

Empirical Data for Assessing Public Health Needs

■ Overview of today's lectures

Empirical Data for Assessing Public Health Needs

10.00-11.00	Demographic Data	SG
11.15-12.15	Epidemiological Data	LR

Practical Aspects of Field-Based Research

12.30-13.00	The Research Process – A Fieldwork Perspective	SG
14.00-14.30	Challenges Conducting Fieldwork in Rural Zimbabwe (Exercise)	SG
14.30-16.30	Student-led Case Studies	LR/SG

■ **Demographic Data**

Sources of Demographic Data

Demographic Indicators

Contemporary Demographic Patterns

■ **Sources of Demographic Data**

Population censuses

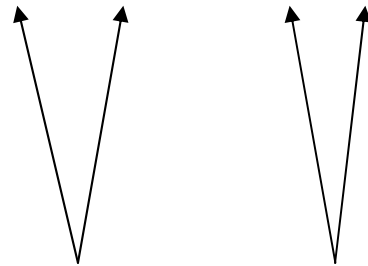
Vital registration

Surveys

Data quality issues

The Basic Demographic Equation - Stock and Flow Statistics

$$P(t_2) = P(t_1) + B - D + I - E$$



census

vital registration

Population Censuses

- *De facto* basis – everyone physically resident on a certain night counted
- *De jure* basis – people “normally resident” in a specified area counted

- Questions on sex, age, occupation, marital status, ...
can calculate total population & population structure (stocks)
- Questions on births & deaths to household members (flows) – developing countries use “indirect” methods

- National censuses – almost all countries, typically every 10 years

Vital Registration

- Continuous data collection process
 - Data on events (flows)
 - Legal requirement to register all births, marriages & deaths (information from death certificates)
 - Migration registration less common (examples: Netherlands & Sweden)
- n.b.: in theory, once have one population count, no need for more

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Vital registration: *Information Collected in E&W by Vital Registration*

■ Births

Date of birth
Place of birth
Name of child
Sex of child

Names of child's parents
Occupation of parents

Description of informant

■ Marriages

Date of marriage
Place of marriage
Names if bride & groom

Occupations of bride & groom
Previous marital status of bride & groom
Ages of bride & groom

Names of parents of bride & groom
Occupation of fathers of bride & groom
Form of ceremony

■ Deaths

Date of death
Place of death
Name of deceased
Sex of deceased
Occupation of deceased

Age of deceased at death
Cause of death
(up to three causes)

Description of informant

Source: A. Hinde, 1998.

Population Surveys

- Supplementary information – limited detail possible in censuses & VR
- Substitute for censuses – sample surveys may be a cheaper option
- Examples: E&W – National Statistics Longitudinal Study (prospective cohort)
- Examples: Developing countries - WFS & DHS fertility surveys (retrospective sample surveys) – *birth histories, HIV/AIDS*

Data Quality Issues

- Coverage, hard-to-reach populations & participation bias
- Response bias – recall & social desirability
- Age misreporting – age omissions, age heaping, age shifting ...
- Official corruption/manipulation



*"According to the Census Bureau, our state will gain two congressmen.
... That's the price we pay for overpopulation."*

As required by the Constitution, the decennial census provides the basis for fair reapportionment states of seats in the House of Representatives. It is also used to set district boundaries for state legislative bodies.

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Data Quality Issues:

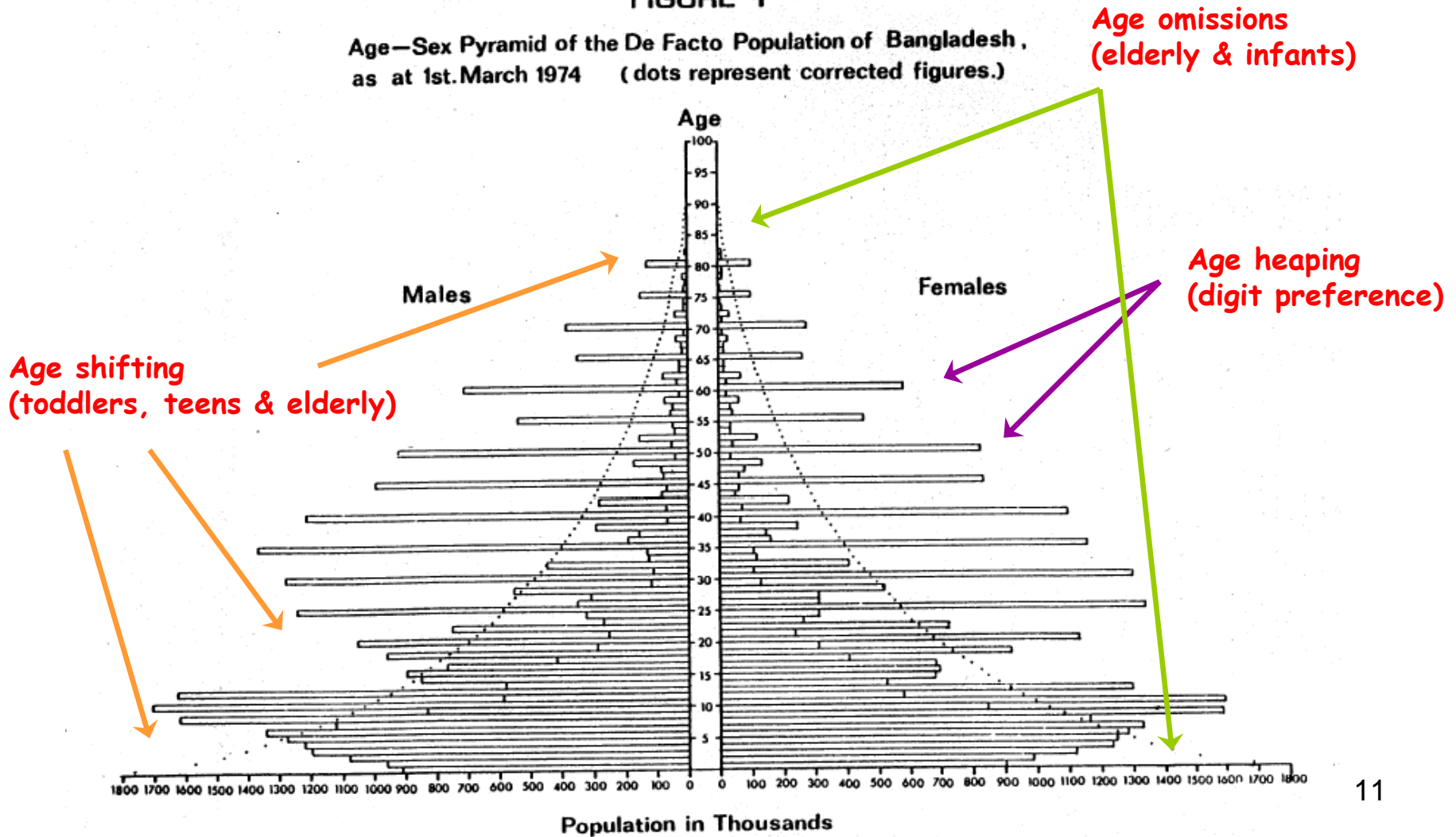
Coverage

- Undercounts tend to be selective:
 - Single people living alone
 - Old people living alone
 - Mobile people – teenagers, students, ... people with multiple residences
 - Very young children – not yet named?
 - Hard-to-reach populations - nomadic groups, homeless, remote villages, difficult to find urban properties ...
 - Ethnic minorities – illegal immigrants or lack of trust in Government use of data
 - Truncation of large households

- Methods of assessment – re-run (USSR), post-enumeration surveys, forward/back projection using VR data, analysis of trends in sex ratio (India) or inter-censal growth rates ...

Data Quality Issues:
Age Misreporting

FIGURE 1
Age—Sex Pyramid of the De Facto Population of Bangladesh,
as at 1st.March 1974 (dots represent corrected figures.)



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Data Quality Issues:

Age Misreporting

- **Why significant?**

Depends on proposed use of data – e.g.: gross *versus* net errors

Age = a key variable in most demographic analyses

e.g.: birth & death rates vary by age, birth history analyses, ...

- **Methods of assessment**

Whipple Index for age heaping

- **Possible remedies**

Event calendars

Aggregate into 5-year age-groups

Official Statistics

- WHO, UNAIDS, UNICEF, national governments etc.
- Often use data from secondary sources
- Mathematical models (e.g. UN estimates of AIDS mortality)

■ Demographic Indicators

“demographic” rate =
$$\frac{\text{number of events of a specific type in a given period}}{\text{number of people at risk of experiencing that type of event in the given time period}}$$

sometimes referred to as an “*occurrence/exposure ratio*”

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■ Mortality Rates

$$\text{CDR} = \frac{\text{number of deaths occurring (registered) in year}}{\text{total mid-year population}} \times 1000$$

Singapore 1996: $15,590 / 3,612,000 \times 1000 = 4.3$ deaths / 1000 population

UK 1996: $638,896 / 58,801,000 \times 1000 = 10.9$ deaths / 1000 population

India 1996: $8,500,000 / 955,220,000 \times 1000 = 8.9$ deaths / 1000 population

Uganda 1996: $402,000 / 18,440,000 \times 1000 = 21.8$ deaths / 1000 population

n.b.: deaths for Uganda & India are estimates from surveys or sample registration systems. Population totals from census but only approximate.

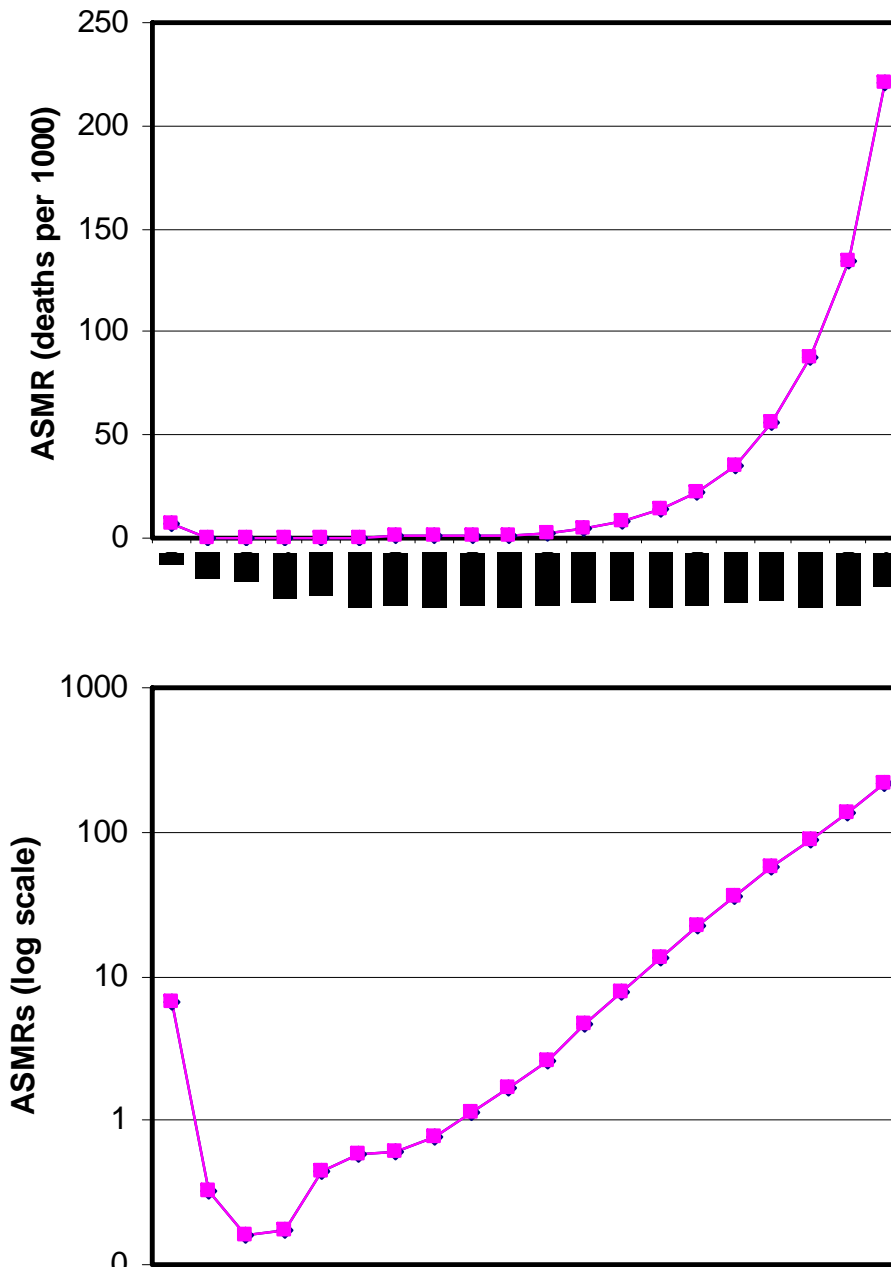
Selected countries, 1970s – arranged in ascending order of CDR

Country	CDR	e ₀ (m)
Bahamas	4.6	64.0
Hong Kong	5.2	67.4
Japan	6.0	72.1
Mauritius	7.1	60.7
Jamaica	7.1	62.7
Ceylon	7.7	64.8
Spain	7.7	69.7
USA	8.8	68.7
Paraguay	8.9	60.3
Poland	9.3	66.9
USSR	9.6	64.0
England & Wales	11.9	69.7
West Germany	13.9	68.8
Kenya	14.0	46.9
India	15.0	41.9
Haiti	17.4	47.1
Malawi	26.5	40.9

Sources: UN Demographic Yearbook, 1978, 1997

Age-group	Population (1000s)	Deaths (both sexes)	ASMR (per 1000)
0-1	694.50	4539	6.54
1-4	2760.10	874	0.32
5-9	3258.90	516	0.16
10-14	3126.60	521	0.17
15-19	3106.50	1401	0.45
20-24	3878.90	2236	0.58
25-29	4255.60	2541	0.60
30-34	3881.50	2932	0.76
35-39	3407.50	3807	1.12
40-44	3516.50	5862	1.67
45-49	3394.90	8938	2.63
50-54	2722.90	12515	4.60
55-59	2577.00	20014	7.77
60-64	2533.60	34245	13.52
65-69	2422.50	55025	22.71
70-74	2115.10	74755	35.34
75-79	1625.40	91328	56.19
80-84	1151.40	100882	87.62
85-89	598.20	80315	134.26
90+	249.30	55067	220.89
All ages	51276.90	558313	10.89

Age-Specific Mortality Rates *England & Wales, 1992*



ASMR schedule comparisons valid but cumbersome; prefer a single indicator ...

Standardization: methods for eliminating the distortions in the CDR arising from differences in age structure

“Direct” Standardization: apply a common “standard” population age structure to ASMRs from comparison populations

“Indirect” Standardization: apply ASMRs from one “standard” population to the population age structures of all comparison populations

Indirect standardization has the advantage that it can be used where reliable data on mortality by age are not available - not collected or want to compare sub-populations where numbers may be small

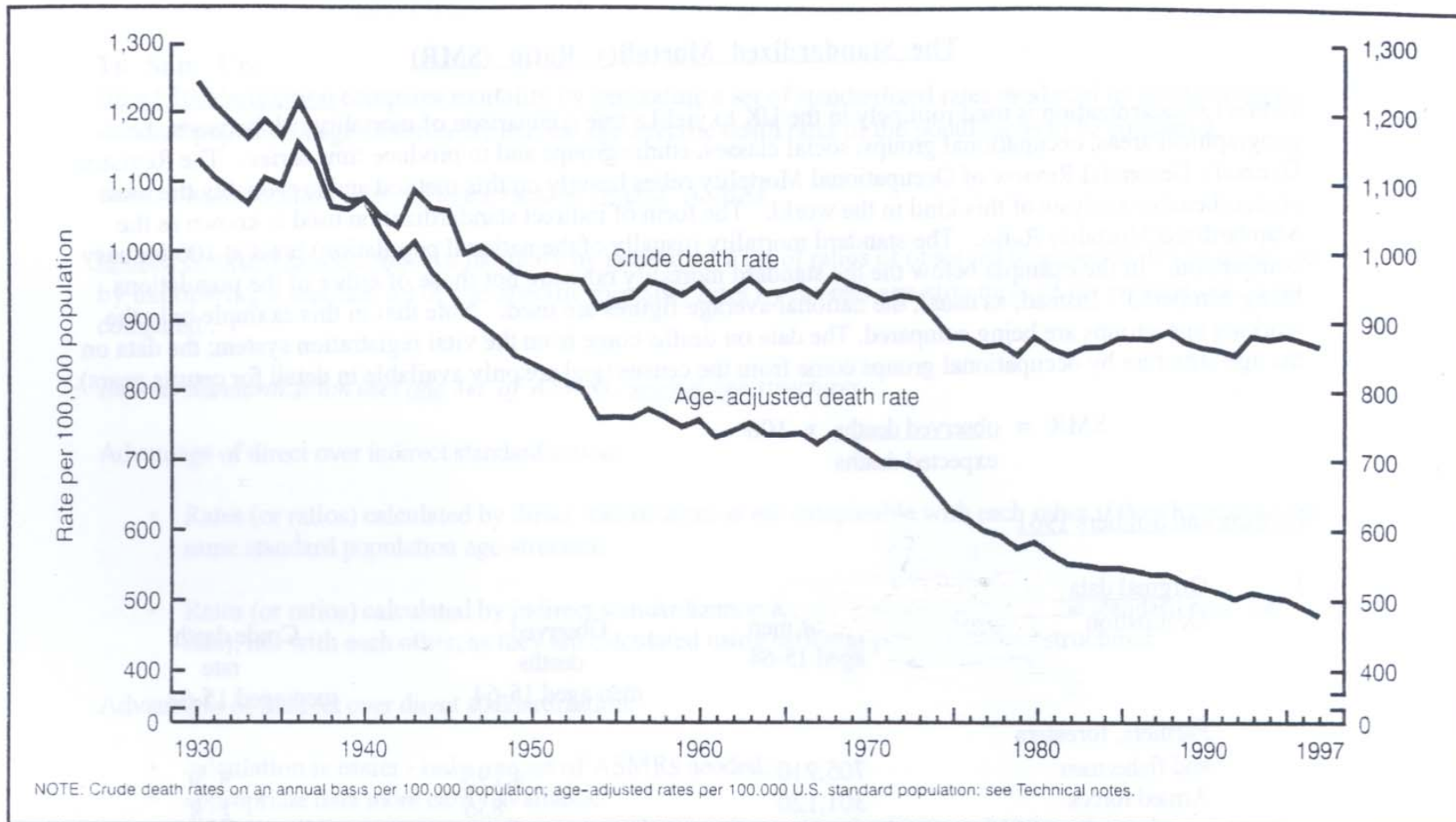


Figure 1. Crude and age-adjusted death rates: United States, 1930–97

$$\text{SMR} = \text{Standardized Mortality Ratio} = \frac{\text{observed deaths}}{\text{expected* deaths}} \times 100$$

i.e. 'expected' if a 'standard' schedule of ASMRs is applied to the age-structure of given population(s)

Farmers & Soldiers, UK, 1961

Occupation	No of men, 15-64	Observed deaths	CDR, men 15-64
Farmers, foresters & fishermen	705,910	4,195	5.9
Armed forces	301,120	856	2.8

Question: *do farmers really have 2.1 times the death rate of soldiers?*

Age	National death rates	Farmers: #	Expected deaths	Soldiers: #	Expected deaths
15-24	1.028	134,560	138	165,030	170
25-34	1.118	124,100	139	73,240	82
35-44	2.411	132,220	319	42,250	102
45-54	7.072	160,110	1,132	15,930	113
55-64	21.710	154,920	3,363	4,670	101
Total expected deaths			5,091		568

SMR (farmers) = $\text{obs/exp} \times 100 = 4195/5091 \times 100 = 82$

SMR (soldiers) = $\text{obs/exp} \times 100 = 856/568 \times 100 = 151$

e_0 average number of years a newborn infant can expect to live under current mortality levels

e_x expectation of life at exact age x

Calculated using “Life Table” methods from data on age-specific mortality rates pertaining in the given time period

See Newell, Rowland etc.

$$\text{IMR} = \frac{\text{number of deaths age 0-1}}{\text{number of live births in the calendar year}} \times 1000$$

$$\text{E\&W 1985: } 6,141 / 656,417 \times 1000 = 9.36 \text{ deaths / 1000 live births}$$

Mid-year population for 0-1s would be difficult to obtain

**IMR is always smaller than the ASMR for ages 0-1 in stable populations:
total births greater than mid-year population**

$$\text{Neonatal mortality rate} = \frac{\text{number of deaths within first 4 weeks}}{\text{number of live births in the year}} \times 1000$$

$$\text{Post-neonatal mortality rate} = \frac{\text{number of deaths within 5-52 weeks}}{\text{number of live births in the year}} \times 1000$$

Early neonatal = week 1

$$\text{Perinatal mortality rate} = \frac{\text{still births \& early neonatal deaths}}{\text{total births (live \& still) in the year}} \times 1000$$

 Fertility Rates

$$\text{CBR} = \frac{\text{live births occurring in year}}{\text{total mid-year population}} \times 1000$$

$$\text{E\&W 1990: } 706,140 / 50,718,800 \times 1000 = 13.9 \text{ births / 1000 population}$$

$$\text{India 1991: } 25,400,000 / 849,638,000 \times 1000 = 29.9 \text{ births / 1000 population}$$

$$\text{Uganda 1991: } 840,000 / 16,671,705 \times 1000 = 50.4 \text{ births / 1000 population}$$

n.b.: births for Uganda & India are estimates from surveys or sample registration systems. Population totals from census but only approximate.

$$\text{ASFR} = \frac{\text{live births in a year to given age-group}}{\text{total mid-year population of women in the age-group}} \times 1000$$

$$f_a = \frac{B_a}{FP_a}$$

f_a is the age-specific fertility rate at age a ,
 B_a is the number of live births to women at that age, and
 FP_a is the female mid-year population aged a (single year or, more usually, 5-year age group)

ASMFR, equivalent for married women only.

$$\text{TFR} = \sum_{a=15}^{49} f_a$$

TFR, "Period" measure – Cohort equivalent is "Completed Family Size" (**CFS**)

Hypothetical measure – requires caution in interpretation ...

Inflated by shifts forward in the timing of fertility & deflated when fertility is being deferred (as in Europe at present)

Sometimes referred to as a 'ratio'

England & Wales, 1990

Age-group (1)	No of live births to women in age-group (2)	No of women in age-group (3)	ASFRs (2) / (3)
15-19	55,541	1,667,600	.03331
20-24	180,136	1,964,000	.09172
25-29	252,577	2,063,200	.12242
30-34	152,264	1,789,100	.08511
35-39	51,905	1,664,300	.03119
40-44	9,220	1,836,100	.00502
45-49	497	1,496,700	.00033
Σ (ASFRs)			.36910
TFR = 5 * Σ (ASFRs)			1.8455

2010: 1.9

TMFR, equivalent for married women only.

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■ Contemporary Demographic Patterns

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WORLD POPULATION PATTERNS 2010

	Annual Growth Rate	Crude Birth Rate	Crude Death Rate	Total Fertility Rate	Life Expectancy at Birth	Infant Mortality Rate
	%	0/00	0/00	per woman	years	0/00
WORLD	1.2	20	8	2.5	69	46
Africa	2.4	37	13	4.7	55	76
North America	0.6	13	8	2.0	78	6
South America	1.3	19	6	2.3	74	22
Asia	1.2	19	7	2.2	70	41
Europe	0.0	11	11	1.6	76	6
Oceania	1.1	18	7	2.5	76	21

Source: Population Reference Bureau

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WORLD POPULATION PATTERNS 2010 *selected countries*

	Annual Growth Rate	Crude Birth Rate	Crude Death Rate	Total Fertility Rate	Life Expectancy at Birth	Infant Mortality Rate
	%	0/00	0/00	per woman	years	0/00
UK	0.4	13	9	1.9	80	4.7
Ireland	1.0	17	6	2.1	79	3.5
Italy	0.0	10	10	1.4	82	3.6
USA	0.6	14	8	2.0	78	6.4
Russian Fed	-0.2	12	14	1.5	68	8.2
China	0.5	12	7	1.5	74	21
India	1.5	23	7	2.6	64	53
Japan	0.0	9	9	1.4	83	2.6
Afganistan	2.1	39	18	5.7	44	155

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WORLD POPULATION PATTERNS 2010 *selected countries*

	Annual Growth Rate	Crude Birth Rate	Crude Death Rate	Total Fertility Rate	Life Expectancy at Birth	Infant Mortality Rate
	%	0/00	0/00	per woman	years	0/00
Sierra Leone	2.4	40	16	5.1	48	89
Nigeria	2.4	42	17	5.1	47	75
Uganda	3.4	47	13	6.5	47	76
Zimbabwe	1.3	30	17	3.7	37	60
Bolivia	2.0	27	7	3.5	65	45
Brazil	1.0	17	6	2.0	72	24

Source: Population Reference Bureau

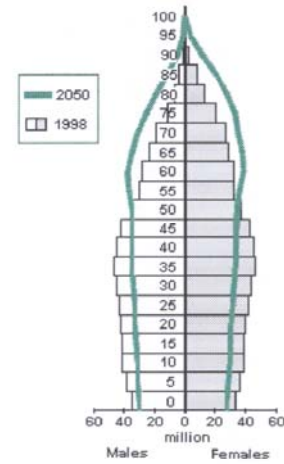
WORLD POPULATION PATTERNS 2010 *highest and lowest*

	Total Fertility Rate	Life Expectancy at Birth
	per woman	years
Highest	7.4 Niger	83 Japan
Lowest	1.0 Hong Kong Taiwan	41 Lesotho

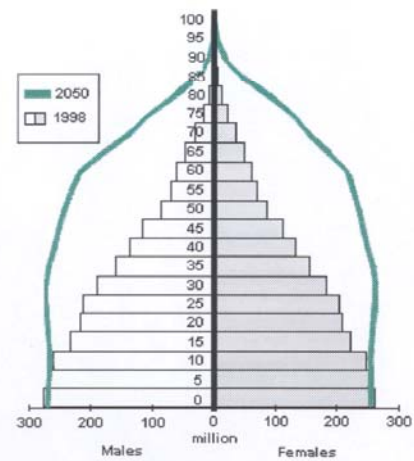
Source: Population Reference Bureau

Figure I. Age pyramids for more and less developed regions, 1998 and 2050 (Medium variant projections)

More Developed Regions

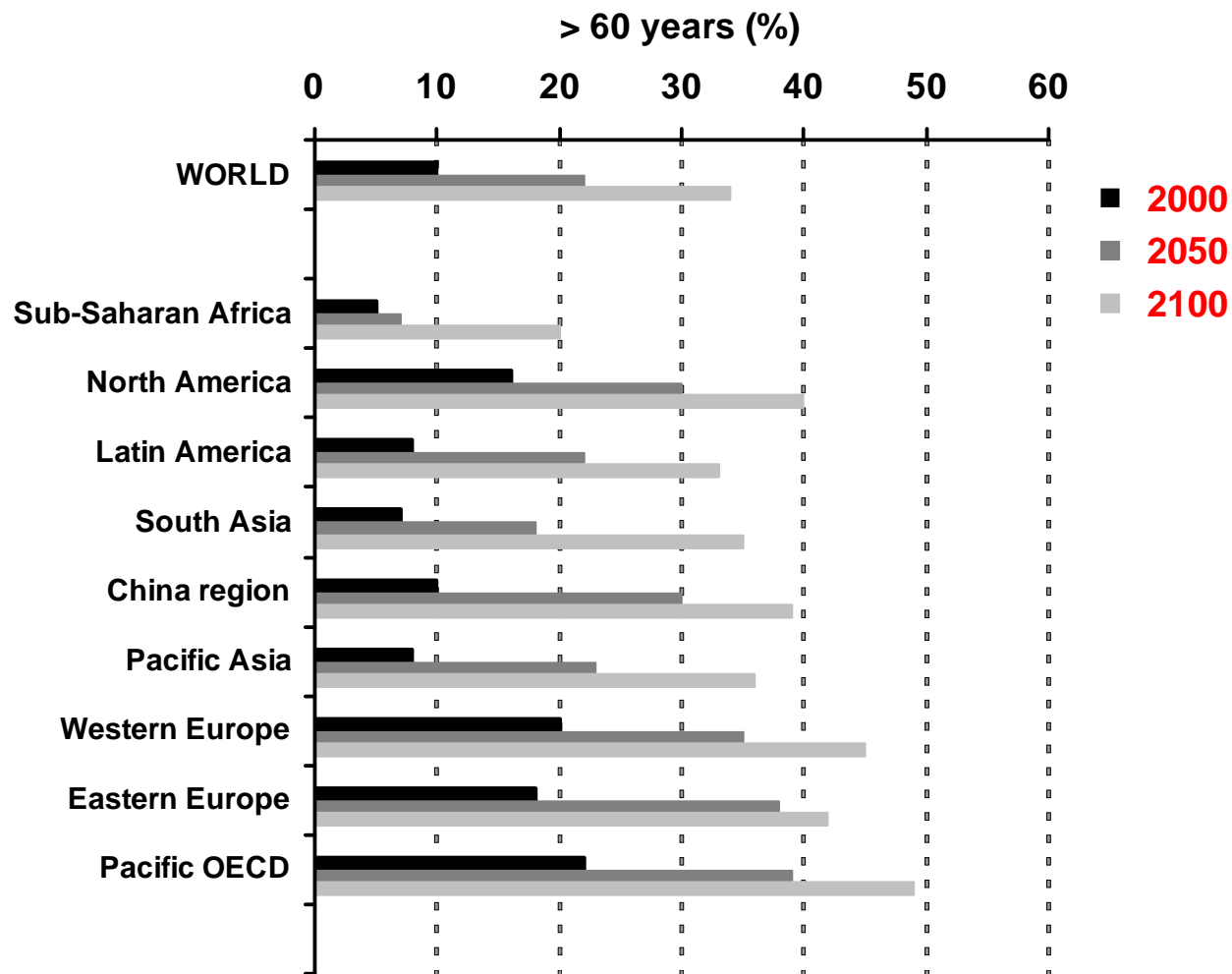


Less Developed Regions



Source: United Nations Population Division, *World Population Prospects: The 1998 Revision*, forthcoming.

Population ageing Proportion of population aged over 60 years



Other contemporary demographic trends & concerns:

- Ageing & quality of life amongst the elderly
- International migration
- Urbanisation
- Negative population growth
- Changes in marriage patterns – age, ever-, divorce, single parent families, pre/extra-marital sex, ...
- Rise in orphan levels in Africa
- Sex ratio at birth – sex selection
- Maternal mortality