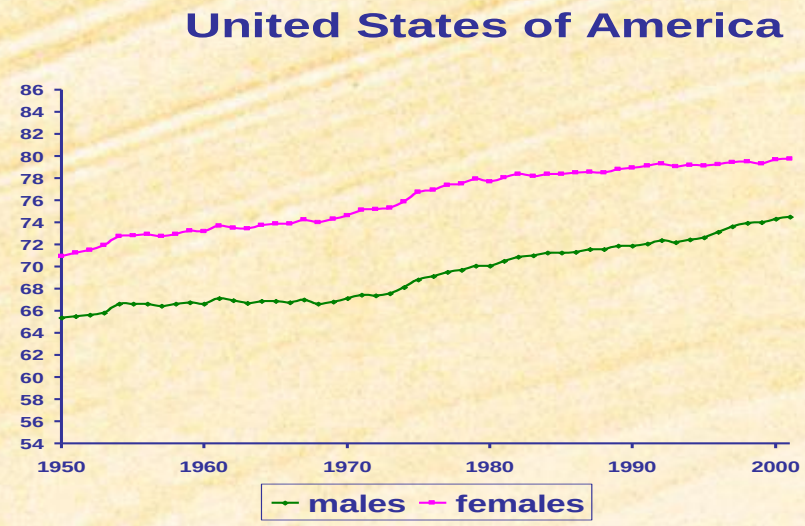
- Total and cause-specific mortality indicators used for health sector planning, evaluation, and research

Life Expectancy, 1950-2001, Selected Countries

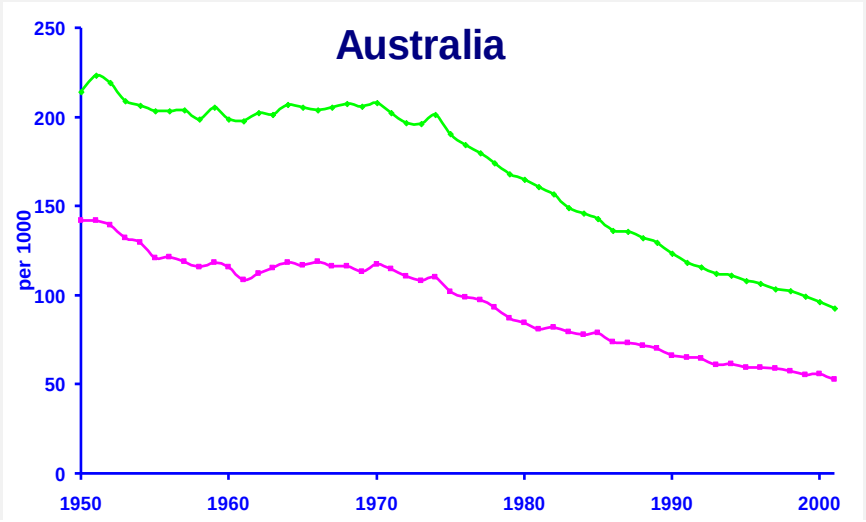


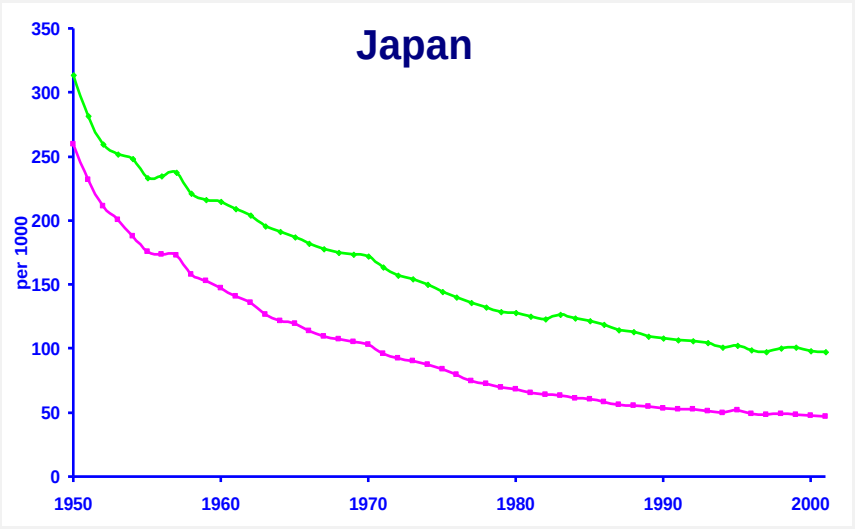


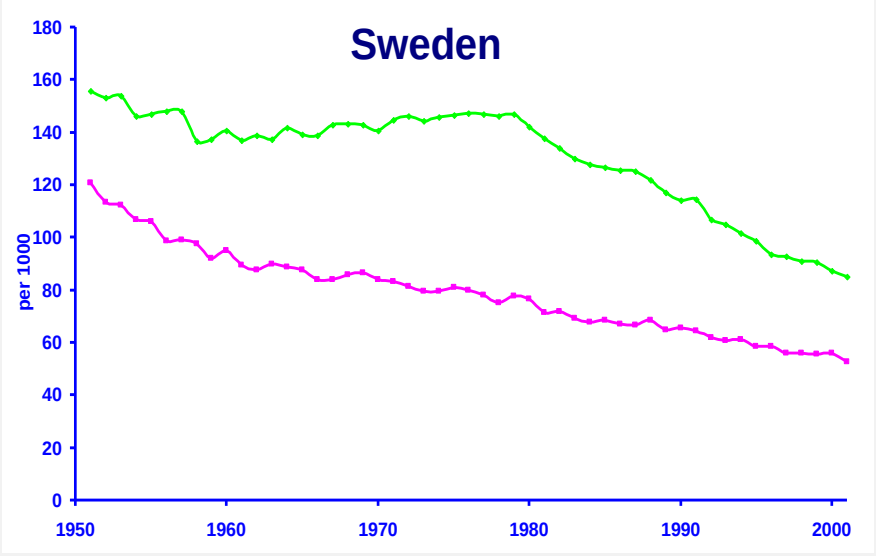


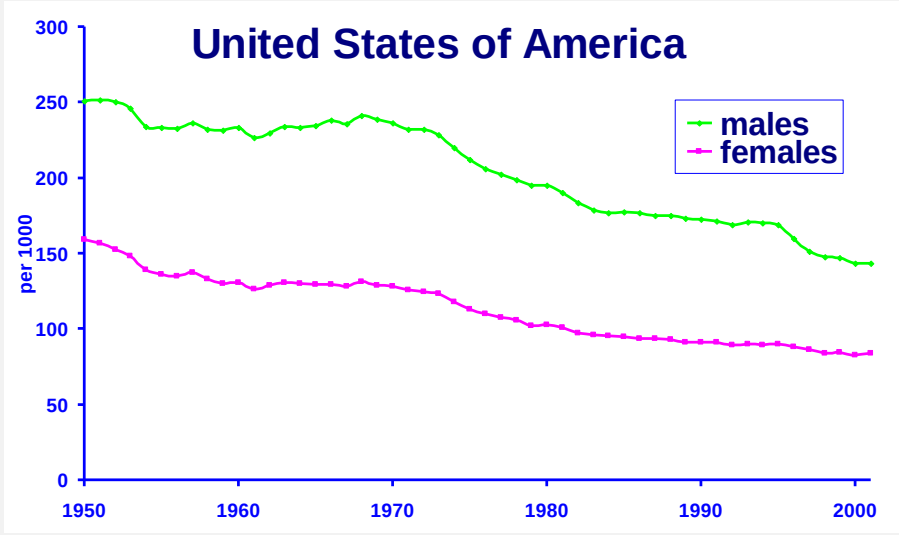


Adult mortality (45q15) trend, 1950-2001

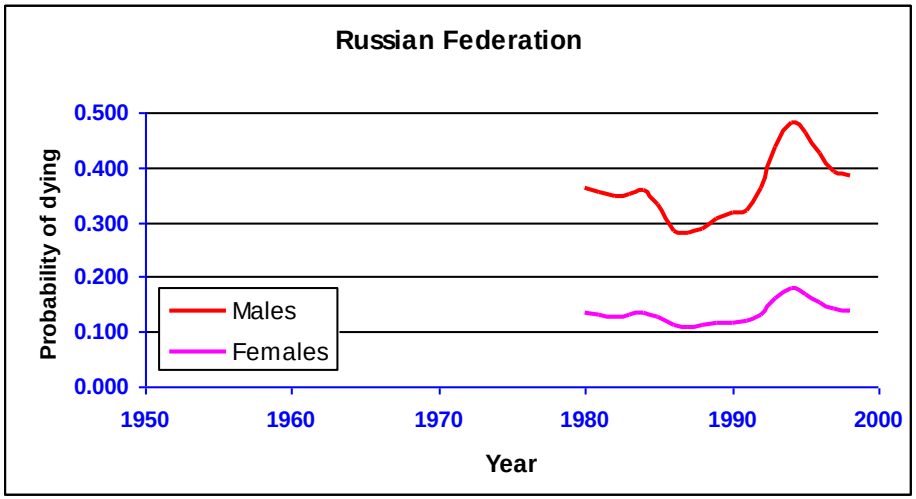


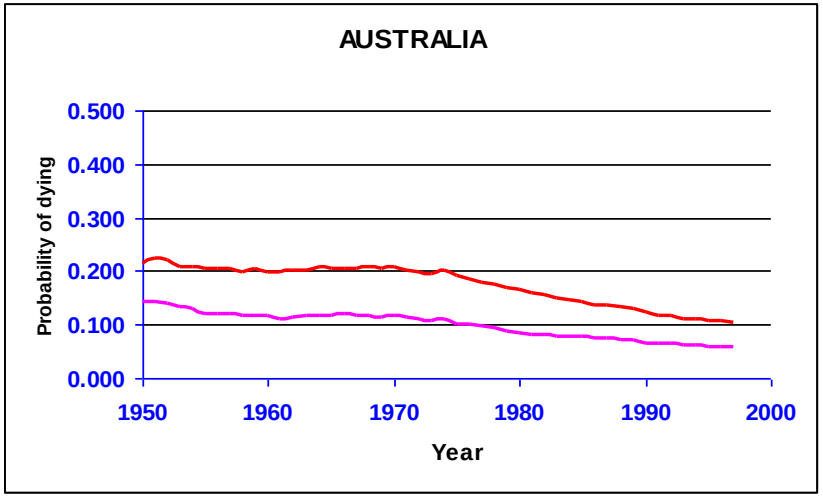


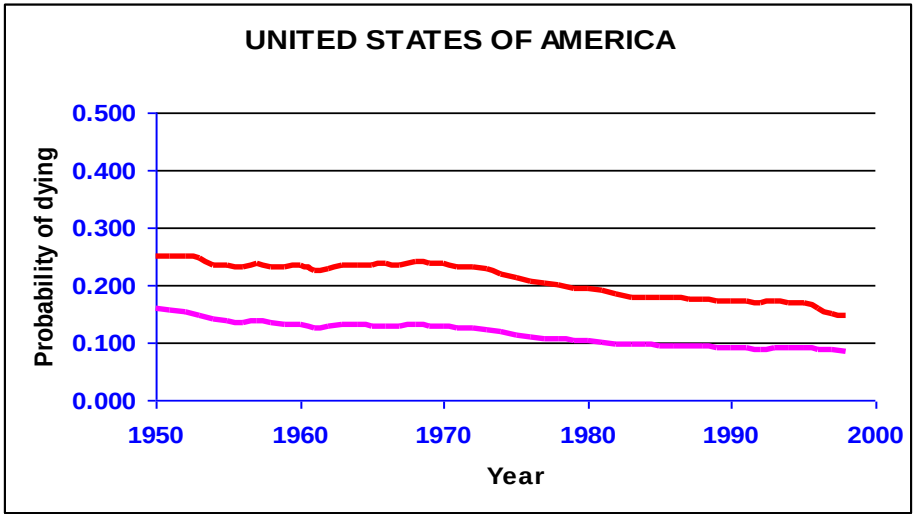


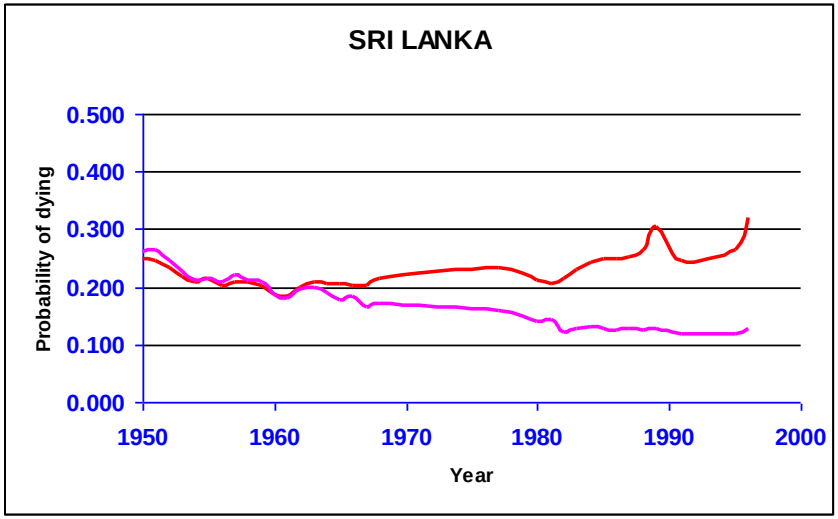


Trends in the probability of dying between ages 15 and 60, selected countries, 1950-1998

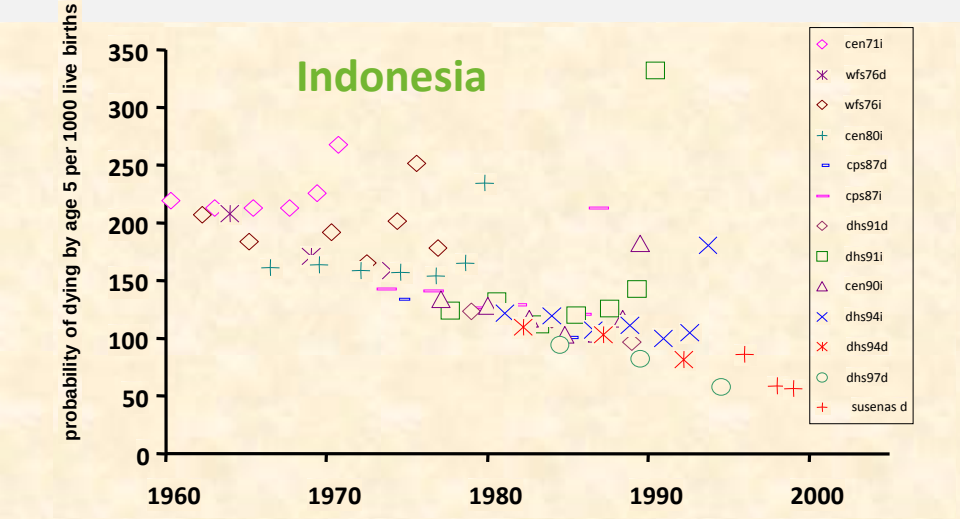


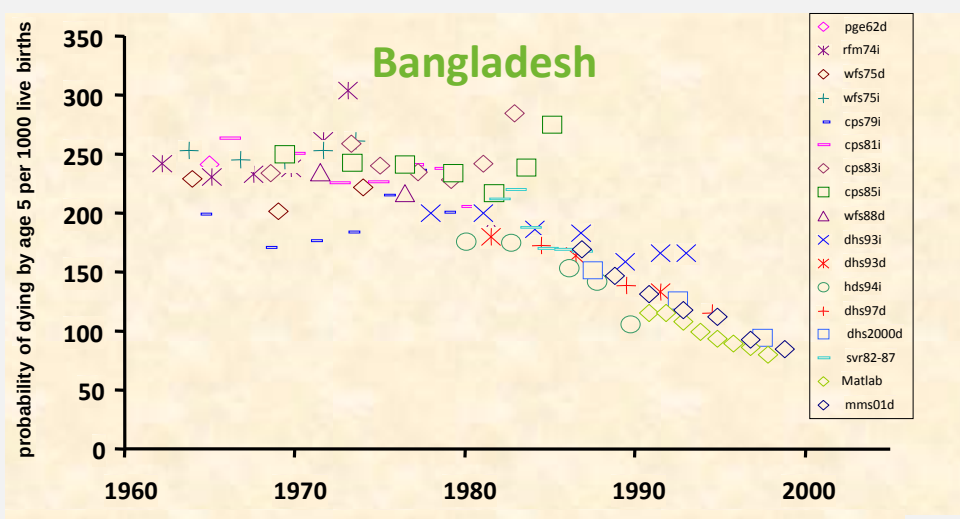


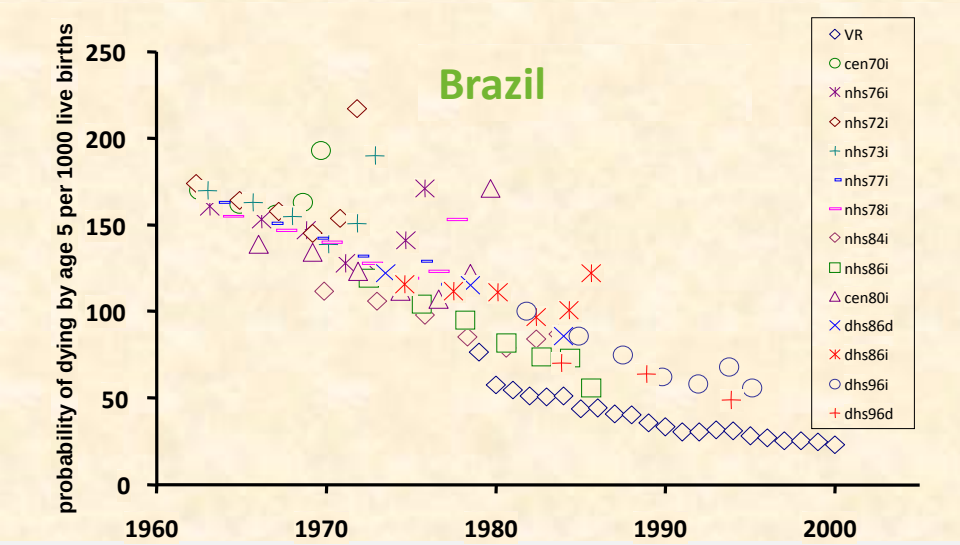


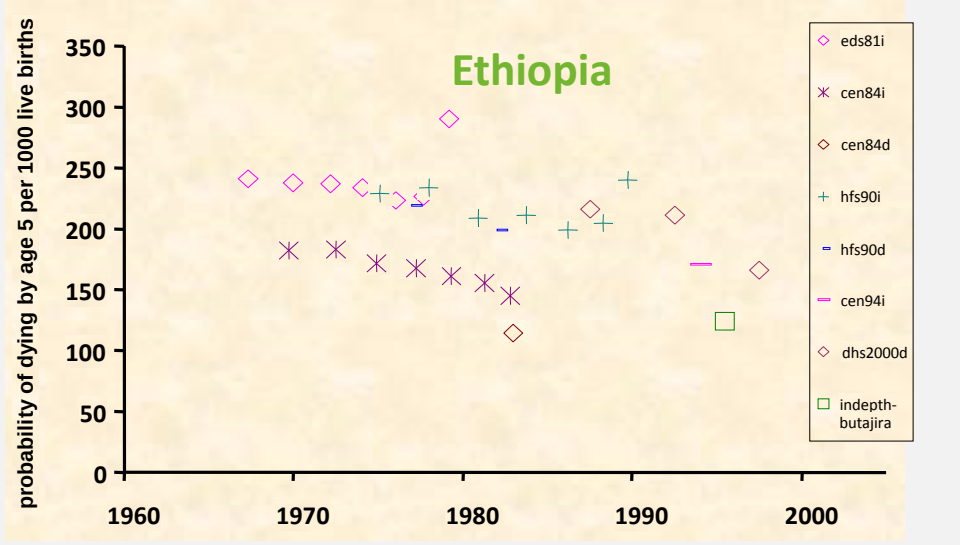


q5 Data Plots for the Top 20 Developing Countries: 5-8





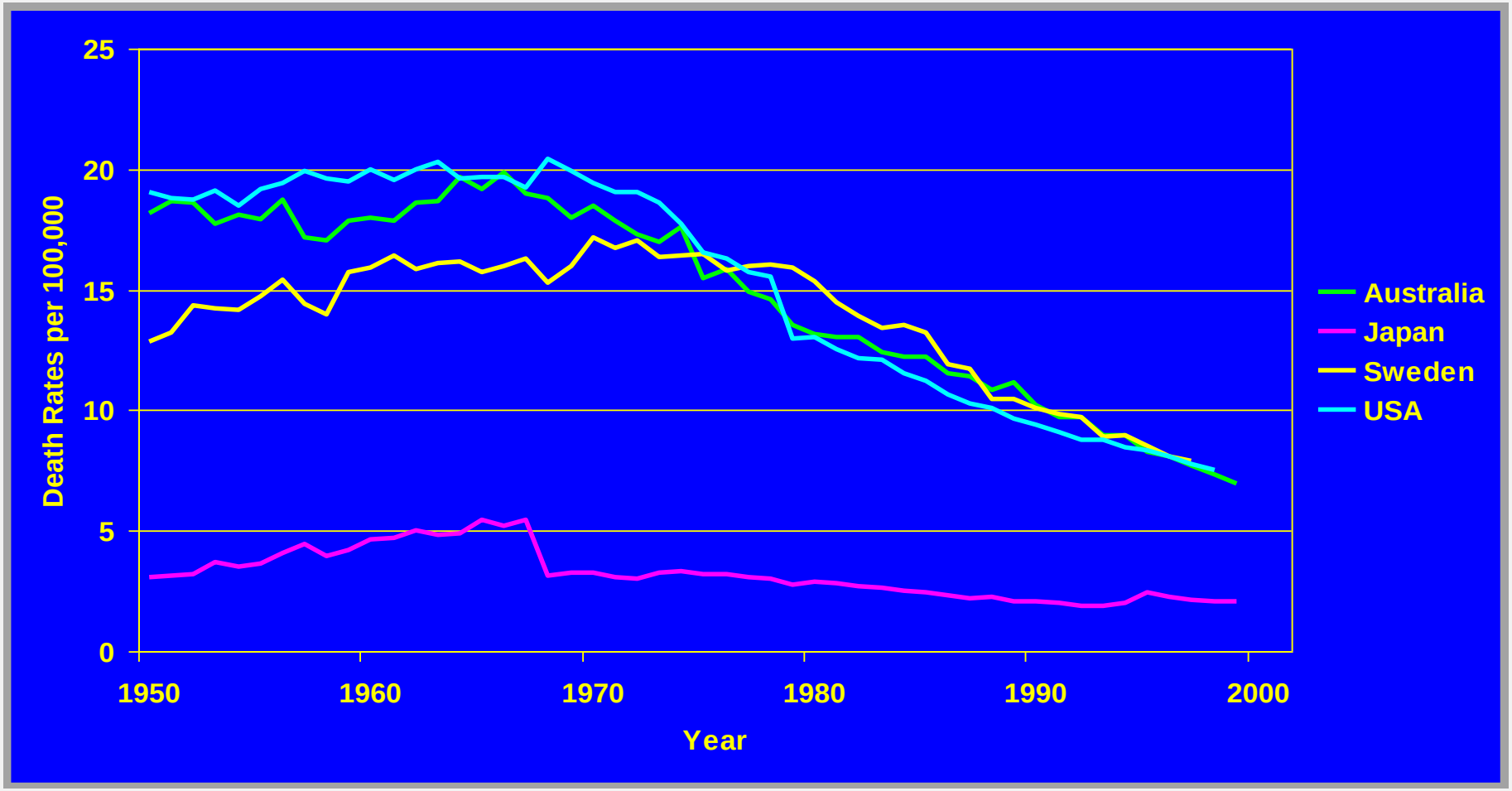




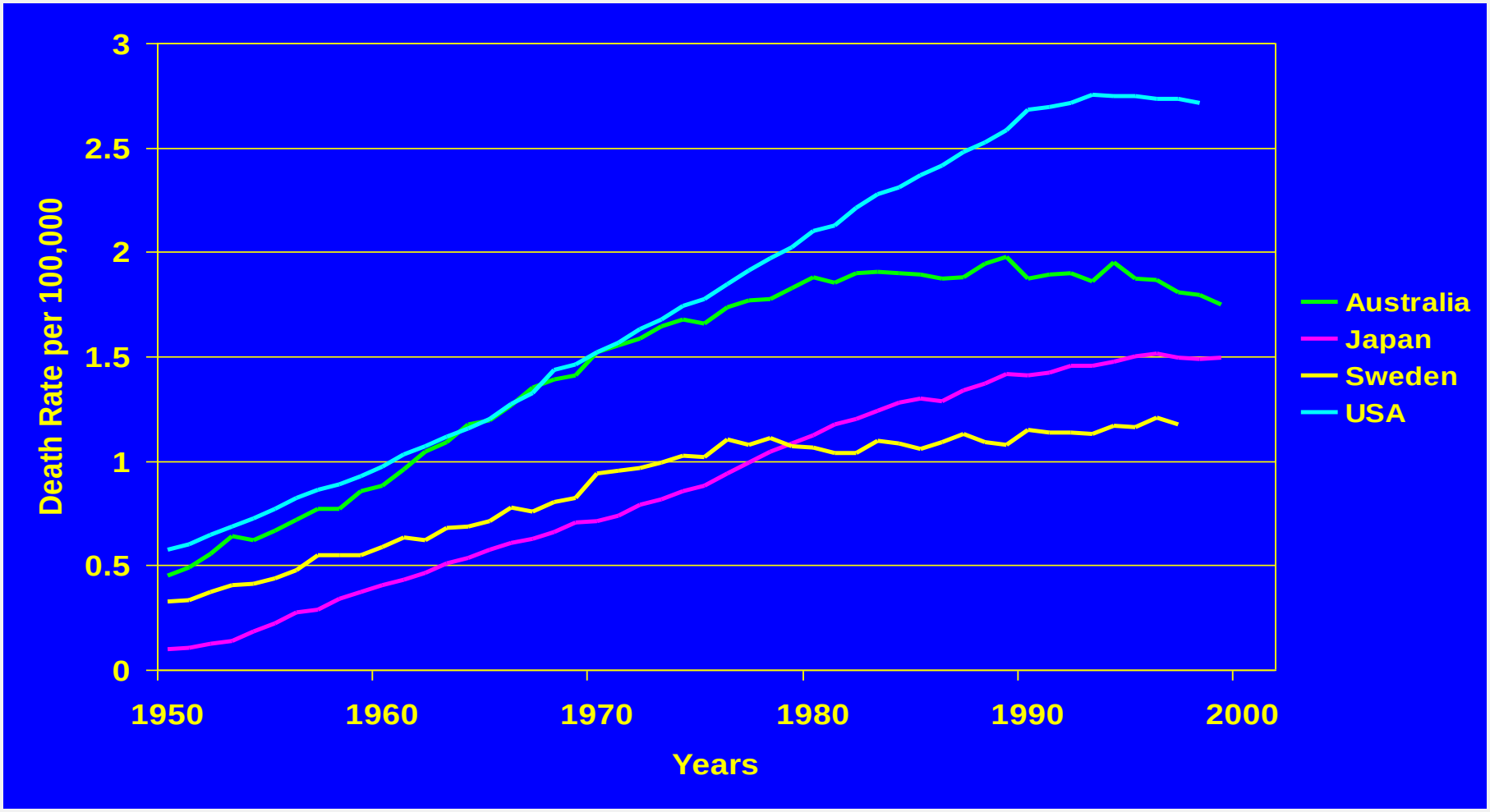
Uses of cause of death data

- To study and EXPLAIN trends / differentials in overall mortality
- To guide priorities for resource allocation for intervention programs, biomedical and sociomedical research
- To monitor public health programs
- To provide clues for epidemiological research
- MORTALITY STATISTICS EASIER TO ACQUIRE AND MORE RELIABLE THAN MORBIDITY– you only die once!

Trends in Mortality from *Ischaemic Heart Disease* 1950 – 2000 (age-standardized death rate at ages 60+)



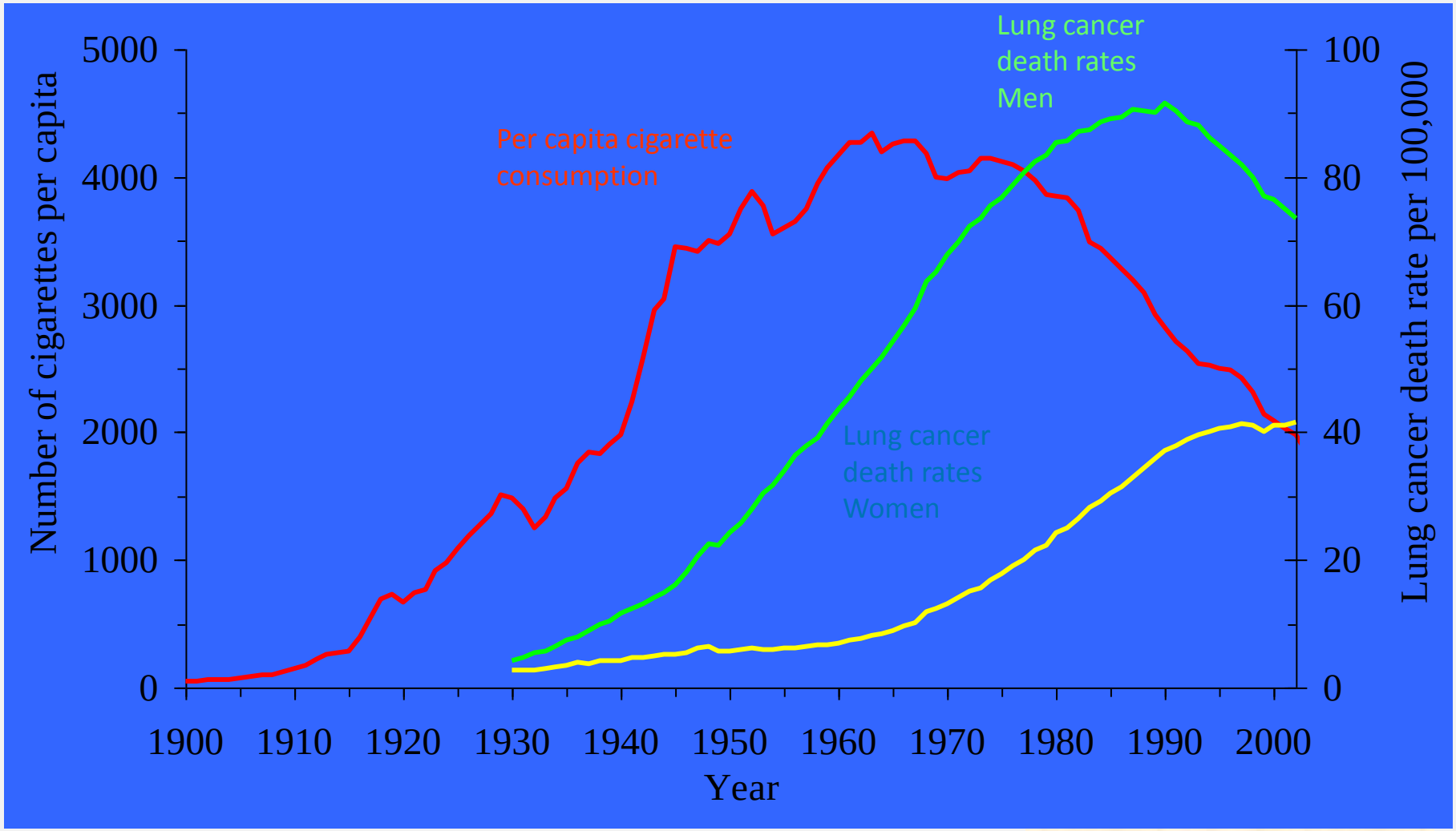
Trends in Mortality from *Lung Cancer* 1950 – 2000 (age-standardized death rate at ages 60+)



Specific examples

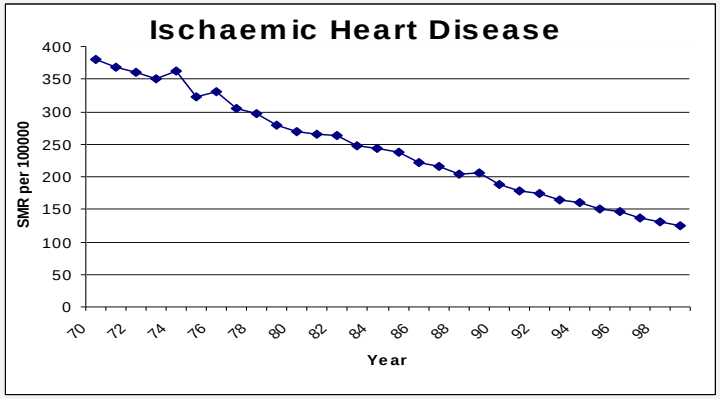
- Risk factors: smoking & lung cancer
- Interventions: Road safety / speed control /seatbelt / drink driving
- Epidemiological research: monitoring cardiovascular mortality, diabetes mortality
- Screening programs: breast cancer mammography / pap smear
- Health services: DOTS treat\ment program; Maternal and child health care

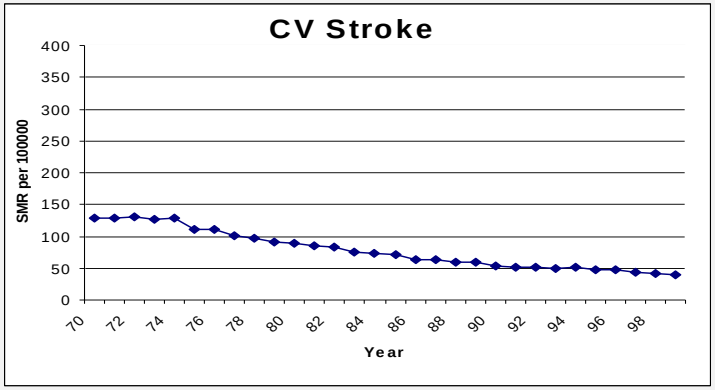
Rear View Mirror- Trends in Cigarette Consumption and Lung Cancer Mortality in the US

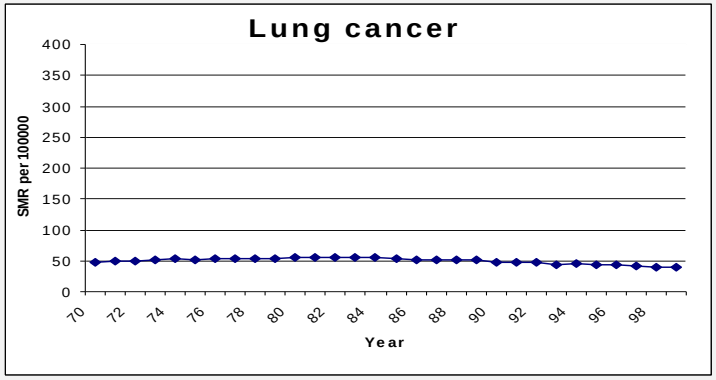


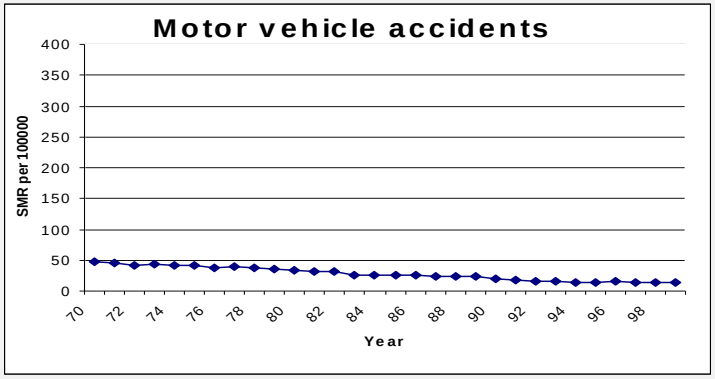
Examples of time trends

Trends in standardized mortality rates : Australia 1970 - 2000









Conclusions

- Obvious need for summarizing data
- Variety of summary indices
- Choice depends on data availability, and interpretational need
- Important to document methods, justify choices, and make rational inferences