World Mortality Report 2011

United Nations

Department of Economic and Social Affairs
Population Division

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United Nations
New York, 2012

DESA

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Note

Suggested citation:

PREFACE

The *World Mortality Report 2011*, prepared by the Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, provides an overview of the estimated and projected trends in mortality at the world level, for development groups and major areas; the analysis also focuses on country and regional data for selected mortality indicators. In addition to examining the summary indicator of life expectancy at birth, the report analyzes levels and trends in mortality for key age groups in childhood and provides a snapshot of adult and "old age" mortality levels. The report also revisits the impact of the HIV/AIDS epidemic on estimated and projected mortality in light of recent updates in HIV prevalence levels and treatment coverage. An analysis of trends in life expectancy decomposed by age group is also presented to highlight the contributions of mortality change at different ages over recent decades. Lastly, the report presents an alternative way of examining the life tables from *World Population Prospects* to understand how the survival experience of cohorts differs from the period life expectancy measure.

The mortality estimates presented in this report are available in digital form. Interested users can purchase the CD-ROM[1] containing the corresponding data and results of the *World Mortality Report 2011*. A description of the data provided on the CD-ROM and an order form are presented on pages 39 to 42 of this publication and are also posted on the Population Division's web site (*www.unpopulation.org*). The CD-ROM also includes an updated data inventory.

The Population Division is grateful to the Statistics Division of the United Nations Department of Economic and Social Affairs for its continuing cooperation. The Population Division also acknowledges the assistance and cooperation of the World Health Organization, UNICEF, Measure DHS, the Human Mortality Database, the International Programs Center of the U.S. Census Bureau, and IPUMS-International as well as national statistical offices in providing some of the data that inform the estimates presented in this report.

For information about the *World Mortality Report 2011*, please contact the Director, Population Division, Department of Economic and Social Affairs, United Nations, New York, NY 10017, USA (Fax: 1-212-963-2147).

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[1] United Nations, Department of Economic and Social Affairs, Population Division (2011a). *World Mortality Report 2011*, CD-ROM Edition, Datasets in Excel and PDF formats (POP/DB/MORT/2011).

CONTENTS

TABLES

The following symbols have been used in the tables throughout this report:

Two dots (..) indicate that data are not available or are not reported separately.
A hyphen (-) indicates that the item is not applicable.
An em dash (—) indicates that the amount is nil or negligible.
A full stop (.) is used to indicate decimals.
Years given refer to 1 July.

When referring to mortality estimates from *World Population Prospects: The 2010 Revision,* use of a hyphen (-) between years, for example, 1995-2000, signifies the full period from 1 July of the first year to 30 June of the second year.

Numbers and percentages in tables do not necessarily add to totals because of rounding.

References to countries, territories and areas:

The term "country" as used in the text of this publication also refers, as appropriate, to territories or areas. The designations "developed" and "developing" countries and "more developed" and "less developed" regions are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process.

More developed regions comprise all regions of Europe plus Northern America, Australia/New Zealand and Japan.

Less developed regions comprise all regions of Africa, Asia (excluding Japan) and Latin America and the Caribbean, as well as Melanesia, Micronesia and Polynesia.

The group of least developed countries comprises 48 countries: Afghanistan, Angola, Bangladesh, Benin, Bhutan, Burkina Faso, Burundi, Cambodia, Central African Republic, Chad, Comoros, Democratic Republic of the Congo, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gambia, Guinea, Guinea-Bissau, Haiti, Kiribati, Lao People's Democratic Republic, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Myanmar, Nepal, Niger, Rwanda, Samoa, São Tomé and Príncipe, Senegal, Sierra Leone, Solomon Islands, Somalia, Sudan, Timor-Leste, Togo, Tuvalu, Uganda, United Republic of Tanzania, Vanuatu, Yemen and Zambia.

Other less developed countries comprise the less developed regions excluding the least developed countries.

The designation sub-Saharan Africa is commonly used to indicate all of Africa except northern Africa, with the Sudan included in sub-Saharan Africa.

Countries and areas are grouped geographically into six major areas: Africa; Asia; Europe; Latin America and the Caribbean; Northern America; and Oceania. These major areas are further divided into 21 geographical regions.

Names and compositions of geographical areas follow those of "Standard country or area codes for statistical use" (ST/ESA/STAT/SER.M/49/Rev.3), available at: http://unstats.un.org/unsd/methods/m49/m49.htm.

The following abbreviations/acronyms have been used:

AIDS	Acquired Immunodeficiency Syndrome
ART	Antiretroviral Therapy
DESA	Department of Economic and Social Affairs
HIV	Human Immunodeficiency Virus
IMR	Infant Mortality Rate
IPUMS	Integrated Public Use Microdata Series
PMTCT	Prevention of Mother-to-Child HIV Transmission
SAR	Special Administrative Region
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNICEF	United Nations Children's Fund
UNPD	United Nations Population Division
WHO	World Health Organization

Africa

Eastern Africa	*Middle Africa*	*Northern Africa*	*Western Africa*
Burundi	Angola	Algeria	Benin
Comoros	Cameroon	Egypt	Burkina Faso
Djibouti	Central African Republic	Libyan Arab Jamahiriya	Cape Verde
Eritrea	Chad	Morocco	Côte d'Ivoire
Ethiopia	Congo	Sudan[1]	Gambia
Kenya	Democratic Republic of the	Tunisia	Ghana
Madagascar	Congo	Western Sahara	Guinea
Malawi	Equatorial Guinea		Guinea-Bissau
Mauritius[2]	Gabon	*Southern Africa*	Liberia
Mayotte	São Tomé and Príncipe		Mali
Mozambique		Botswana	Mauritania
Réunion		Lesotho	Niger
Rwanda		Namibia	Nigeria
Seychelles*		South Africa	Saint Helena[3,*]
Somalia		Swaziland	Senegal
Uganda			Sierra Leone
United Republic of			
Tanzania[4]			Togo
Zambia			
Zimbabwe			

Asia

Eastern Asia[5]	*South-Central Asia*[6]	*South-Eastern Asia*	*Western Asia*
	Central Asia		
China[7]	Kazakhstan	Brunei Darussalam	Armenia
China, Hong Kong SAR[8]	Kyrgyzstan	Cambodia	Azerbaijan[9]
China, Macao SAR[10]	Tajikistan	Indonesia	Bahrain
Democratic People's	Turkmenistan	Lao People's Democratic	Cyprus[11]
Republic of Korea	Uzbekistan	Republic	Georgia[12]
Japan		Malaysia[13]	Iraq
Mongolia	*Southern Asia*	Myanmar	Israel
Republic of Korea		Philippines	Jordan
	Afghanistan	Singapore	Kuwait
	Bangladesh	Thailand	Lebanon
	Bhutan	Timor-Leste	Occupied Palestinian
	India	Viet Nam	Territory[14]
	Iran (Islamic Republic of)		Oman
	Maldives[15]		Qatar
	Nepal		Saudi Arabia
	Pakistan		Syrian Arab Republic
	Sri Lanka		Turkey
			United Arab Emirates
			Yemen

Europe

Eastern Europe	*Northern Europe*	*Southern Europe*	*Western Europe*
Belarus	Channel Islands[16]	Albania	Austria
Bulgaria	Denmark	Andorra*	Belgium
Czech Republic	Estonia	Bosnia and Herzegovina	France
Hungary	Faeroe Islands*	Croatia	Germany
Poland	Finland[17]	Gibraltar*	Liechtenstein*
Republic of Moldova	Iceland	Greece	Luxembourg
Romania	Ireland	Holy See[18],*	Monaco*
Russian Federation	Isle of Man*	Italy	Netherlands
Slovakia	Latvia	Malta	Switzerland
Ukraine	Lithuania	Montenegro	
	Norway[19]	Portugal	
	Sweden	San Marino*	
	United Kingdom of Great Britain and Northern Ireland[21]	Serbia[20]	
		Slovenia	
		Spain[22]	
		The former Yugoslav Republic of Macedonia[23]	

Latin America and the Caribbean

Caribbean	*Central America*	*South America*
Anguilla*	Belize	Argentina
Antigua and Barbuda*	Costa Rica	Bolivia
Aruba	El Salvador	Brazil
Bahamas	Guatemala	Chile
Barbados	Honduras	Colombia
British Virgin Islands*	Mexico	Ecuador
Cayman Islands*	Nicaragua	Falkland Islands (Malvinas)*
Cuba	Panama	French Guiana
Dominica*		Guyana
Dominican Republic		Paraguay
Grenada		Peru
Guadeloupe[24]		Suriname
Haiti		Uruguay
Jamaica		Venezuela (Bolivarian Rep. of)
Martinique		
Montserrat*		
Netherlands Antilles[25]		
Puerto Rico		
Saint Kitts and Nevis*		
Saint Lucia		
Saint Vincent and the Grenadines		
Trinidad and Tobago		
Turks and Caicos Islands*		
United States Virgin Islands		

Northern America

Bermuda*
Canada
Greenland*
Saint Pierre and Miquelon*
United States of America

Oceania

Australia/New Zealand	*Melanesia*	*Micronesia*	*Polynesia*[26]
Australia[27]	Fiji	Guam	American Samoa*
New Zealand	New Caledonia	Kiribati*	Cook Islands*
	Papua New Guinea	Marshall Islands*	French Polynesia
	Solomon Islands	Micronesia	Niue*
	Vanuatu	(Federated States of)	Samoa
		Nauru*	Tokelau*
		Northern Mariana Islands*	Tonga
		Palau*	Tuvalu*
			Wallis and Futuna Islands*

Sub-Saharan Africa

Angola	Côte d'Ivoire	Kenya	Niger	Sudan
Benin	Democratic Republic	Lesotho	Nigeria	Swaziland
Botswana	of the Congo	Liberia	Réunion	Togo
Burkina Faso	Djibouti	Madagascar	Rwanda	Uganda
Burundi	Equatorial Guinea	Malawi	Saint Helena	United Republic
Cameroon	Eritrea	Mali	São Tomé and Príncipe	of Tanzania
Cape Verde	Ethiopia	Mauritania	Senegal	Zambia
Central African Republic	Gabon	Mauritius	Seychelles	Zimbabwe
Chad	Gambia	Mayotte	Sierra Leone	
Comoros	Ghana	Mozambique	Somalia	
Congo	Guinea	Namibia	South Africa	
	Guinea-Bissau			

NOTE: Countries or areas with a population of less than 100,000 in 2010 are indicated by an asterisk (*). These countries or areas are included in the regional totals, but are not shown separately.

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NOTES

[1] Including South Sudan, which became independent on 9 July 2011.
[2] Including Agalega, Rodrigues and Saint Brandon.
[3] Including Ascension and Tristan da Cunha.
[4] Including Zanzibar.
[5] Includes other non-specified areas.
[6] The regions Southern Asia and Central Asia are combined into South-Central Asia.
[7] For statistical purposes, the data for China do not include Hong Kong and Macao, Special Administrative Regions (SAR) of China.
[8] As of 1 July 1997, Hong Kong became a Special Administrative Region (SAR) of China.
[9] Including Nagorno-Karabakh.
[10] As of 20 December 1999, Macao became a Special Administrative Region (SAR) of China.
[11] Including Northern-Cyprus.
[12] Including Abkhazia and South Ossetia.
[13] Including Sabah and Sarawak.
[14] Including East Jerusalem.
[15] Including Transnistria.
[6] Refers to Guernsey and Jersey.
[7] Including Åland Islands.
[8] Refers to the Vatican City State.
[9] Including Svalbard and Jan Mayen Islands.
[20] Including Kosovo.
[21] Also referred to as United Kingdom.
[22] Including Canary Islands, Ceuta and Melilla.
[23] Also referred to as TFYR Macedonia.
[24] Including Saint-Barthélemy and Saint-Martin (French part).
[25] Refers to Curaçao, Sint Maarten (Dutch part), Bonaire, Saba and Sint Eustatius.
[26] Including Pitcairn.
[27] Including Christmas Island, Cocos (Keeling) Islands and Norfolk Island.

INTRODUCTION

From the vantage point of 2011, the world can look back at six decades of great progress in health and survival. Large portions of the global population have benefitted from those gains. According to the *2010 Revision* of *World Population Prospects*, life expectancy at birth for the world as a whole rose from 46.6 years in 1950-1955 to 69.3 years in 2010-2015. The proportion of the world's population living in countries where life expectancy was below 60 years fell from 68 per cent in the early 1950s to 12 per cent in 2010-2015, while the share living in countries with life expectancy of 70 years or higher rose from 1 per cent to 57 per cent. Over the same period, the probability of dying in early childhood —that is, the number of deaths under age five per 1,000 live births— fell from 203 per 1,000 to 60 per 1,000.

Despite such progress, wide disparities remain in levels of mortality across countries and regions. Reducing such disparities in survival is a central goal of international development efforts. The projections of mortality in the *2010 Revision*, which for the first time extend to 2100, give a glimpse of how levels of global mortality, and gaps between countries and regions, may evolve in the future.

The *World Mortality Report 2011* provides an overview of the estimated and projected trends in mortality at the world level, for development groups and for major areas; the analysis also focuses on country and regional data for selected mortality indicators[1]. In addition to examining the summary indicator of life expectancy, the report analyzes levels and trends in mortality for key age groups in childhood and provides a snapshot of adult and "old age" mortality levels. The report also revisits the impact of the HIV/AIDS epidemic on estimated and projected mortality in light of recent updates in HIV prevalence levels and treatment coverage. An analysis of trends in life expectancy decomposed by age group is also presented to highlight the contributions of mortality change at different ages over recent decades. Lastly, the report presents a new way of examining the life tables from *World Population Prospects* to understand the actual survival experience of cohorts.

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NOTE

[1] The estimates for the world, development groups, major areas and regions were calculated as weighted averages that also included mortality estimates for countries or areas with populations below 100,000 inhabitants in 2010, as well as other non-specified areas. These countries or areas represent very small portions of the world population and the overall number of deaths.
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I. LEVELS AND TRENDS OF MORTALITY

A. LIFE EXPECTANCY AT BIRTH

The level of life expectancy at birth expresses mortality levels in a population for a given time period. The measure summarizes the average length of time that a person born in that period would live if he or she experienced the mortality rates of that period throughout his or her lifetime. It provides a useful snapshot of mortality that is comparable across populations and time periods.

Distribution of world population by the level of life expectancy

Figure I.1 shows the changing proportions of world population according to the level of life expectancy since 1950, as assessed in *World Population Prospects: The 2010 Revision*. In 1950-1955, 68 per cent of the world population lived in countries where life expectancy at birth was lower than 60 years. Between 1950-1955 and 2010-2015, survival improved to the extent that only 12 per cent of the current world population now lives in countries with life expectancy below 60. The challenges of poverty, conflict and HIV/AIDS remain persistent obstacles to improving survival in many of the countries where life expectancy remains low.

At the other end of the spectrum, in 1950-1955 only a few countries had life expectancy greater than 70 years, and only 1 per cent of the world population lived in such countries. In 2010-2015, 57 per cent of world population lives in countries with life expectancy above 70 years, while for 9 per cent of the global population life expectancy has reached 80 or higher.

Figure I.1. Percentage distribution of the world population by level of life expectancy at birth, 1950-1955 to 2095-2100
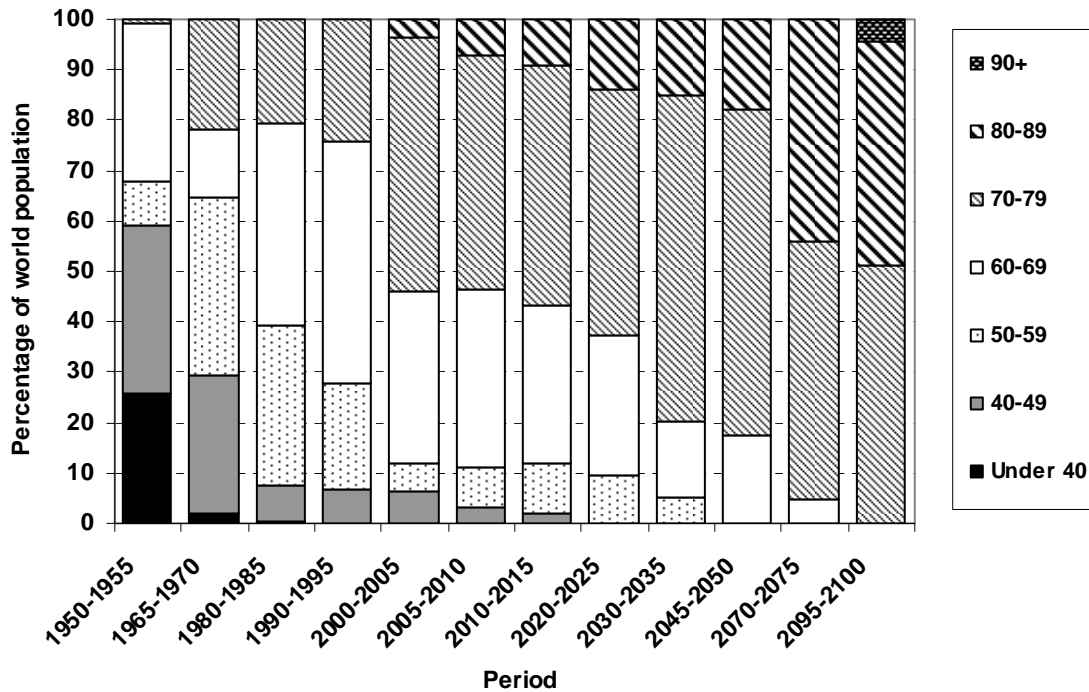
But what can be anticipated in the future? The projections of mortality in the *2010 Revision* are based on an assessment of recent mortality trends in each country combined with global models of life expectancy change. The projections envision that by 2045-2050, life expectancy will be above 60 years in all countries and by 2095-2100, there may be no countries with life expectancy lower than 70 years. In these projections, life expectancy figures of 90 years or higher begin to emerge after 2075 and it is projected that by 2095-2100, 4 per cent of world population would live in countries with life expectancy of 90 years or higher.

Trends in life expectancy for development groups and major areas

In 1950-1955, average life expectancy for the world stood at 47.7 years (table I.1). In the developing world, the transition away from high levels of mortality had only just begun. The least developed countries had life expectancy of just 37.2 years, while the other less developed countries life expectancy was somewhat higher at 43.0 years. The more developed countries had already experienced improvements in life expectancy before 1950, having reached an average level of 65.9 years, 23.6 years higher than the level for the less developed regions as a whole. For the world's major areas, life expectancy ranged from a low of 38.2 years in Africa to a high of 68.7 years in Northern America.

All areas of the world have achieved major gains in life expectancy in the past 60 years (figure I.2). The world as a whole gained an additional 21.6 years of life expectancy since the early 1950s, reaching an estimated average life expectancy of 69.3 years in 2010-2015. The less developed regions gained 25.2 years of life expectancy. In the more developed regions, gains were smaller at 12.1 years of life expectancy, because major reductions in child mortality, which have a larger impact than changes in adult mortality on overall life expectancy change, had already occurred by 1950 in those regions.

TABLE I.1. LIFE EXPECTANCY AT BIRTH BY DEVELOPMENT GROUP AND MAJOR AREA,
1950-1955, 2010-2015, 2045-2050 AND 2095-2100

Development group or major area	Life expectancy at birth (years) - Both sexes combined -				Average gain in life expectancy per decade (years)		
	1950-1955	2010-2015	2045-2050	2095-2100	1950-1955 to 2010-2015	2010-2015 to 2045-2050	2045-2050 to 2095-2100
World	47.7	69.3	75.6	81.1	3.6	1.8	1.1
More developed regions	65.9	78.0	82.7	88.2	2.0	1.4	1.1
Less developed regions	42.3	67.5	74.4	80.1	4.2	2.0	1.1
Least developed countries	37.2	58.8	69.1	77.5	3.6	2.9	1.7
Other less developed countries	43.0	69.4	75.8	81.1	4.4	1.8	1.1
Africa	38.2	57.4	68.2	77.1	3.2	3.1	1.8
Asia	42.9	70.4	76.7	81.8	4.6	1.8	1.0
Europe	65.6	76.5	81.7	87.4	1.8	1.5	1.1
Latin America and the Caribbean	51.3	74.7	79.9	84.6	3.9	1.5	0.9
Northern America	68.7	79.0	83.2	88.4	1.7	1.2	1.0
Oceania	60.5	77.7	82.5	86.7	2.9	1.4	0.8

Figure I.2. Life expectancy at birth by development group, 1950-2100
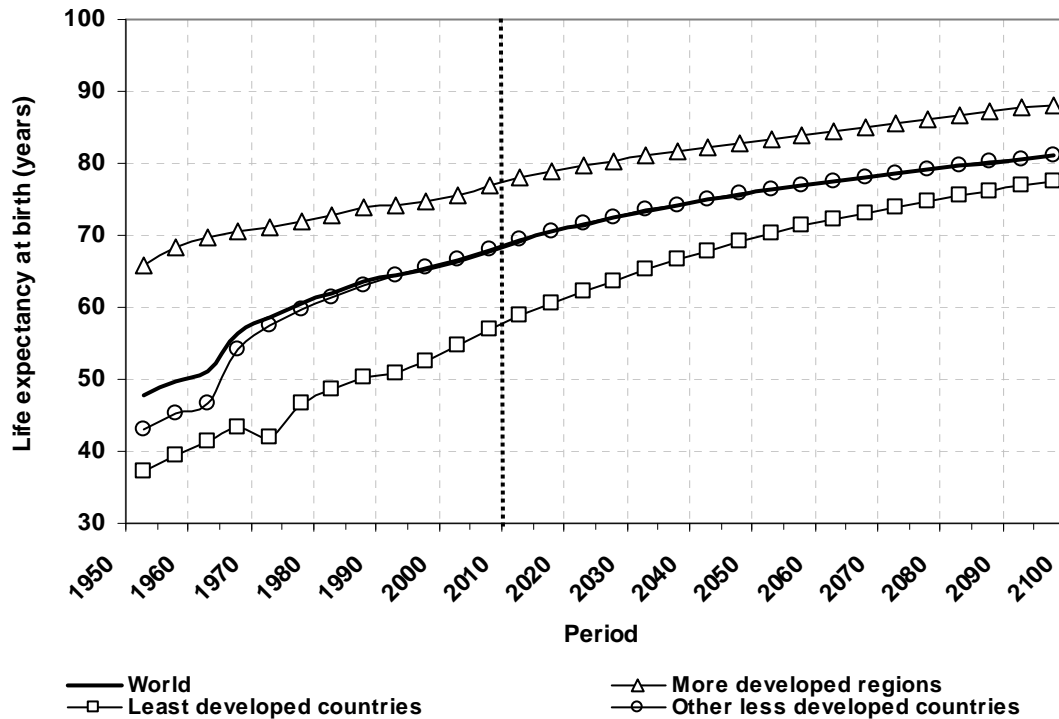
While future trends in life expectancy are far from certain, the *2010 Revision* projects that life expectancy will continue to improve in all regions and development groups, with global life expectancy reaching 75.6 years in 2045-2050 and 81.1 years in 2095-2100. The projection assumptions take into account the recent experience of life expectancy change in each country to select a model for the speed of life expectancy increase based on global experience[1]. For countries highly affected by the HIV/AIDS epidemic, models of HIV infection and treatment are incorporated into the mortality projection[2].

The rate of life expectancy increase is projected to decelerate in all regions from its pace in the last half of the twentieth century (table I.1), with global life expectancy increase slowing from 3.6 years per decade between 1950-1955 and 2010-2015 to 1.8 years per decade between 2010-2015 and 2045-2040. It is projected that annual increase will slow further to 1.1 years per decade between 2045-2050 and 2095-2100. However, the projections suggest that Africa will maintain rapid life expectancy improvement relative to other regions.

How high will life expectancy become by 2095-2100? The more developed regions are projected to reach a level of 88.2 years for both sexes combined by the end of the century, with Europe reaching a level of 87.4 years and Northern America reaching 88.4 years. Life expectancy in the less developed regions is projected to increase to 80.1 years. The lowest level of life expectancy projected for that period will be in Africa, where the projected level of 77.1 years would be slightly lower than the level that is found in the more developed regions today. Life expectancy in Asia is projected to reach nearly 82 years by the end of the century, while in Latin America and the Caribbean it is projected to reach 84.6 years.

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[1] A detailed description of the life expectancy projection models employed in World Population Prospects may be found in World Population Prospects: The 2006 Revision, Volume III: Analytical Report (p. 129; available online at http://www.un.org/esa/population/publications/WPP2006RevVol_III/WPP2006RevVol_III_final.pdf).

[2] Further information on HIV/AIDS modeling in the 2010 Revision is available at http://esa.un.org/unpd/wpp/Documentation/pdf/WPP2010_ASSUMPTIONS_AND_VARIANTS.pdf.

Gaps in life expectancy between development groups and major areas

The rapid progress in mortality reduction in the less developed regions means that the gap in life expectancy between the less developed regions and the more developed regions narrowed from 24 years in 1950-1955 to 11 years in 2010-2015. Progress in the least developed countries, which saw a gain of 22 years, trailed that of the other less developed countries, where life expectancy increased by 26 years. The life expectancy gap between the least developed countries and the other less developed countries widened from 6 years to 11 years.

Within the less developed regions, progress in mortality reduction has differed greatly among the major areas (figure I.3). Asia and Latin American and the Caribbean experienced steady increases in life expectancy throughout the second half of the twentieth century. Latin America and the Caribbean had the highest life expectancy among major areas in the less developed regions throughout this period, increasing from 51.3 years in 1950-1955 to 74.7 years in 2010-2015. The biggest rise in life expectancy among all major areas occurred in Asia, from 42.9 years in 1950-1955 to 70.4 years in 2010-2015. In Africa, life expectancy increased steadily from the 1950s until the early 1980s, but progress has been slower since then, with very little gain in life expectancy achieved between the late 1980s and late 1990s. There have been indications of a recovery in more recent years, as estimated life expectancy at birth for the continent reached 57.4 years in 2010-2015.

Figure I.3. Life expectancy at birth by major area, 1950-2100
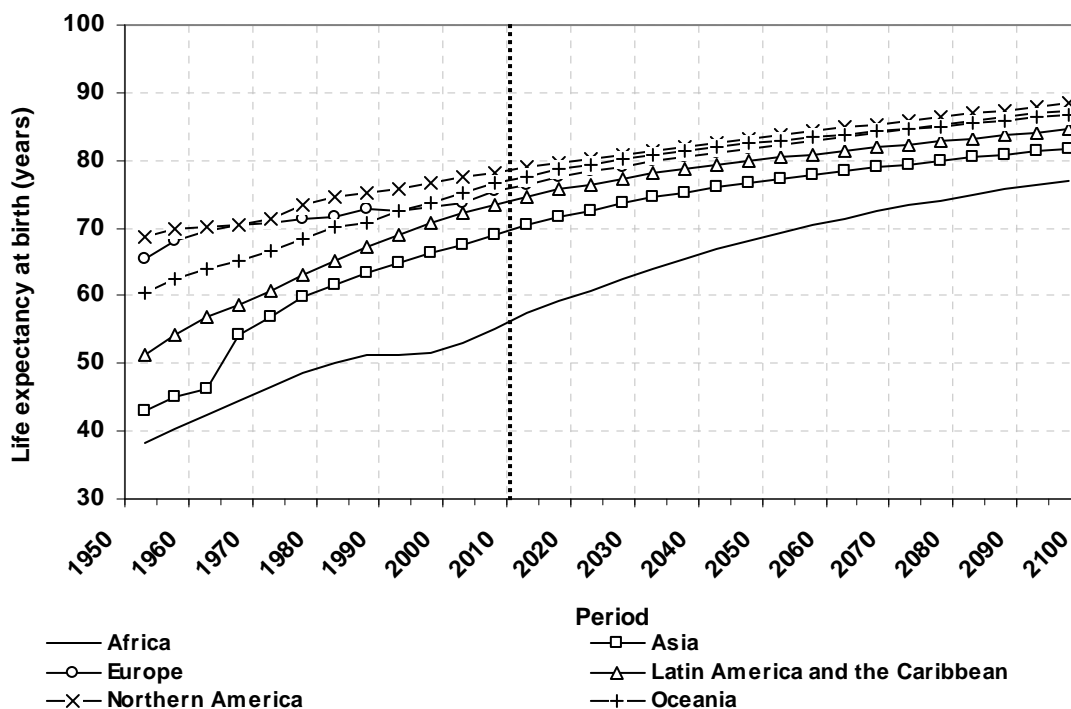
Within the more developed regions, trends for Northern America and Europe have diverged since the early 1970s. The two major areas had nearly equal life expectancy in 1965-1970, 70.5 and 70.3 years, respectively. Northern America subsequently experienced continually rising life expectancy, reaching 79.0 years in 2010-2015.

Europe, on the other hand, experienced a slowdown in the increase of life expectancy in the late 1960s and stagnating levels in the 1990s. Increases resumed in the early 2000s and Europe's life expectancy stood at 76.5 years in 2010-2015. The stagnating trend for Europe as a whole was strongly influenced by declines in life

expectancy in some Eastern European countries. Eastern Europe saw a major erosion of its life expectancy in relation to that of other European regions during the 1960s to the 1990s, with the gap between Eastern Europe and Western Europe, for example, rising from just 1.4 years in 1960-1965 to 11.1 years in 2000-2005 then decreasing to 9.9 years in 2010-2015 (data not shown).

Differences in life expectancy by sex

In all development groups and major areas, women have higher life expectancy than men (table I.2). Worldwide, women's life expectancy advantage was 4.5 years in 2010-2015. In the more developed regions, life expectancy is 6.7 years higher for women than for men, while in the less developed regions women's life expectancy is 3.7 years higher. The difference by sex is smaller in the least developed countries, at 2.4 years. In all development groups, the sex gap in life expectancy has grown since 1950-1955. This change has been larger in the less developed regions, where the sex difference in life expectancy was quite small in 1950-1955, with less than one year of difference life expectancy between women and men at that time.

Among the world's major areas, women's advantage in life expectancy in 2010-2015 ranges from 2.6 years in Africa to 7.4 years in Europe. In the more developed regions, the sex difference is higher in Europe (7.4 years) than in Northern America (5.1 years) largely due to a wider sex difference in Eastern Europe (10.3 years) compared to other European regions (4.8 years in Northern Europe, 5.3 years in Western Europe, and 5.6 years in Southern Europe; data not shown). Latin America and the Caribbean has the largest female advantage in life expectancy (6.2 years) among the major areas comprised by the less developed regions. The relatively small female advantage in Africa in 2010-2015 is to a large extent a consequence of the differential impact of the HIV/AIDS epidemic on mortality levels by sex, with HIV prevalence estimated to be greater among women than among men within that region of the world.

Between 2010-2015 and 2045-2050, the sex difference in life expectancy in the less developed regions is projected to increase towards the current world level (4.5 years), meaning that, as a whole, life expectancy is projected to rise faster for women than for men in those regions. Africa is expected to experience the largest widening of the sex difference, partly due to a decline in the risk of dying from AIDS and the assumption that the sex ratio of HIV infection will trend towards unity in the future, while in Asia the increase will be considerably smaller. On the other hand, it is projected that males from Latin America and the Caribbean as well as from the more developed regions will experience somewhat faster life expectancy increase than females, causing the sex difference in life expectancy to decrease.

Countries with the highest and lowest life expectancies

Table I.3 shows the countries with the highest and the lowest life expectancies at birth in different periods. The ten countries with the highest life expectancies in the current period, 2010-2015, have life expectancy of 81.7 or higher for both sexes combined. All but two of these countries are located in the more developed regions. Presently, Japan has the highest life expectancy in the world, at 83.7 years for 2010-2015.

The ten countries with lowest life expectancies in 2010-2015 had values ranging from 48.2 to 51.0 years. While these levels of life expectancy are some 20 years higher than the lowest values found in the 1950s, they are more than 30 years lower than the highest life expectancy levels found in the current period. Most of the countries in the list of lowest life expectancies are affected by challenges such as HIV/AIDS or conflict.

Projections of life expectancy for 2045-2050 show that the lists of countries with highest and lowest levels are expected to remain similar to those in 2010-2015. The countries with the highest life expectancy are projected to gain about 4 additional years of life expectancy by 2050, while those with the lowest life expectancies are projected to gain about 9-13 years.

TABLE I.2. LIFE EXPECTANCY AT BIRTH BY SEX, BY DEVELOPMENT GROUP AND MAJOR AREA,
1950-1955, 2010-2015, AND 2045-2050

Development group or major area	Life expectancy at birth (years) - Both sexes combined -						Difference (years, female - male)		
	1950-1955		2010-2015		2045-2050		1950-1955	2010-2015	2045-2050
	Male	Female	Male	Female	Male	Female			
World	46.7	48.7	67.1	71.6	73.2	78.0	2.0	4.5	4.8
More developed regions	63.4	68.4	74.6	81.3	79.9	85.6	5.0	6.7	5.7
Less developed regions	41.9	42.7	65.6	69.4	72.2	76.7	0.8	3.7	4.5
Least developed countries	36.5	38.0	57.6	60.1	67.1	71.2	1.5	2.4	4.1
Other less developed countries	42.7	43.4	67.5	71.4	73.6	78.1	0.7	3.9	4.5
Africa	36.9	39.5	56.1	58.7	66.1	70.3	2.6	2.6	4.2
Asia	42.8	43.1	68.5	72.4	74.6	78.9	0.2	3.9	4.3
Europe	62.9	68.0	72.8	80.2	78.8	84.7	5.1	7.4	5.9
Latin America and the Caribbean	49.6	53.1	71.6	77.8	77.0	82.7	3.5	6.2	5.7
Northern America	65.8	71.7	76.4	81.5	80.7	85.8	5.8	5.1	5.1
Oceania	58.2	63.1	75.5	79.9	80.3	84.6	4.9	4.5	4.3

United Nations Department of Economic and Social Affairs/Population Division
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TABLE I.3. TEN COUNTRIES OR AREAS WITH THE HIGHEST AND TEN COUNTRIES OR AREAS WITH THE LOWEST LIFE EXPECTANCY AT BIRTH,
1950-1955, 2010-2015 AND 2045-2050

	1950-1955			2010-2015			2045-2050	
Rank	Country or area[a]	Life expectancy (years)	Rank	Country or area[a]	Life expectancy (years)	Rank	Country or area[a]	Life expectancy (years)
A. Highest life expectancy at birth								
1.	Norway	72.6	1.	Japan	83.7	1.	Japan	87.4
2.	Iceland	72.1	2.	China, Hong Kong SAR	83.2	2.	China, Hong Kong SAR	87.2
3.	Netherlands	71.9	3.	Switzerland	82.5	3.	Switzerland	86.4
4.	Sweden	71.7	4.	Australia	82.1	4.	Israel	86.3
5.	Denmark	70.9	5.	Iceland	82.0	5.	Australia	86.0
6.	New Zealand	69.6	6.	Israel	82.0	6.	Iceland	85.8
7.	Switzerland	69.3	7.	Italy	82.0	7.	France	85.8
8.	Australia	69.3	8.	Spain	81.8	8.	Spain	85.8
9.	United Kingdom	69.3	9.	France	81.7	9.	Italy	85.7
10.	Channel Islands	69.2	10.	Sweden	81.7	10.	Sweden	85.7
B. Lowest life expectancy at birth								
1.	Afghanistan	28.8	1.	Sierra Leone	48.2	1.	Lesotho	58.0
2.	Sierra Leone	29.7	2.	Guinea-Bissau	48.8	2.	Dem. Republic of the Congo	61.5
3.	Mali	29.8	3.	Dem. Republic of the Congo	48.9	3.	Sierra Leone	61.7
4.	Timor-Leste	30.0	4.	Lesotho	49.1	4.	Zambia	62.1
5.	Angola	30.0	5.	Swaziland	49.2	5.	Swaziland	62.3
6.	Mozambique	31.3	6.	Afghanistan	49.3	6.	Guinea-Bissau	62.5
7.	Guinea	31.6	7.	Central African Republic	49.5	7.	Afghanistan	62.8
8.	Gambia	31.7	8.	Zambia	49.6	8.	Botswana	63.0
9.	Burkina Faso	31.8	9.	Chad	50.1	9.	Mozambique	63.2
10.	Guinea-Bissau	32.5	10.	Mozambique	51.0	10.	Chad	63.2
	WORLD	47.7		WORLD	69.3		WORLD	76.6

[a] Countries or areas with 100,000 persons or more in 2010.

B. MORTALITY IN CHILDHOOD

Infant mortality is measured as the probability of dying between birth and exact age 1, while under-five mortality is measured as the probability of dying between birth and exact age 5. Both measures are important indicators of children's well-being and, more broadly, of socioeconomic development. Under-five mortality, in particular, is a closely monitored public health indicator and its reduction by two-thirds between 1990 and 2015 is the central target of Millennium Development Goal 4 of the United Nations Millennium Declaration. Marked improvements in infant and child survival have been achieved since 1950, and while further gains are projected to 2100, the pace of future progress is expected to be slower than in the past in all but the least developed countries.

Levels and trends in infant mortality

Worldwide in 2010-2015, 42 out of every 1,000 infants are expected to die before their first birthdays. For the world as a whole, the probability of dying before age 1 fell from 133 per 1,000 in 1950-1955 to 42 per 1,000 in 2010-2015, a reduction of 69 per cent (table I.4 and figure I.4). Infant survival in the less developed regions lags behind that in the more developed regions, and the chances of surviving to the first birthday are especially low in the least developed countries. In the more developed regions, the infant mortality rate (IMR) fell from 60 per 1,000 in 1950-1955 to 6 per 1,000 in 2010-2015, a decline of 90 per cent, while in the less developed regions the IMR declined by 69 per cent, from 151 per 1,000 to 46 per 1,000. Progress was slowest in the least developed countries where the IMR fell from 192 per 1,000 in 1950-1955 to 73 per 1,000 in 2010-2015, a decline of 62 per cent.

Over the next several decades, progress in infant survival is expected to accelerate in the least developed countries, but decelerate in the other less developed countries and the more developed regions, reflecting slower rates of decline in countries that have already achieved low IMR. By 2045-2050, the IMR in the least developed countries is projected to fall by 52 per cent to 35 deaths per 1,000 live births. The other less developed countries are projected to achieve a 43 per cent decline in the IMR by 2045-2050, to 22 per 1,000, a level that is still more than triple the IMR in the more developed regions in 2010-2015.

TABLE I.4. INFANT MORTALITY RATE BY DEVELOPMENT GROUP AND MAJOR AREA, 1950-1955, 2010-2015, 2045-2050 AND 2095-2100

Development group or major area	Infant mortality rate (infant deaths per 1,000 live births) - Both sexes combined -				Average annual rate of decline (per cent)		
	1950-1955	2010-2015	2045-2050	2095-2100	1950-1955 to 2010-2015	2010-2015 to 2045-2050	2045-2050 to 2095-2100
World	133.4	41.8	23.4	11.5	1.9	1.7	1.4
More developed regions	59.8	6.0	4.2	2.7	3.8	1.0	0.9
Less developed regions	150.8	46.0	25.8	12.7	2.0	1.7	1.4
Least developed countries	191.5	72.7	34.9	15.6	1.6	2.1	1.6
Other less developed countries	144.9	37.7	21.6	11.1	2.2	1.6	1.3
Africa	179.6	71.4	34.7	15.5	1.5	2.1	1.6
Asia	145.0	36.9	20.6	10.9	2.3	1.7	1.3
Europe	72.6	6.4	4.2	2.6	4.0	1.2	0.9
Latin America and the Caribbean	127.3	18.7	8.9	3.6	3.2	2.1	1.8
Northern America	31.2	6.3	4.6	2.9	2.7	0.9	0.9
Oceania	59.8	19.2	9.6	4.9	1.9	2.0	1.4

Figure I.4. Infant mortality rate by development group, 1950-2100
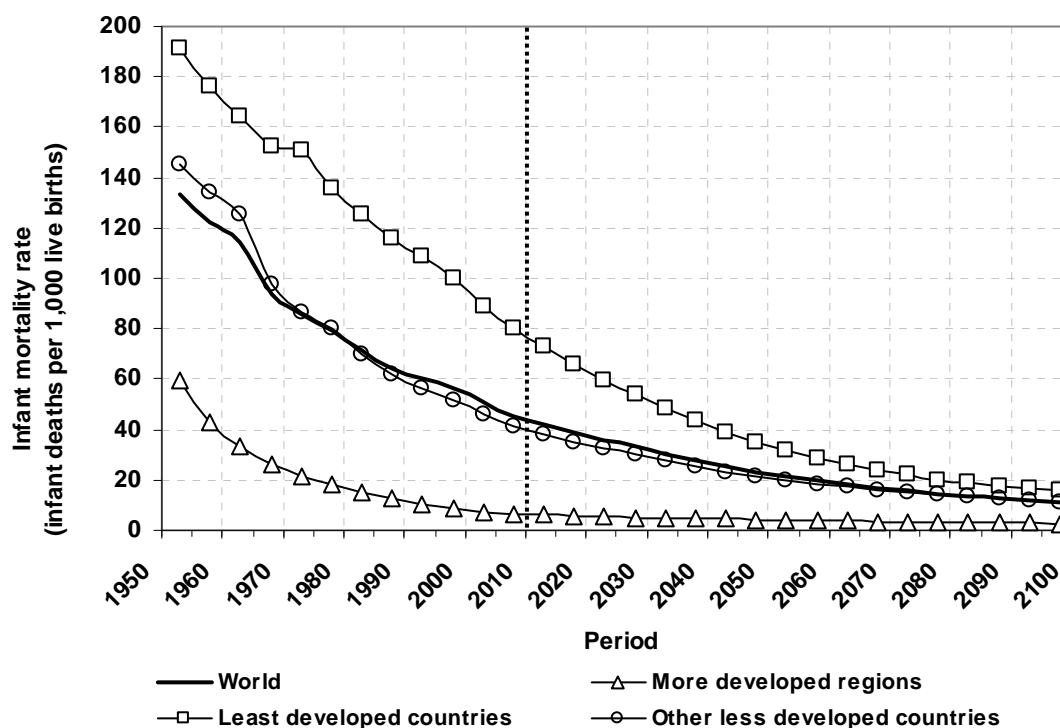
Of the world's major areas, Africa has seen the slowest progress in lowering infant mortality (table I.4 and figure I.5), with an average annual decline of just 1.5 per cent between 1950-1955 and 2010-2015, compared to 1.9 per cent for the world. In Africa, an estimated 71 out of 1,000 babies born during 2010-2015 will die before their first birthdays. While the region's progress in infant survival is projected to accelerate with an average annual decline in the IMR of 2.1 per cent between 2010-2015 and 2045-2050, that rate will be slower than what Asia achieved over the past half century, with an average 2.3 per cent annual decline between 1950-1955 and 2010-2015. Asia achieved a 75 per cent reduction in infant mortality since 1950-1955 and while progress is expected to continue, the projected IMR in 2045-2050, at 21 per 1,000, remains four times that in Europe and Northern America and more than twice the projected rate in Latin America and the Caribbean.

Among the less developed regions, Latin America and the Caribbean had the lowest IMR throughout the second half of the 20th century, falling from 127 per 1,000 in 1950-1955 to 19 per 1,000 in 2010-2015. Infant survival in the region is projected to continue to improve at a fairly rapid pace, with the IMR declining by an average 2.1 per cent annually between 2010-2015 and 2045-2050. In Europe and Northern America, where IMR is already below 7 per 1,000 in 2010-2015, infant deaths are expected to become even rarer, largely due to improvements in neonatal survival. By 2045-2050, fewer than 5 infant deaths per 1,000 live births are projected for both Europe and Northern America.

Figure I.5. Infant mortality rate by major area, 1950-2100

Legend:
——— Africa
—□— Asia
—○— Europe
—△— Latin America and the Caribbean
—✕— Northern America
—+— Oceania
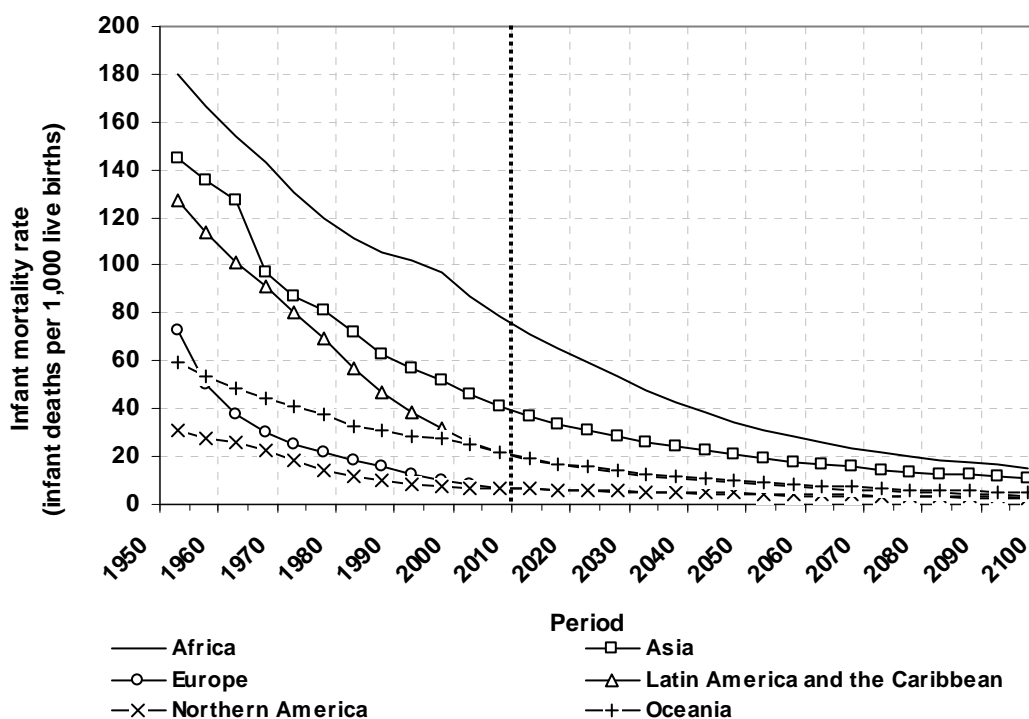
Levels and trends in under-five mortality

Overall, trends in under-five mortality were similar to those observed for infant mortality. Estimates of under-five mortality for the world, development groups and major areas are provided in table I.5 for 1950-1955, 2010-2015, 2045-2050 and 2095-2100. Worldwide, under-five mortality fell by 70 per cent, from 203 deaths per 1,000 live births to 60 deaths per 1,000 live births, between 1950-1955 and 2010-2015. In 2010-2015, the probability of dying between birth and age 5 in the less developed regions is 66 per 1,000, which is more than eight times higher than in the more developed regions, where it is 8 per 1,000. During the most recent period, the least developed countries experienced a high level of under-five mortality, 112 per 1,000, although this is about one third the rate of 1950-1955 (306 per 1,000). Among the other less developed countries, the risk of dying before age five is less than half that of the least developed countries, at 52 per 1,000. Among the less developed regions, Latin America

and the Caribbean experienced the most rapid improvement in child survival since 1950, with an average annual decline in the under-five mortality rate of 3.4 per cent. The pace of decline in under-five mortality in Africa was slower with an average annual rate of 1.6 per cent. Asia experienced an intermediate pace of decline with the under-five mortality rate falling by an average of 2.6 per cent each year between 1950-1955 and 2010-2015.

Projected future trends in under-five mortality rates also track closely the infant mortality trends. By 2045-2050, the projected global under-five mortality rate is 32 child deaths per 1,000 life births: just 15 per cent of the level estimated in 1950-1955. Africa, Latin America and the Caribbean, and Oceania are expected to achieve the fastest future gains in child survival, with projected average annual rates of decline in the under-five mortality rate of over 2 per cent between 2010-2015 and 2045-2050.

TABLE I.5. UNDER-FIVE MORTALITY RATE BY DEVELOPMENT GROUP AND MAJOR AREA,
1950-1955, 2010-2015, 2045-2050 AND 2095-2100

Development group or major area	Under-five mortality (deaths under age 5 per 1,000 live births) - Both sexes combined -				Average annual rate of decline (per cent)		
	1950-1955	2010-2015	2045-2050	2095-2100	1950-1955 to 2010-2015	2010-2015 to 2045-2050	2045-2050 to 2095-2100
World	203.4	60.0	31.5	14.5	2.0	1.8	1.5
More developed regions	69.0	7.7	5.7	3.8	3.6	0.9	0.8
Less developed regions	235.2	66.1	34.7	16.1	2.1	1.8	1.5
Least developed countries	306.1	112.0	48.2	19.5	1.7	2.4	1.8
Other less developed countries	225.0	51.9	28.6	14.1	2.4	1.7	1.4
Africa	286.4	112.3	48.2	19.4	1.6	2.4	1.8
Asia	226.1	48.6	26.7	14.0	2.6	1.7	1.3
Europe	81.6	8.6	5.7	3.7	3.8	1.2	0.9
Latin America and the Caribbean	188.9	23.8	11.3	4.5	3.4	2.1	1.8
Northern America	33.6	7.5	6.1	4.2	2.5	0.6	0.8
Oceania	87.9	24.4	11.8	6.1	2.1	2.1	1.3

Despite falling risks of mortality during childhood, some regions have experienced an increase in the annual numbers of child deaths as a consequence of high fertility, which has produced rapid growth in the size of the population under five. While the numbers of deaths to children in the more developed regions and the other less developed regions have fallen precipitously since 1960, in the least developed countries the average annual number of child deaths increased from around 3 million in the 1950's to close to 4 million in the 1990's (figure I.6). Thereafter, improving survival of children together with falling fertility produced a decrease in the numbers of deaths to children, to an average of 3.2 million annually over the period in 2010-2015. As these trends continue into the future, by 2050 the numbers of deaths that occur annually to children under five is projected to fall below 2 million in the least developed countries, accounting for two out of every five child deaths globally.

C. MORTALITY IN ADULTHOOD

As death in childhood becomes increasingly rare, a growing share of global disparities in survival is driven by differential risks of mortality between the ages of 15 and 59 and at ages 60 and over. Thus, it is important to measure and better understand the mortality levels and patterns during adulthood. Unfortunately, while death registration systems in some countries shed light on the risks of mortality experienced at various ages, valid measures of adult mortality are not yet available throughout many countries of the less developed regions where such systems are not yet in place. When possible, other sources of information have been incorporated, such as mortality rates from sibling survival histories or estimates of excess deaths due to AIDS. Despite these efforts, for several developing countries, the levels and trends of adult mortality described in *World Population Prospects: The 2010 Revision*, are derived from child mortality and a model life table age pattern of mortality, rather than an empirical observation of adult deaths. Therefore, many of the regional trends and differences in adult mortality mirror closely those described for childhood mortality. With this in mind, the discussion below is focused on regional patterns in the levels of adult mortality estimated for the most recent period, 2010-2015.

Figure I.6. Estimated and projected number of deaths under age five by development group, 1950-2100
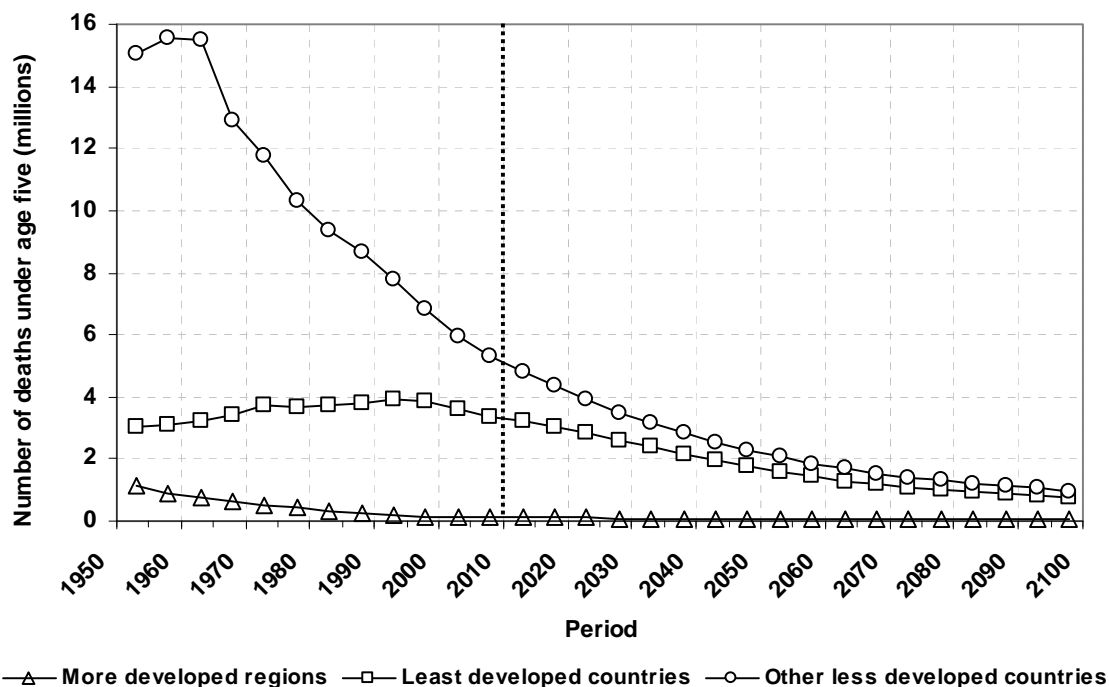
Note: The numbers of deaths are annual averages for each five-year periods.

Levels of adult mortality

As mortality levels decrease, especially among children, global disparities in longevity increasingly reflect differences in the risks of mortality during adult ages. To assess adult mortality, two measures are highlighted in this report. The first is the probability of dying between the ages of 15 and 60 years, denoted as $_{45}q_{15}$. In 2010-2015 the value of $_{45}q_{15}$ for the world (both sexes combined) is estimated at 161, indicating that at the prevailing mortality rates for the period, 161 out of 1,000 15-year-olds are expected to die before age 60. This measure is particularly relevant for health policy in that it captures the risks of mortality affecting young and middle-aged adults, most of whose deaths are considered to be "preventable", such as through changes in risk behaviours (e.g., tobacco use) or through medical intervention (e.g., early detection and treatment of cervical cancer). The second measure selected to describe adult mortality is the life expectancy at age 60, denoted as *e60*. This value indicates the average number of additional years one is expected to live once having reached age 60. In 2010-2015 *e60* is estimated at 20 years for the world, indicating that given the mortality rates prevailing over that period, on average, a person aged 60 could expect to live another 20 years, to reach age 80.

Just as child survival is highly correlated with the level of development, so too are measures of adult survival, and adult mortality risks in developing regions are much higher than those in developed regions. Under the mortality conditions of the 2010-2015 period, the probability that a person 15-years–old in the less developed regions will die by age 60 is 172 per 1,000 (table I.6), which is 51 per cent higher than in the more developed regions, where the risk of dying between ages 15 and 60 is 114 per 1,000. The least developed countries are particularly disadvantaged in terms of adult survival, with 267 per 1,000 15-year-olds estimated to die by age 60.

Among the more developed regions, $_{45}q_{15}$ in 2010-2015 stands at 99 per 1,000 in Northern America and 131 per 1,000 in Europe. Notably, despite the relatively high level of development, the level of $_{45}q_{15}$ in Europe is only slightly below the levels in Asia and Latin America and the Caribbean (146 per 1,000 and 135 per 1,000, respectively). The European average is pulled downward by the relatively high adult mortality in Eastern Europe, especially among men. Among the less developed regions, Africa has the highest level of adult mortality, with a $_{45}q_{15}$ of 305 per 1,000 in 2010-2015. In some countries, the HIV/AIDS epidemic has stalled or reversed progress in adult survival, pushing up the average $_{45}q_{15}$ for the region.

Disparities in survival at more advanced ages, after age 60, follow a pattern similar to the survival disparities observed at younger ages. In the less developed regions, persons aged 60 in 2010-2015 are estimated to have, on average, an additional 19 years to live, compared to 23 years in the more developed regions. Older adults in the least developed countries are again most disadvantaged in terms of survival, with 60-year-olds expected to live an average of 17 additional years. In Africa, survival prospects at older ages lag behind those of other regions: with *e60* estimated at 17 years, 60-year olds in Africa have 7 fewer years of life remaining relative to their peers in Oceania where *e60* is estimated at 24 years.

TABLE I.6. PROBABILITY OF DYING BETWEEN THE AGES OF 15 AND 60 YEARS AND LIFE EXPECTANCY AT AGE 60 BY SEX, BY DEVELOPMENT GROUP AND MAJOR AREA, 2010-2015

Development group or major area	Probability of dying between age 15 and 60 ($_{45}q_{15}$) (deaths under age 60 per 1,000 alive at age 15)				Life expectancy at age 60 (*e60*) (years)			
	Both sexes	Male	Female	Ratio Male/ female	Both sexes	Male	Female	Absolute difference - years (female - male)
World	161	192	130	1.5	20.1	18.5	21.6	3.1
More developed regions	114	156	72	2.2	22.7	20.6	24.6	4.0
Less developed regions	172	199	143	1.4	18.8	17.6	20.0	2.5
Least developed countries	267	286	249	1.1	16.7	16.1	17.2	1.1
Other less developed countries	159	188	128	1.5	19.0	17.7	20.4	2.6
Africa	305	323	289	1.1	16.9	16.0	17.8	1.7
Asia	146	175	116	1.5	19.3	17.9	20.7	2.8
Europe	131	183	77	2.4	21.7	19.5	23.6	4.1
Latin America and the Caribbean	135	176	95	1.9	21.7	20.1	23.1	3.0
Northern America	99	126	72	1.7	23.3	21.6	24.8	3.2
Oceania	99	119	79	1.5	23.6	22.0	25.2	3.2

Sex differences in adult mortality

At the world level the male-to-female ratio of $_{45}q_{15}$ is 1.5, meaning that men are 50 per cent more likely to die between the ages of 15 and 60 than are women. In the more developed regions, particularly in Europe, men are more than twice as likely to die between these ages. Among the less developed regions, the sex differential in $_{45}q_{15}$ in Latin America and the Caribbean (1.9 in 2010-2015) is wider than the differentials in the other major areas. In Asia and Africa, the male-to-female ratios in $_{45}q_{15}$ are estimated to be substantially lower, at 1.5 for Asia and 1.1 for Africa in 2010-2015. HIV/AIDS has reduced women's survival advantage in Africa, where more women than men are estimated to have HIV, and is largely responsible for the relatively low sex ratio in adult mortality in the region.

The assessment of sex differences in $_{45}q_{15}$ across development groups and major areas can mask even greater heterogeneity that exists across smaller geographic regions. To shed light on that variability, figure 1.7 presents adult mortality rates by sex for the 21 regions of the world in 2010-2015. The highest levels of adult mortality for both males and females are estimated to occur in the four regions that constitute sub-Saharan Africa (Eastern, Middle, Southern and Western Africa). Southern Africa has the highest adult mortality levels in the world, where more than half of all men and women are expected to die between the ages of 15 and 60 (with $_{45}q_{15}$s of 506 and 512 per 1,000, respectively). Southern Africa is also the region of the world most affected by HIV/AIDS, which has amplified adult mortality risks in the region. Across Africa's five regions, Northern Africa has the lowest levels of adult mortality, with $_{45}q_{15}$ estimated at 156 and 107 per 1,000, respectively, for males and females.

At the opposite end of the spectrum, Australia/New Zealand, Northern, Southern and Western Europe, as well as Northern America are among the regions with the lowest levels of adult mortality in the world. As noted above, the European average is heavily influenced by relatively high adult mortality in Eastern Europe, where $_{45}q_{15}$ for both sexes combined stood at 207 per 1,000 in 2010-2015 (data not shown), higher than the average for less developed regions.

Figure I.7. Adult mortality rate (45q15) by sex and region[a], 2010-2015
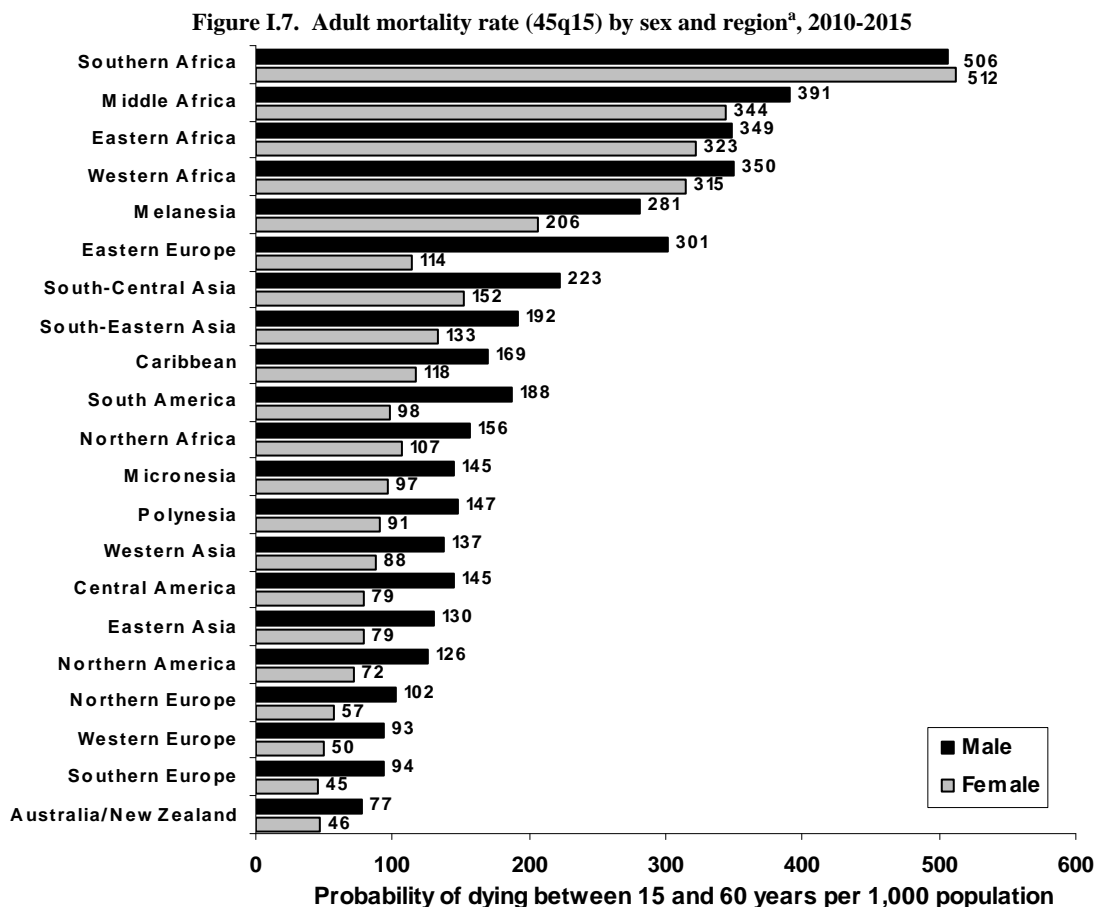
[a] Sorted by the level of mortality for both sexes combined.

Male adult mortality is higher than female adult mortality in all regions of the world, except in Southern Africa, where high female-to-male ratio of HIV prevalence has elevated female adult mortality rates to levels similar to those of adult males. Overall, the magnitude of the differences in adult mortality risks by sex varies considerably across regions. Within the more developed regions, males in Eastern Europe have exceptionally high adult mortality, 301 per 1,000. As a consequence, Eastern Europe has the largest sex differential in adult mortality of any world region, with a male-to-female ratio of 2.7. Southern Europe is the only other region with a male-to-female ratio above 2, though in contrast to Eastern Europe where the high ratio results from male mortality that is exceptionally high, Southern Europe's high ratio is mainly attributable to relatively low female mortality.

At more advanced ages, women tend to live longer than men in all regions of the world. Estimates of *e60* for 2010-2015 indicate that at the world level, a 60-year-old woman would, on average, outlive a 60-year-old man by 3 years. The female advantage in survival at old age is greatest in the more developed regions, where the sex difference in *e60* is estimated at 4 years, and smallest among the least developed countries, where it is estimated at 1 year. Across the world's major areas, the female advantage in survival beyond age *60* is greatest in Northern America and Oceania, where women would live more than 3 years longer on average than men, and smallest in Africa, where older women would outlive older men by less than 2 years on average.
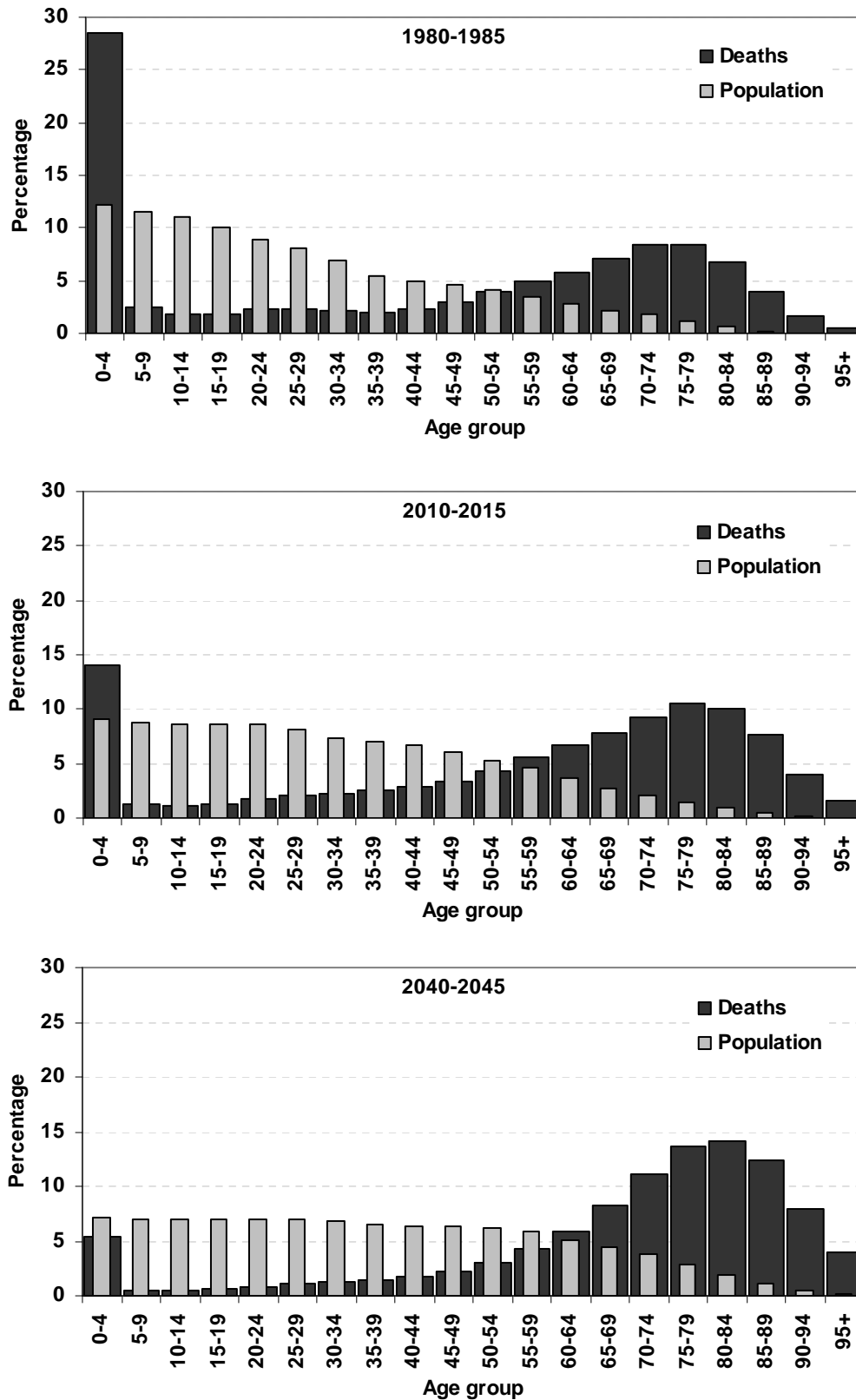
D. AGE DISTRIBUTION OF DEATHS

Declining trends in mortality in childhood and adulthood are producing a shift in the age distribution of deaths to progressively older ages (figure I.8). Over the period 1980-1985, an average of 47 million deaths occurred annually worldwide and 29 per cent of those deaths were concentrated among children under five. By 2010-2015 the average annual number of deaths had increased to 58 million, but deaths among children under five had declined to account for less than 14 per cent of global mortality. In the future, the age distribution of deaths is projected to shift even further such that by 2040-2045, less than 6 per cent of the 86 million deaths annually will occur to children under five.

Notably, the proportion of deaths that occurred to persons aged 15-59 changed relatively little between 1980-1985 and 2010-2015. However, the lack of change in the proportion should not be mistaken to indicate a lack of improvement in survival during adulthood. On the contrary, substantial gains in adult survival were achieved over the past 30 years, but those gains were masked in part by the concurrent shift in population age structure toward adult ages. In 1980-1985 people aged 15-59 comprised 57 per cent of the global population and accounted for 25 per cent of all deaths, but by 2010-2015 despite the fact that this age group had grown to make up 62 per cent of the population, its share of mortality had grown only slightly to 26 per cent. The proportion of all deaths that occur to persons aged 15-59 is expected to decline over the next 30 years, such that by 2040-2045 this age group will account for 16 per cent of mortality worldwide.

With improvements in the prevention and treatment of diseases commonly associated with old age, deaths occurring after age 60 have been postponed to progressively older ages. In 1980-1985, 43 per cent of deaths occurred to persons aged 60 or over and 13 per cent occurred at age 80 or above. By 2010-2015, the proportion of deaths occurring above age 60 had grown sharply to 58 per cent and the share of deaths concentrated above age 80 had risen to 23 per cent. Projected future reductions in mortality indicate that in 2040-2045, 77 per cent of deaths worldwide will occur above age 60; 38 per cent of deaths will occur above age 80. Despite the fact that persons aged 90 and over will comprise less than one per cent of the global population in 2040-2045, this age group is projected to account for 12 per cent of mortality, reflecting the increasing postponement of death to very advanced ages.

**Figure I.8. Percentage distribution of deaths and population by age, world,
1980-1985, 2010-2015 and 2040-2045**

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While virtually all of the world's populations have achieved progress in postponing death to older ages, disparities persist such that the distribution of deaths by age differs markedly across development groups. Figure I.9 presents the percentage distribution of deaths by broad age group for development groups, starting in 1980-1985. Despite some success at reducing mortality among children, the proportion of deaths occurring below age 15 in the least developed countries remained high in 2010-2015 at 43 per cent (the vast majority of those deaths occur before age 5). Moreover, projected future mortality rates indicate that in 2040-2045 still 20 per cent of mortality in the least developed countries would occur among children ages 0-14, which is a higher proportion than in the other less developed countries in 2010-2015 (15 per cent). In the other less developed countries, it is projected that deaths of children under 15 will account for only 5 per cent of all deaths in 2040-2045.

In the least developed countries, the reduction in the proportion of childhood deaths is accompanied by an increase in the proportion of deaths distributed across all three adult age groups. The share of deaths occurring at ages 15-59 in the least developed countries grew from 23 per cent in 1980-1985 to 30 per cent in 2010-2015 and is projected to increase further to 31 per cent in 2040-2045. The proportion of deaths to those aged 60-79 likewise increased from 14 per cent to 20 per cent over the past 30 years and is projected to grow to 33 per cent over the next 30 years. Deaths postponed to age 80 or later were rare in the least developed countries in 1980-1985, but these populations are projected to experience a rapid increase in the percentage of deaths concentrated at very advanced ages, from around 7 per cent in 2010-2015 to 16 per cent in 2040-2045.

Figure I.9. Percentage distribution of deaths by broad age group for development groups, 1980-1985, 2010-2015, and 2040-2045
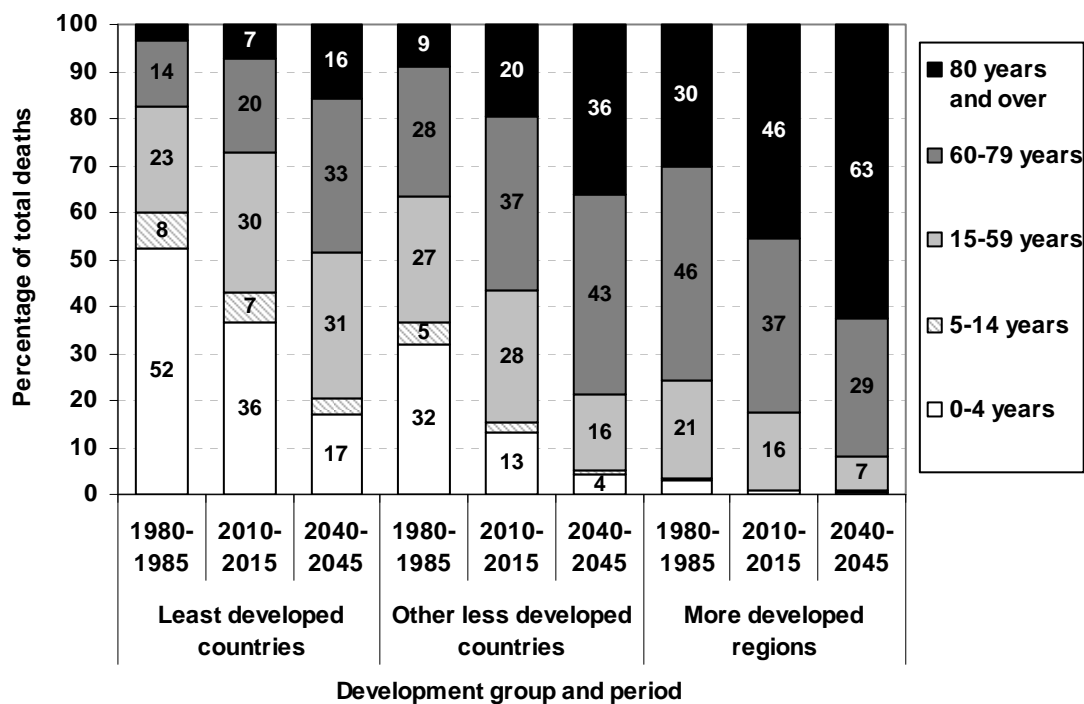
As progress continues in preventing premature mortality in the other less developed countries, the proportion of deaths occurring to those aged 15-59 is projected to decline in the future, from 28 per cent in 2010-2015 to 16 per cent in 2040-2045, as an increasing number of deaths are postponed beyond age 60. The proportion of deaths that occur among persons aged 60-79 in the other less developed countries is projected to grow to 43 per cent in 2040-2045, while deaths above age 80 will account for 36 per cent of all mortality.

In 1980-1985, the vast majority (76 per cent) of deaths in the more developed regions occurred to persons older than 60. By 2010-2015, this proportion rose to 83 per cent while nearly half (46 per cent) were concentrated above age 80. Thirty years into the future, death before age 60 is projected to become even less frequent in the more developed regions, accounting for fewer than one in ten deaths. The proportion that occurs among those aged 60-79 is also projected to shrink, to 29 per cent, while that which occurs among those aged 80 and over will grow to 63 per cent.

E. CONTRIBUTIONS OF AGE-SPECIFIC MORTALITY DECLINE TO CHANGES IN LIFE EXPECTANCY

The gains in life expectancy at birth observed over time reflect changes in mortality rates that occur across the various age ranges. Progress in longevity achieved over the past few decades was influenced in large part by substantial reductions in the mortality risks in childhood, especially in less developed regions both because of rapid declines in child mortality rates and because deaths averted very young ages produce larger gains in life expectancy at birth relative to deaths averted at older ages. However, given the low levels of child mortality that had been achieved by 2010-2015, gains in survival among adults are expected to play a larger role in shaping future progress in longevity.

Figure I.10 shows the number of years of life expectancy at birth gained over the past 30 years due to reductions in mortality among six age groups in each of the major areas, as well as the

age-specific contribution to progress in longevity projected over the coming 30 years.

In Africa more than 59 per cent of the 7.3-year gain in life expectancy at birth between 1980-1985 and 2010-2015 was due to progress in survival among children under 5. Close to 2.5 years (34 per cent) of the total gain in life expectancy in Africa was due to reductions in mortality in the first year of life alone (data not shown). In contrast, improvement in survival among adults contributed relatively little to Africa's total gain in longevity since 1980. Gains among those aged 15 to 59—the age group most affected by the HIV/AIDS epidemic—added only 1.1 years to the life expectancy at birth over the last 30 years. An additional year was added due to mortality reductions between ages 60 and 79, while improvements in survival beyond age 80 contributed only 0.1 years (0.4 per cent) of the total gain in life expectancy at birth in Africa over the last three decades.

Like Africa, large proportions of the gains in life expectancy at birth in both Asia and Latin America and the Caribbean were attributable to reductions in mortality risks among children. Since 1980, improved survival to age five produced gains in life expectancy close to 4 years in both major areas, accounting for 45 per cent of the total gain in life expectancy in Asia and 40 per cent of that in Latin America and the Caribbean. Improvements in survival between ages 15 and 59 accounted for just over one quarter of the total gains in survival in both regions from 1980-1985 to 2010-2015. In Latin America and the Caribbean, gains in survival above age 60 were greater than in Asia and the additional life expectancy at birth achieved through mortality reductions above age 80 in Latin America and the Caribbean (0.7 years) was more than twice that achieved in Asia (0.3 years) over the past three decades.

In Oceania, just one quarter of the total change in life expectancy at birth since 1980 was due to progress in survival among children, while the remaining three quarters was attributable to mortality reductions above age 15. Oceania gained 1.6 years (21 per cent) of life expectancy at

Figure I.10. Change in life expectancy at birth from 1980-1985 to 2010-2015 and 2010-2015 to 2040-2045 due to mortality reductions in each age group, by major area
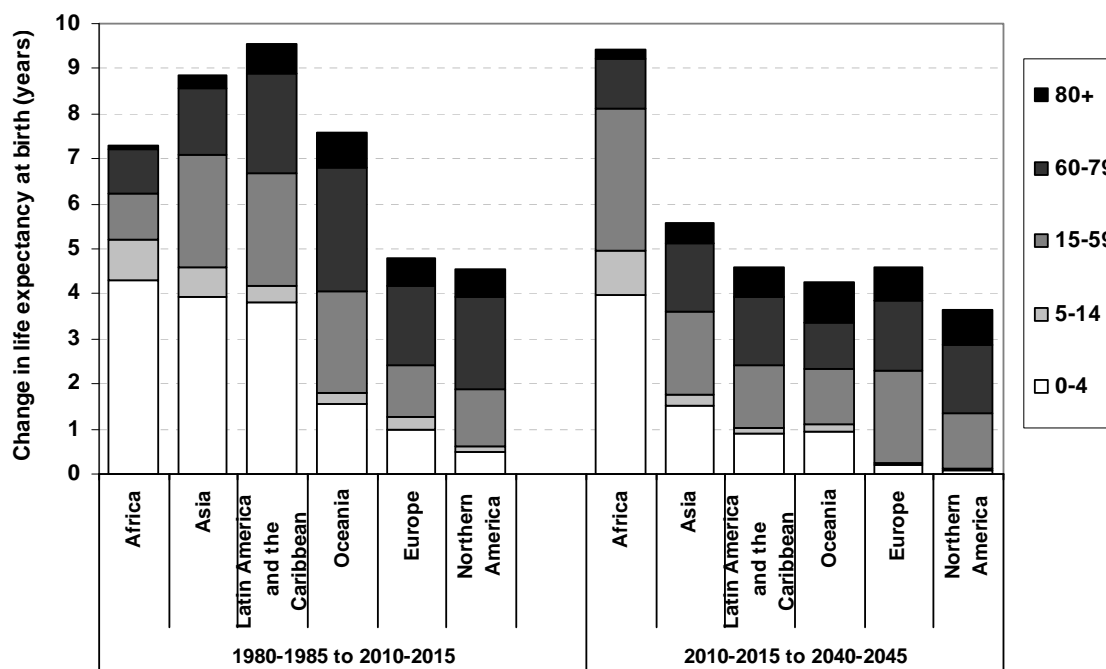
birth as a result of improved survival to age five, and an additional 0.2 years (3 per cent) due to mortality reductions between ages 5 and 14. The 60 to 79 year age range contributed most to longer lives in Oceania: an additional 2.8 years (37 per cent) of life expectancy at birth was gained as a result of increased survival in this age range between 1980-1985 and 2010-2015. Improvements in survival above age 80 also added 0.8 years (10 per cent) to the length of life in Oceania .

As in Oceania, in both Europe and Northern America the contributions of mortality reductions among adults far outweighed those among children in contributing to overall gains in the life expectancy at birth since 1980. Improved survival above age 15 accounted for 73 per cent of progress in longevity in Europe and 87 per cent in Northern America. Reductions in mortality in the 15-59 age group added 1.1 years of life expectancy in Europe, which was less than the 1.3 years added in Northern America, due in part to persistently high risks of adult mortality in Eastern Europe. In both Europe and Northern

America, survival gains above age 80 accounted for 13 per cent of the total gain in longevity between 1980-1985 and 2010-2015.

Future gains in longevity are anticipated to increasingly reflect mortality gains at older ages in all major areas. In Africa over the next 30 years, continued progress in child survival is expected to produce gains in life expectancy similar to those achieved over the previous three decades, but improvements in survival at adult ages are expected to far surpass those in the past in terms of their contributions to overall longevity: mortality reduction below age 15 is anticipated to extend life expectancy at birth by 5.0 years between 2010-2015 and 2040-2045, compared to 5.2 years between 1980-1985 and 2010-2015, while improved survival above age 15 will add an additional 4.5 years to life expectancy over the coming 30 years, compared to just 2.1 years over the past 30 years. In total, Africa is anticipated to advance life expectancy at birth by more than 9 years over the next three decades, compared to just over 7 years over the previous three decades.

In Asia, as well as in Latin America and the Caribbean, gains in life expectancy over the next 30 years are anticipated to be smaller than those achieved over the previous 30 years and in the future a smaller proportion will be attributable to reductions in childhood mortality than in the past. While improvements in survival below age 15 accounted for more than half of Asia's overall gain in longevity between 1980-1985 and 2010-2015, this age group is expected to account for less than one third of the total increase in the average length of life between 2010-2015 and 2040-2045. Similarly, in Latin America and the Caribbean, the share of improvements in longevity that occurred due to increases in survival below age 15 is expected to fall by almost half to 23 per cent over the coming 30 years, compared to 44 per cent over the previous 30 years. In both Asia and Latin America and the Caribbean, as well as in Oceania, the share of the total gain in life expectancy between 2010-2015 and 2040-2045 that is due to reductions in mortality above age 80 is expected to be more than double what it was between 1980-1985 and 2010-2015.

In Oceania, Europe and Northern America, future gains in longevity are expected to be dominated by mortality decline among adults. Across these three major areas, the share of the total gain in life expectancy anticipated over the next 30 years that is due to improvements in survival above age 15 ranges from 74 per cent in Oceania to 97 per cent in Northern America. In Europe, improvements in survival between ages 15 and 59 will account for a greater proportion of overall progress in longevity than any other age range (44 per cent) due in large part to anticipated reductions in adult mortality in Eastern Europe, where non-communicable diseases and injuries currently pose substantial mortality risks before age 60 (WHO, 2011). In Northern America, better survival between the ages of 60 and 79 will account for more of the gains in life expectancy at birth than any other age range (42 per cent).

F. LONGEVITY OF COHORTS

The traditional life expectancy at birth measure reflects the average length of life among a hypothetical cohort of individuals if they were exposed throughout their lives to the age-specific mortality risks of a given period. Thus the life expectancy at birth in 1950-1955, estimated at 48 years for the world, describes the average length of life (or age at death) that the "cohort" of individuals born in 1950-1955 would have had if they had lived out their entire lives facing the prevailing mortality risks observed during 1950-1955. This is the life expectancy at birth obtained from a "period life table". In practice, this period measure does not reflect the true overall experience of that or any cohort, since their lives have been lived over many periods and the age-specific mortality risks have changed over time. An alternative assessment of survival that draws on the age-specific mortality rates observed over multiple time periods better reflects the overall experience of a given cohort, but can be performed only for "extinct" cohorts – that is, cohorts for which all of the members are deceased. This is the life expectancy at birth obtained from a "cohort life table".

While the cohort born in 1950-1955 is not extinct – those surviving were between 56 and 61 years old in 2011—the mortality projections produced by the Population Division in *World Population Prospects: The 2010 Revision* facilitate the construction of a plausible cohort life table against which to compare the period life table values. This approach reflects improvements in survival that have already occurred for those born in 1950-1955, as well as the anticipated future progress in longevity represented by the medium variant projections.

Of the 490 million people who were born worldwide over the period 1950-1955, 73 per cent survived at least to age 30, 61 per cent to age 60, and given the projected mortality rates in the medium variant over the next few decades, 13 per cent are expected to survive to celebrate their 90th birthdays. The improvements in survival that have taken place over the life course of the 1950-1955 birth cohort are evident in the comparison between the estimated and projected survival curve for the cohort and the survival curve that would have occurred if mortality rates had remained unchanged from their 1950-1955 levels (figure I.11). With no change in mortality rates over the life of the cohort, 70 per cent would have

Figure I.11. Percentage of the 1950-1955 birth cohort surviving to each age and percentage that would have survived if mortality rates had remained constant at 1950-1955 levels, world
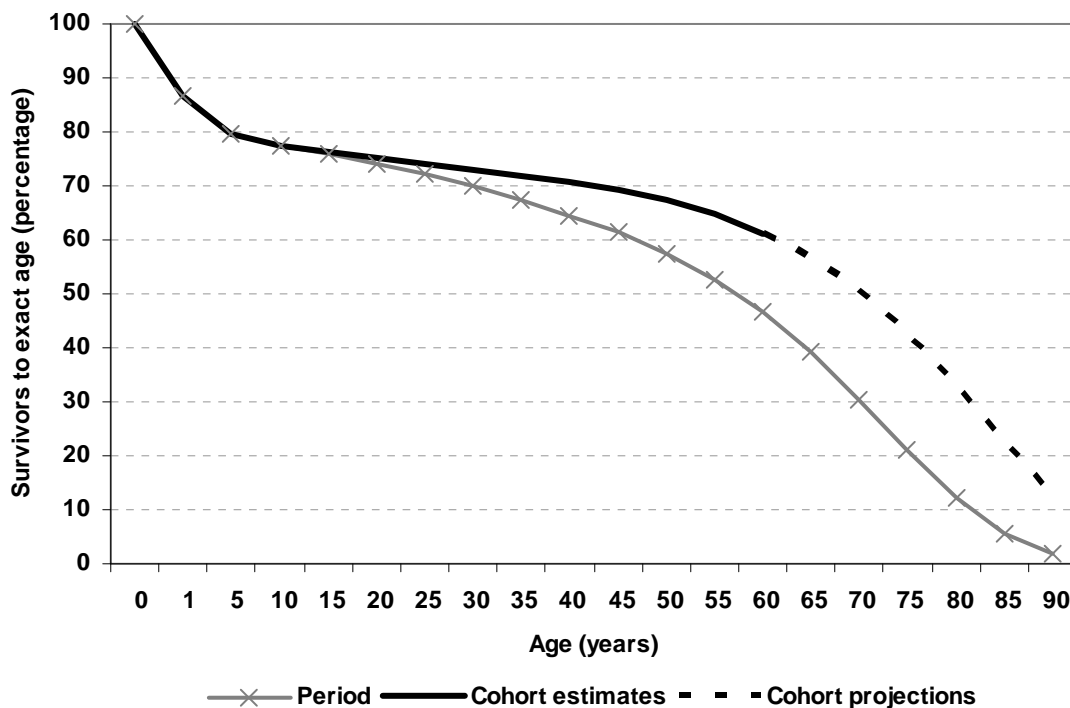
celebrated a 30th birthday, just 47 per cent a 60th birthday, and a low 2 per cent would have lived to see age 90. The life expectancy at birth (average age at death) for the true cohort is expected to be 57 years, while it would have been nearly 10 years shorter if no mortality changes had occurred since 1950-1955.

The differences between the period and cohort life expectancies at birth are largest for those regions that have achieved the most rapid improvements in survival (figure I.12). In both Asia and Oceania, the cohorts born in 1950-1955 would live more than 10 years longer on average than they would have at the prevailing mortality rates of their birth years. This progress reflects successes in, *inter alia*, reducing malaria risks, expanding coverage of vaccines, and improving public health since 1950.

In Latin America and the Caribbean the life expectancy of the 1950-1955 birth cohort would exceed that which would have occurred with no improvement in mortality by 9 years. Progress in these regions reflects improvements in preventing mortality due to infectious diseases, as well as

advancements in the early detection and treatment of non-communicable diseases, especially heart diseases and stroke (WHO, 2011).

In Africa, the region of the world with the lowest period life expectancy in 1950-1955 at 38 years, progress in reducing mortality was slower through the lifetimes of the 1950-1955 birth cohort. As a result, members of the cohort would live only 44 years on average, just 6 years longer than what would have occurred without any change in mortality rates during their lifetimes. This occurred despite the fact that this cohort was less affected by AIDS-related mortality relative to later birth cohorts. Figure I.13 shows the logged age-specific mortality rates for the cohorts born in 1950-1955, 1960-1965 and 1970-1975 in Southern Africa, the region of the world most affected by the AIDS epidemic. For the 1950-1955 birth cohort, mortality rates were high in infancy and early childhood, fell to their lowest point in the 10-14 year age range, grew sharply in adolescence and young adulthood and then increased linearly after age 35. Those born 10 years later in 1960-1965 suffered less mortality in childhood compared to the 1950-1955 birth

Figure I.12. Period life expectancy at birth in 1950-1955 and the life expectancy of the 1950-1955 birth cohort, by major area
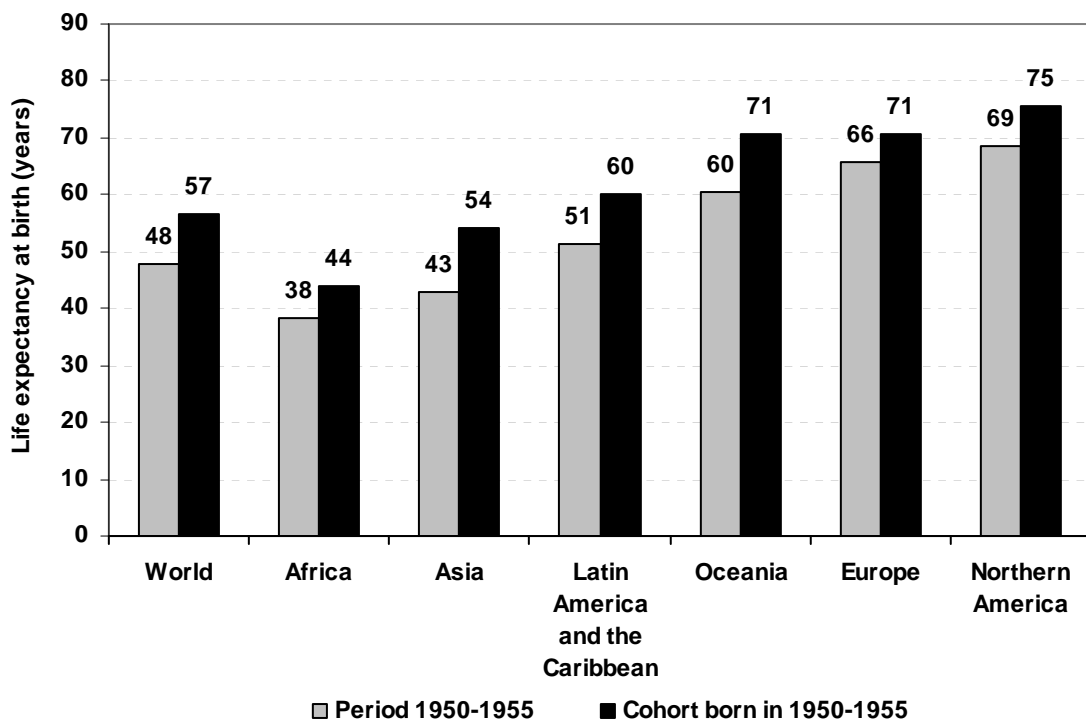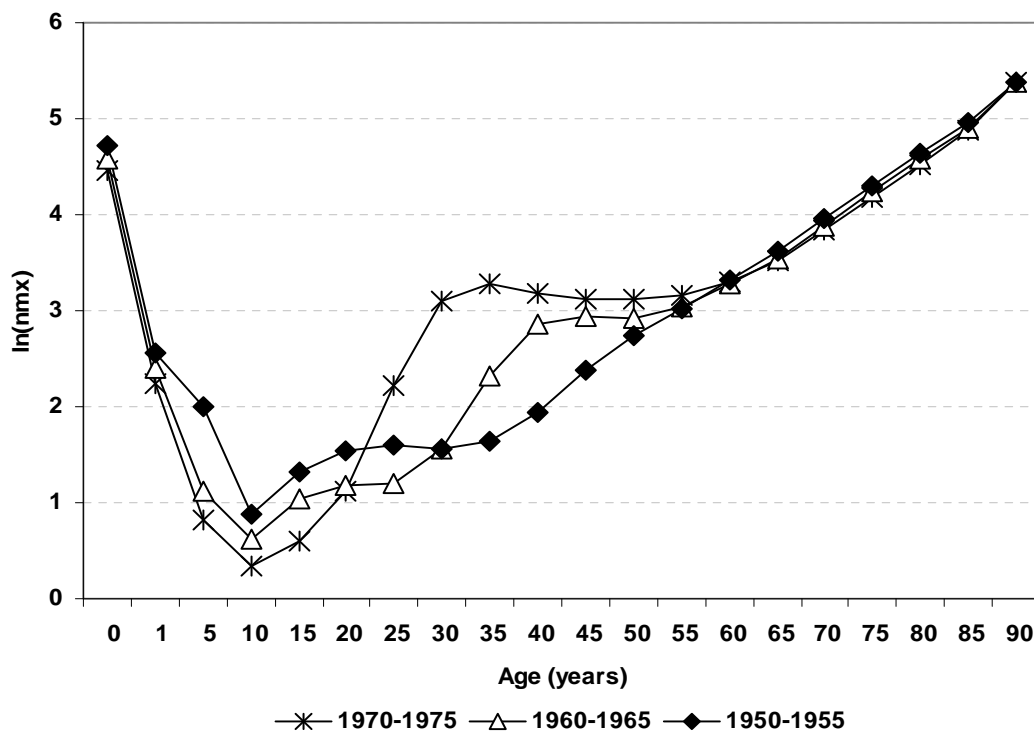

Figure I.13. Mortality rates by age for 1950-1955, 1960-1965 and 1970-1975 birth cohorts, Southern Africa

United Nations Department of Economic and Social Affairs/Population Division

cohort, especially after infancy, and continued to experience lower mortality rates until age 30, when the mortality risks of AIDS pushed the all-cause mortality rates higher than what had been experienced by the 1950-1955 birth cohort. The 1970-1975 birth cohort experienced even greater AIDS mortality risks than the earlier cohorts and those risks presented at even younger ages as is evident by the higher mortality rates between aged 20 and 60 compared to earlier birth cohorts.

In Europe and Northern America the life expectancies at birth of the 1950-1955 birth cohorts had the smallest proportional differences relative to the period measures, at less than 19 per cent, in part because life expectancy at birth was already relatively high in the 1950s. The

experience of those born in Eastern Europe in 1950-1955, however, differs markedly from their peers in the other more developed regions. They have lived through prolonged political, economic and social transitions that have stymied improvements in health and longevity by preventing these populations from being able to take advantage of the advancements in preventive health care and treatment enjoyed by many other developed countries. As a result, they have seen little improvement in survival during their lifetimes (figure I.14), such that life expectancy for the cohort at 65 years, was only one year higher than what would have occurred if mortality rates had remained constant at their 1950-1955 levels.

Figure I.14. Percentage of the 1950-1955 birth cohort surviving to each age and the percentage that would have survived if mortality rates had remained constant at 1950-1955 levels, Eastern Europe
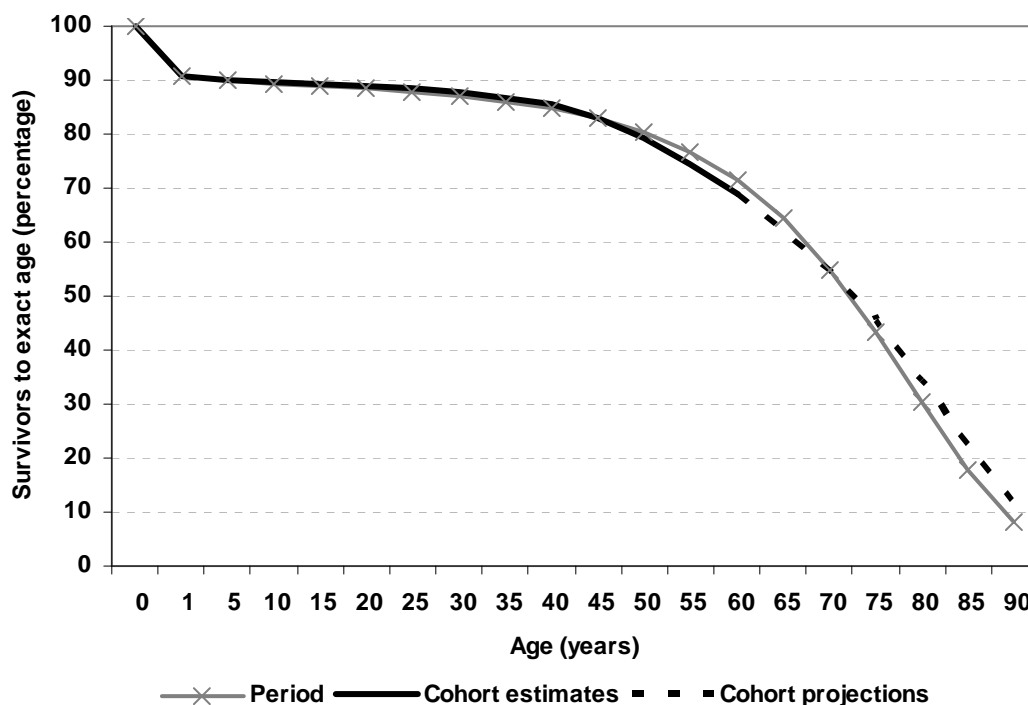
Future projected improvements in survival indicate that more recent birth cohorts will enjoy substantially longer lives than those of their parents' and grandparents' generations. At the world level, nine out of every ten people born in 2000-2005 were expected to survive to celebrate their 30th birthdays compared to just seven of ten of those born in 1950-1955 (figure I.15). Improvements in survival are projected to

continue at adult ages as well: 8 out of 10 persons born in 2000-2005 would survive to at least age 60, compared to 6 out of 10 of the 1950-1955 birth cohort. While survival to age 90 or above was expected to be rare among those born in 1950-1955 (just over 1 in 10), based on current projections, nearly one quarter of those born in 2000-2005 are expected to celebrate their 90th birthdays in 2090-2095.

Figure I.15. Percentages of cohorts born in 1950-1955 and 2000-2005 surviving to ages 30, 60, and 90, by major area

Percentage of birth cohort surviving to age 30

Percentage of birth cohort surviving to age 60

Percentage of birth cohort surviving to age 90

■ Cohort born 1950-1955   ☐ Cohort born 2000-2005
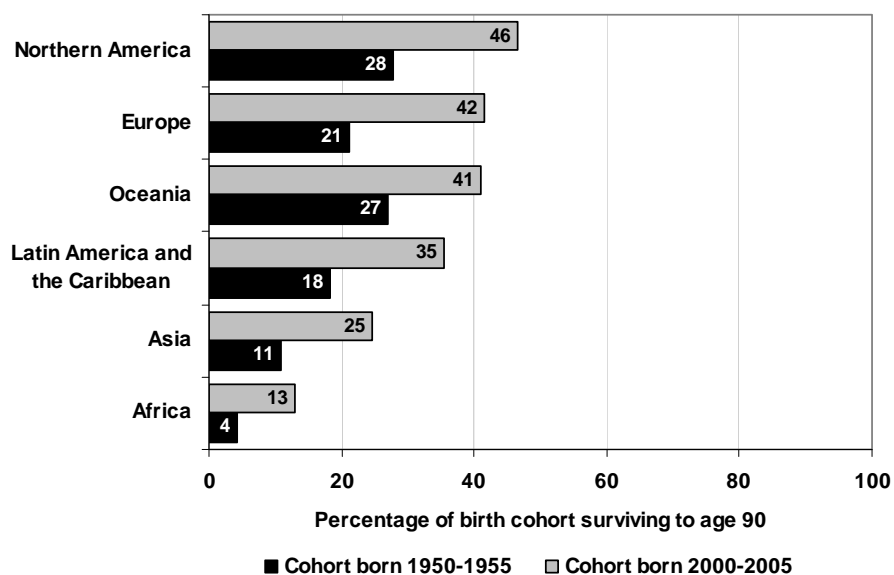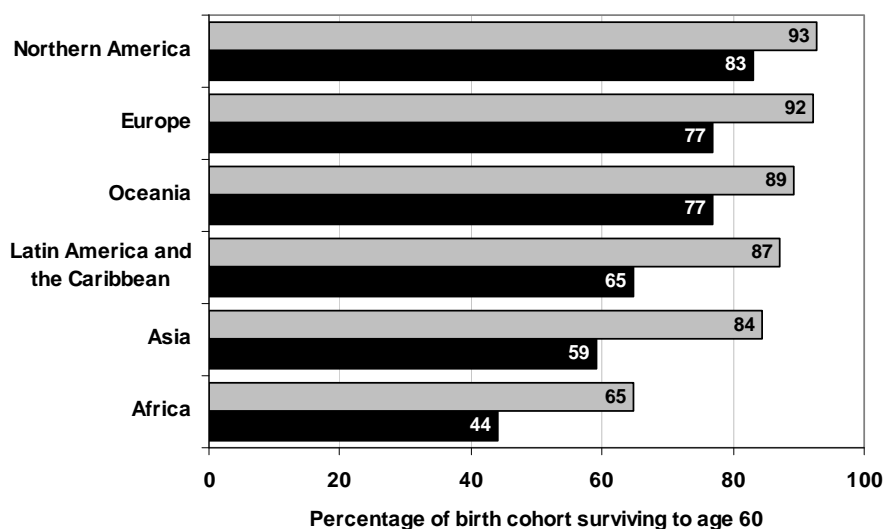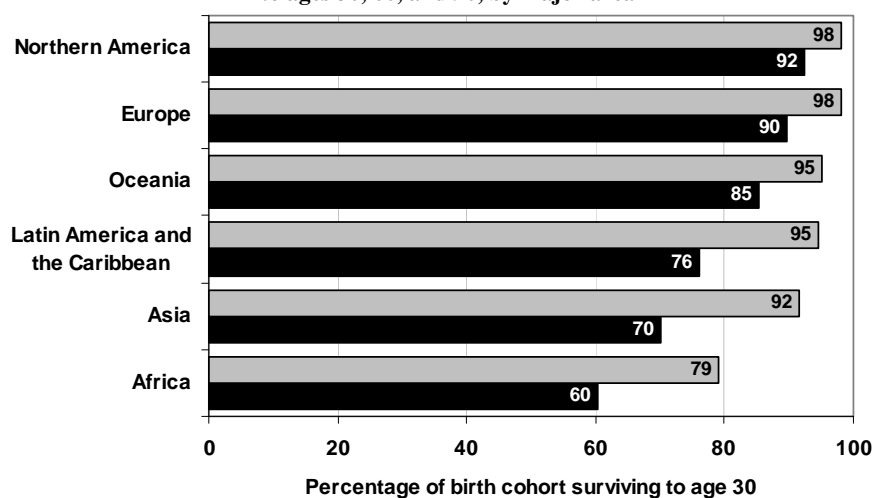
Disparities in survival between the major areas are expected to shrink at younger ages, but persist at advanced ages. People born in 1950-1955 in Africa were about half as likely to survive to age 60 compared to their peers in Northern America, but for the 2000-2005 cohort survival to age 60 in Africa is expected to catch up to 70 per cent of that in Northern America. However, while 13 per cent of Africa's 2000-2005 birth cohort would survive to at least age 90, that figure remained well behind that of Northern America, Europe and Oceania, where more than 40 per cent of those born in 2000-2005 are expected to reach age 90.

The patterns of mortality reduction that are producing the improvements in longevity among cohorts are shifting over time. For the global 1950-1955 birth cohort, close to half the difference between the cohort life expectancy at birth and what would have occurred with no change in mortality was due to a reduction in mortality rates before age 50 (half of the area under the curve in figure I.16 comes before age 50 years). Another 25 per cent was due to reduced mortality among those aged 50 to 65, while the remaining 25 per cent would be due to mortality reductions above age 65. In contrast, for the cohort born in 2000-2005, a larger percentage of the difference between the cohort and period life expectancy at birth was expected to be caused by mortality reductions at advanced ages. Half of the improvement in longevity over their lifetimes would be attributable to improved survival above age 65.

Figure I.16. Percentage of difference in life expectancy at birth between period and cohort life tables due to improvements in survival at each age, world, 1950-1955 and 2000-2005
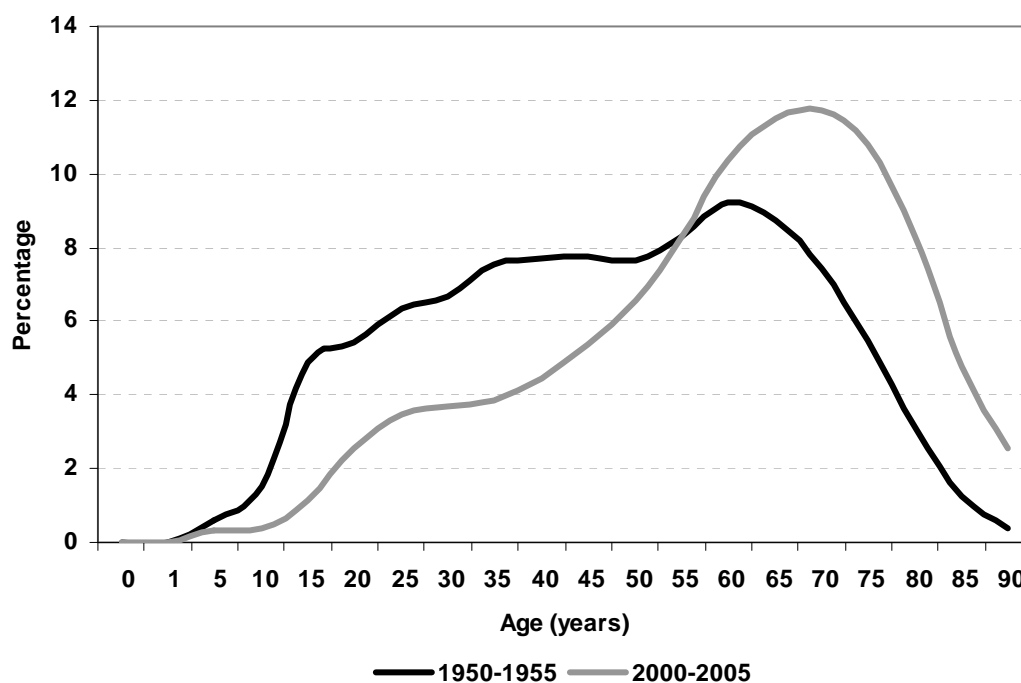
G. Mortality from HIV/AIDS

In 2009, an estimated 33.3 million people worldwide were living with HIV (UNAIDS, 2010) In the *2010 Revision*, the impact of the HIV/AIDS epidemic was explicitly incorporated into the mortality estimates for 48 countries considered to be highly affected by the epidemic (table I.7).

For these 48 countries, two separate mortality processes are modelled: the mortality due to the HIV/AIDS epidemic itself and the mortality that prevails among the uninfected population, called the "No-AIDS scenario". The motivation for separately modelling the impact of HIV/AIDS relates to the unique epidemiological profile of the disease compared to other infectious diseases. First, HIV differs from many other infectious diseases in that it has a very long incubation period during which an HIV-positive person is mostly symptom-free yet still infectious. This long lag period between

initial infection and death, which is further prolonged by antiretroviral drug treatments, complicates the modelling of AIDS-related mortality. Second, HIV differs from several other diseases in that in the absence of treatment, it is almost always fatal. Thus the level of incidence and prevalence today portends the future mortality impact of the epidemic. Third, while most infectious diseases affect the very young or the very old disproportionately, HIV infections and AIDS deaths are concentrated among adults of reproductive and working ages. A dedicated HIV/AIDS epidemic model better represents the mortality of populations highly affected by the epidemic than the model life tables previously available to demographers, which do not reflect the specific age pattern of AIDS-related mortality. Further details about the HIV/AIDS modelling procedure are outlined in box I.1 (p. 30).

TABLE I.7. HIV PREVALENCE IN COUNTRIES AND AREAS MOST AFFECTED
BY THE HIV/AIDS EPIDEMIC, 2009

| Country | HIV prevalence among persons aged 15-49 (percentage) in 2009 | |
	Estimate	*[Low estimate - high estimate]*
Africa		
1. Angola	2.0	[1.6 - 2.4]
2. Benin	1.2	[1.0 - 1.3]
3. Botswana	24.8	[23.8 - 25.8]
4. Burkina Faso	1.2	[1.0 - 1.5]
5. Burundi	3.3	[2.9 - 3.5]
6. Cameroon	5.3	[4.9 - 5.8]
7. Central African Republic	4.7	[4.2 - 5.2]
8. Chad	3.4	[2.8 - 5.1]
9. Congo	3.4	[3.1 - 3.8]
10. Côte d'Ivoire	3.4	[3.1 - 3.9]
11. Dem. Republic of the Congo	...	[1.2 - 1.6]
12. Djibouti	2.5	[1.9 - 3.2]
13. Equatorial Guinea	5.0	[3.5 - 6.6]
14. Eritrea	0.8	[0.6 - 1.0]
15. Ethiopia	...	...
16. Gabon	5.2	[4.2 - 6.2]
17. Gambia	2.0	[1.3 - 2.9]
18. Ghana	1.8	[1.6 - 2.0]
19. Guinea	1.3	[1.1 - 1.6]

TABLE I.7. HIV PREVALENCE IN COUNTRIES AND AREAS MOST AFFECTED
by the HIV/AIDS epidemic, 2009 (*continued*)

| Country | HIV prevalence among persons aged 15-49 (percentage) in 2009 | |
	Estimate	[Low estimate - high estimate]
Africa (continued)		
20. Guinea-Bissau	2.5	[2.0 - 3.0]
21. Kenya	6.3	[5.8 - 6.5]
22. Lesotho	23.6	[22.3 - 25.2]
23. Liberia	1.5	[1.3 - 1.8]
24. Malawi	11.0	[10.0 - 12.1]
25. Mali	1.0	[0.8 - 1.3]
26. Mozambique	11.5	[10.6 - 12.2]
27. Namibia	13.1	[11.1 - 15.5]
28. Nigeria	3.6	[3.3 - 4.0]
29. Rwanda	2.9	[2.5 - 3.3]
30. Sierra Leone	1.6	[1.4 - 2.1]
31. South Africa	17.8	[17.2 - 18.3]
32. Swaziland	25.9	[24.9 - 27.0]
33. Togo	3.2	[2.5 - 3.8]
34. Uganda	6.5	[5.9 - 6.9]
35. United Republic of Tanzania	5.6	[5.3 - 6.1]
36. Zambia	13.5	[12.8 - 14.1]
37. Zimbabwe	14.3	[13.4 - 15.4]
Asia		
1. China	0.1	[0.1 - 0.1]
2. India	0.3	[0.3 - 0.4]
3. Thailand	1.3	[1.0 - 1.6]
Europe		
1. Russian Federation	1.0	[0.9 - 1.2]
Latin America and the Caribbean		
1. Bahamas	3.1	[1.2 - 5.4]
2. Belize	2.3	[2.0 - 2.8]
3. Guyana	1.2	[0.5 - 1.9]
4. Haiti	1.9	[1.7 - 2.2]
5. Jamaica	1.7	[1.1 - 2.5]
6. Suriname	1.0	[0.7 - 1.4]
Northern America		
1. United States of America	0.6	[0.4 - 0.8]

Source: GLOBAL REPORT: UNAIDS Report on the Global AIDS Epidemic 2010. Joint United Nations Programme on HIV/AIDS (UNAIDS), Geneva.

Box I.1. Modelling the impact of HIV/AIDS on mortality[a]

In *World Population Prospects*, the first step in modelling the HIV/AIDS epidemic entails estimating a time trend of annual new infections among adults. The model developed by the UNAIDS Reference Group on Estimates, Modelling and Projections is used to fit past estimates of HIV prevalence[b] provided by UNAIDS in each of the affected countries so as to derive the parameters determining the past dynamics of the epidemic in the respective countries. For most countries, the model is fitted assuming that the relevant parameters have remained constant in the past. Beginning in 2009, the parameter PHI, which reflects the rate of recruitment of new individuals into the high-risk or susceptible group, is projected to decline by half every twenty years. The parameter R, which represents the force of infection, is projected to decline by half every thirty years. The reduction in R reflects the assumption that changes in behaviour among those subject to the risk of infection, along with increases in access to treatment for those living with HIV, will reduce the chances of HIV transmission.

The resulting estimates and projections of HIV prevalence are input to a demographic impact model that allocates adult infections by age and sex and follows infected individuals until their deaths from AIDS or from causes not connected to AIDS (that is, from competing risks). The mean survival time from HIV infection until death is adjusted for the level of coverage of antiretroviral therapy (ART).

In the *2010 Revision*, interventions to prevent the mother-to-child transmission of HIV are modelled on the basis of estimated country-specific coverage levels that, in 2009, averaged 51 per cent among the 48 affected countries, but varied from 6 to 100 per cent among them (with 10 countries having less than 20 per cent coverage of pregnant women in 2009, and 14 countries with more than 75 per cent coverage). These coverage levels are projected to reach 74 per cent on average by 2015, varying between 40 per cent and 95 per cent among the affected countries. After 2015, the coverage of interventions to prevent mother-to-child transmission of HIV is assumed to remain constant until 2100 at the level reached in each of the affected countries in 2015. Among women receiving treatment, the probability of transmission from mother to child is assumed to vary between 2 per cent and 20 per cent depending on the particular combination of breastfeeding practices (mixed breastfeeding, replacement feeding, exclusive breastfeeding), its duration in the population and the type of treatment available (single-dose nevirapine, dual ARV prophylaxis, triple ARV prophylaxis or treatment). These assumptions produce a reduction in the incidence of HIV infection among children born to HIV-positive women, but the size of the reductions varies from country to country depending on the level of coverage that treatment reaches in each country.

The survivorship of infected children takes account of varying access to paediatric treatment. In the *2010 Revision*, children with HIV are divided into two groups: (*i*) those infected inutero, among whom the disease progresses rapidly and whose median survival is set at 1.1 years, and (*ii*) those infected through breastfeeding after birth, among whom the disease progresses slowly and whose average survival is set at 9.4 years without treatment. Explicit inclusion of paediatric treatment is done via country-specific coverage levels which average 33 per cent in 2009 but vary between 0 and 99 per cent among the 48 affected countries (with 8 countries having less than 10 per cent coverage in 2009 and only 7 countries having a coverage level above 75 per cent). By 2015, the projected coverage is expected to reach 58 per cent on average in the 48 affected countries, varying from 40 per cent to 99 per cent. Coverage levels are assumed to remain constant from 2015 to 2100 at the level reached in each country by 2015. The annual survival of children receiving treatment is 85 per cent during the first year and 93 per cent for subsequent years.

The *2010 Revision* incorporates a revised survival for persons receiving treatment with highly active antiretroviral therapy. The proportion of the HIV-positive population receiving treatment in each country is consistent with estimates prepared by the World Health Organization and UNAIDS which averaged 64 per cent in 2009 among the 48 affected countries, but varied between 24 per cent and 100 per cent. Coverage is projected to reach between 40 per cent and 99 per cent by 2015, averaging 84 per cent for the affected countries.

Between 2015 and 2050, coverage levels are assumed to remain constant at the level reached in each country by 2015. It is assumed that adults receiving treatment have, on average, an 86 per cent chance of surviving on the first year of treatment, and a 90 per cent chance of surviving each year thereafter in the absence of other causes of death. Under this assumption, mean survival time after the initiation of therapy is 9.1 years and the median survival time is 5.6 years, in the absence of other causes of death. Therapy is assumed to start at the time full-blown AIDS develops. Without treatment, infected adults have a mean survival time of 2.6 years (and a median survival time of 2.1 years) after the onset of full-blown AIDS.

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[a] Drawn primarily from United Nations, Department of Economic and Social Affairs, Population Division (2011b). *World Population Prospects, The 2010 Revision: Highlights and Advance Tables*. Working Paper No. ESA/P/WP.220, which includes references to the relevant scientific literature.
[b] In countries where the epidemic has spread to the general population, empirical estimates of HIV prevalence are most often based on surveillance data from antenatal clinics or on population surveys. For countries where the epidemic is concentrated in high-risk population groups the prevalence estimates are based on assumptions about the size of such groups and the prevalence levels among them.

Figure I.17.A depicts the estimated and projected number of deaths due to AIDS by region based on the 48 countries for which the impact of the HIV/AIDS epidemic was explicitly incorporated into the mortality levels. Values are per quinquennium. Though these 48 countries account for the vast majority of all AIDS-related deaths at the world level, these figures should not be interpreted as global ones.

Overall, within that group of countries, we saw a dramatic increase in the AIDS-related fatalities from the mid-1980 up until the turn of the millennium, when the number of deaths plateaued at around 9 million deaths per quinquennium (with a peak of 9.4 million in 2005-2010). Within the projection period, the overall number of deaths is expected to decline slightly and then increase slowly to about 10 million in 2045-2050. This increase is partly driven by population growth and also depends to a large extent on the assumptions made with respect to the parameters within the epidemic simulation model.

Of the 48 countries considered to be highly affected by the HIV/AIDS epidemic, 37 are in sub-Saharan Africa, 3 are in Asia (including China and India) and 8 are located in other regions of the world. Sub-Saharan Africa accounts for the vast majority of AIDS-related deaths. The share of AIDS-related deaths in sub-Saharan Africa is projected to increase from about 76 per cent in 2010-2015 to about 90 per cent in 2045-2050. The number of AIDS-related deaths is expected to decline in the 3 Asian countries while remaining at similar levels in other regions.

Looking at the same overall number of AIDS-related deaths, this time broken down by broad age groups (figure I.17-B), it can be seen that AIDS mortality affects mainly the population at ages 15-59. Since the turn of the millennium, about 85 per cent of all AIDS deaths in those 48 countries have occurred at ages 15-59 and that proportion is expected to only slightly increase by 2045-2050. In 2010-2015, this translated into about 7.5 million AIDS deaths.

While the number of children under the age of 15 who died from AIDS-related causes peaked in 2005-2010 (about 1.3 million), a decline in both absolute and relative terms is anticipated in the following decades. Based on recent achievements towards the reduction of the mother-to-child transmission of HIV, one could reasonably anticipate even faster declines in the number of AIDS-related deaths to children. The majority of AIDS-related deaths that occur to those under 15 years of age are concentrated below age 5 (70 per cent in 2005-2010; data not shown).

Though current estimates of AIDS related deaths occurring at ages 60 and above could be underestimated by the current modelling approach and underlying assumptions, is it anticipated that the number of AIDS deaths in that age group will grow in the future. Depending on the magnitude and success of initiatives to expand coverage of antiretroviral treatment, and considering the success of these drugs to postpone AIDS-related deaths to older ages, the number of AIDS deaths taking place in that age group could well be higher than that depicted by the current projections.

Figure I.17-A. Estimated and projected number of deaths due to AIDS by region, per quinquennium, 48 AIDS-affected countries, 1980-2050
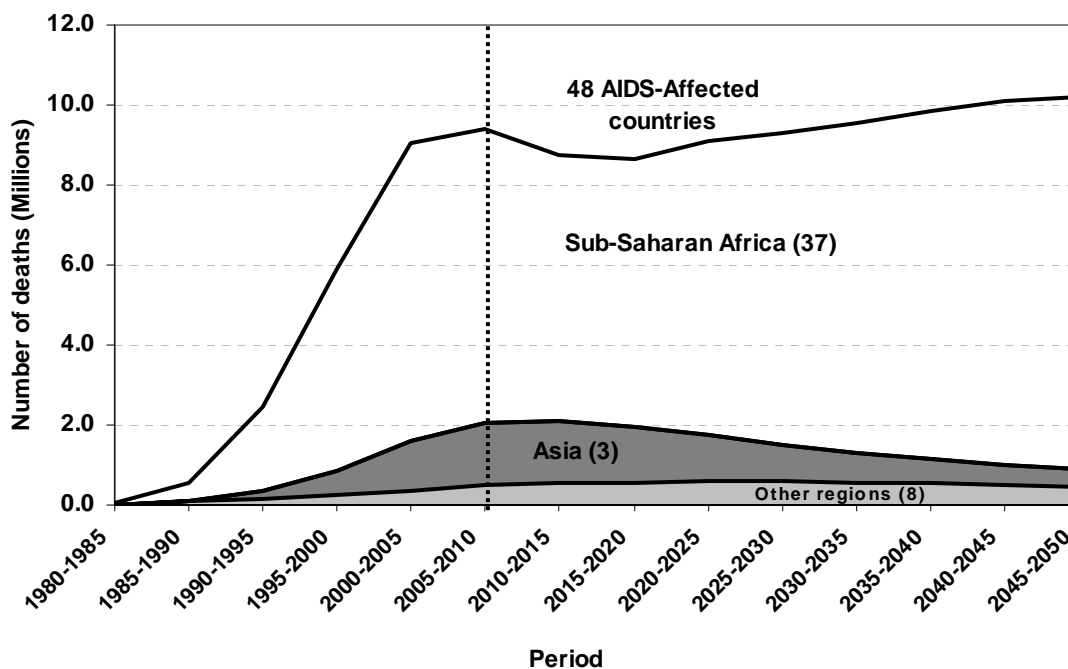
Figure I.17-B. Estimated and projected number of deaths due to AIDS by broad age groups, per quinquennium, 48 AIDS-affected countries, 1980-2050
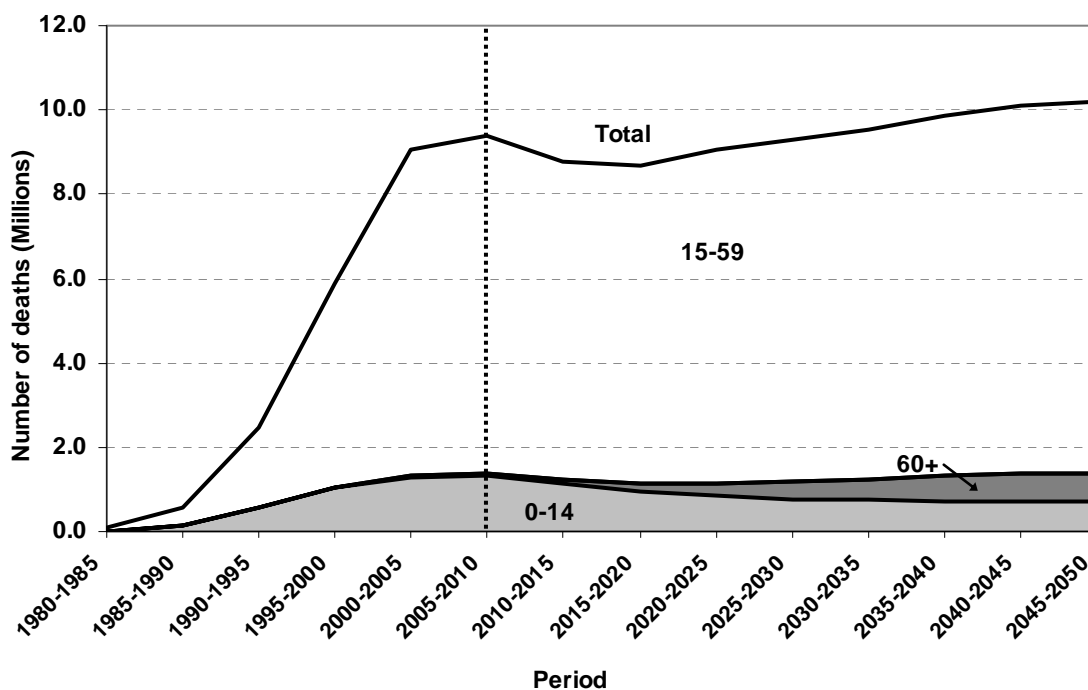
Source: United Nations, Department of Economic and Social Affairs, Population Division (2011). *World Population Prospects: The 2010 Revision.* DEMOBASE extract (Special tabulations).
NOTE: The numbers of deaths due to AIDS are for five-year periods.

United Nations Department of Economic and Social Affairs/Population Division
World Mortality Report 2011

In order to have a better understanding of the impact of the HIV/AIDS epidemic, it is also interesting to observe the magnitude of AIDS-related mortality as compares to non-AIDS mortality. Figures I.18 and I.19 illustrate age-specific differences in mortality between AIDS-related deaths and all other causes of death combined. In 2010-2015, 85.8 per cent of AIDS-related deaths in the 48 affected countries are to occur in the working ages 15-59 (figure I.18), while 13.0 per cent are to occur among children and 1.2 per cent among persons 60 and over. In contrast, among deaths in this group of countries that were not due to AIDS, 25.0 per cent are to occur among working-age adults, 20.0 per cent among children and the majority, 55.0 per cent, among older adults.

In populations where mortality is not highly affected by AIDS, mortality rates tend to follow a J- or U-shaped pattern by age, with higher age-specific death rates in early childhood and late adulthood relative to age-specific death rates among young adults. Figure I.19 shows how AIDS-related deaths can distort the usual age pattern of mortality, comparing estimated age-specific death rates for South Africa in 2010-2015 from the medium variant of the *2010 Revision* with rates estimated in the No-AIDS scenario. The dashed line, referring to the right-hand scale of the graph, shows the magnitude of the impact for each age group. The impact is especially high at ages 25-44, where mortality in each 5-year age group is about 5 to 7 times higher in the medium variant than in the No-AIDS scenario.

Figure I.18. Percentage distribution of AIDS deaths and non-AIDS deaths by broad age group, 48 AIDS-affected countries, 2010-2015
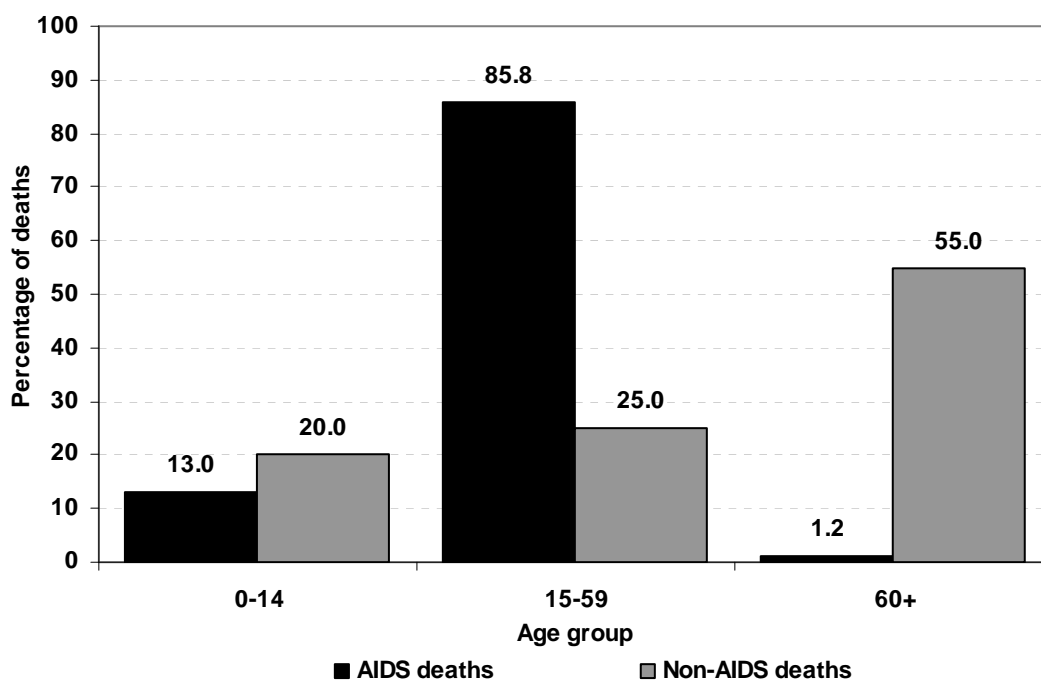
**Figure I.19. Age-specific mortality rates in medium variant and No-AIDS scenario,
and estimated relative impact of AIDS, South Africa, 2010-2015**
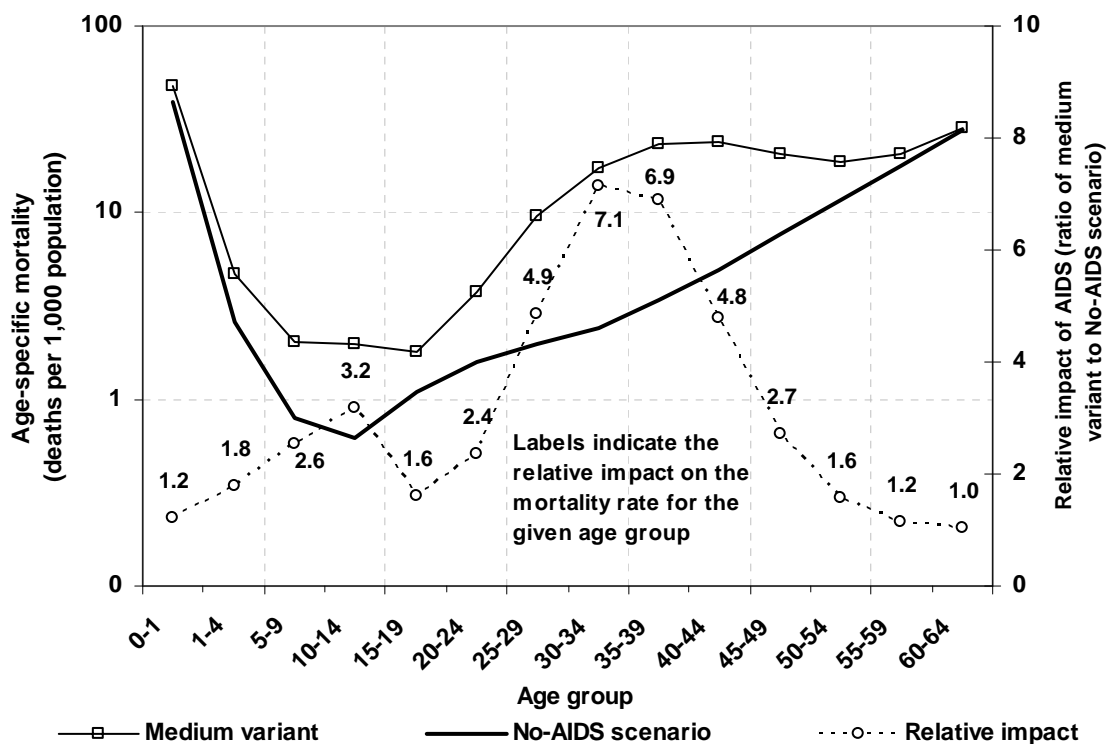
The following discussion will consider the impact of HIV/AIDS on a number of indicators of adult, child, and overall mortality for 2010-2015 in the 48 highly affected countries. It is important to bear in mind that the impact of AIDS on mortality indicators in the most recent period depends on a number of factors besides current HIV prevalence, including the past history of the epidemic, coverage of interventions such as ART and prevention of mother-to-child transmission (PMTCT), and the risks of mortality from causes other than AIDS. In fact, variation in these factors across countries mean that the mortality impact of the HIV/AIDS epidemic, as seen in comparisons of mortality between the medium variant ("with AIDS") and the No-AIDS scenario ("without AIDS"), can differ considerably between countries that had similar prevalence levels in 2009.

The first factor to consider is that variation in the past trajectory of the epidemic in different countries has shaped the differences observed across those countries in the current levels of mortality due to AIDS. Figure I.20 shows the time

trends in adult HIV prevalence in four African countries from 1980-2050. In Uganda and Zimbabwe, for example, the epidemic peaked in the 1990s and then prevalence began to decline. In Namibia and South Africa, the epidemic started later, peaked in the early 2000s, and since then Namibia's prevalence has been experiencing a faster decline than that in South Africa. Due to the long average lag time between infection and death, two countries with similar HIV prevalence at the present time —such as Namibia and Zimbabwe— can have differing levels of AIDS mortality if they had differing prevalence levels 10-15 years earlier. Zimbabwe had the world's highest prevalence levels during much of the 1990s, and as shown below in table I.8. Zimbabwe had one of the largest impacts of HIV/AIDS on life expectancy in 2010-2015 even though HIV prevalence in Zimbabwe had become lower than that of many other countries by 2009.

A second consideration is that coverage rates for ART and PMTCT have expanded rapidly in several countries. Countries that have achieved a high level of coverage of these interventions will

have lower mortality from AIDS than those at a similar prevalence level where treatment is less available.

Thirdly, the impact of AIDS is conditioned by "competing risks". That is, countries where there is a higher risk of mortality from other causes will show a lower impact of AIDS, given the same trajectory of prevalence, because HIV-infected individuals have a greater risk of dying from another cause before succumbing to AIDS.

With these caveats, table I.8 shows the impact of AIDS on indicators of adult mortality ($45q15$, the probability of dying between the ages of 15 and 60, conditional on survival to the age of 15), under-five mortality ($5q0$, the probability of dying between birth and exact age 5) and life expectancy at birth in 2010-2015. Adult mortality is addressed first due to the very large relative impact on mortality in this age group. In 7 countries (Botswana, Lesotho, Malawi, Namibia, South Africa, Swaziland and Zimbabwe), HIV/AIDS more than doubled the probability of dying between ages 15 and 60. In Botswana and Zimbabwe, the risk of dying in this age group was

3.6 and 2.8 times (260 per cent and 184 per cent) higher in the medium variant than in the No-AIDS scenario. Several countries with more moderate prevalence (below 5 per cent) nonetheless experienced large relative impacts on $45q15$, such as Central African Republic (33 per cent) and Cote d'Ivoire (31 per cent), mainly because they had higher prevalence levels in the past.

AIDS can also significantly elevate mortality among children. In the absence of treatment, a large percentage of children who acquire the virus through mother-to-child transmission during pregnancy, delivery or breastfeeding die before age 5. Generally, the absolute impact of AIDS on under-five mortality is largest in the countries with the highest prevalence, while the relative impact can also be significant in countries with lower prevalence where under-five mortality from other causes is relatively low. The largest absolute impact on child mortality in 2010-2015 was in Swaziland, where excess under-five mortality due to AIDS amounted to 20 deaths per 1,000 live births, while the highest relative impact (33 per cent) occurred in South Africa.

Figure I.20. Adult HIV prevalence for selected countries, 1980-2050
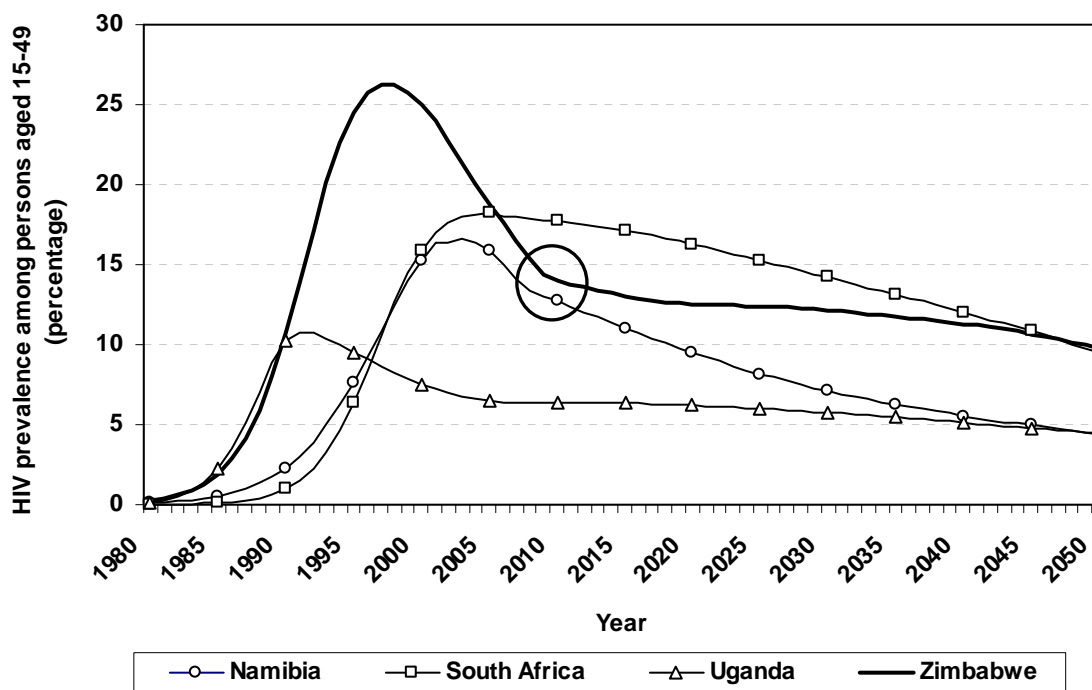
The relative impact on under-five mortality exceeded 25 per cent in all countries of the Southern African region. In some of these countries, lower competing risks of mortality during childhood may also have influenced the magnitude of the relative impact. For instance, at similar prevalence levels, around 13 per cent in both Namibia and Zambia, the relative impact on child mortality in Namibia is greater than in Zambia (31 per cent vs. 12 per cent), partly because child mortality is much lower in Namibia. Outside of Africa, most of the countries considered here experienced absolute impacts on under-five mortality of 5 deaths per thousand or less, while the relative impact exceeded 10 per cent in some countries with low mortality from other causes.

Together, the increased mortality burdens among adults and children can add up to severe reductions in life expectancy. The estimated impact of HIV/AIDS on life expectancy in 2010-2015 is shown in the rightmost columns of table I.8. The largest impact in 2010-2015 was in Botswana, where life expectancy was 17 years lower in the medium variant than in the No-AIDS scenario. The shortfall in life expectancy due to AIDS exceeded 10 years in eight additional countries (Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe) and was between 5 and 10 years in a further seven countries (Cameroun, Central Africa Republic, Côte d'Ivoire, Gabon, Kenya, Uganda, and the United Republic of Tanzania).

The extremely high HIV prevalence estimated for countries in Southern and Eastern Africa have not been found in other parts of the world, and thus the impact on life expectancy seen in table I.8 for other major areas is lower. Outside of Africa, only two other countries, both in Latin America and the Caribbean, had HIV prevalence in 2009 that exceeded two per cent of the population aged 15-49. Adult HIV prevalence was 2.3 per cent in Belize and 3.1 per cent in Bahamas (table I.7). The impact of HIV/AIDS epidemic on life expectancy at birth in 2010-2015 was less than two years in both countries (table I.8).

TABLE I.8. ADULT MORTALITY, UNDER-FIVE MORTALITY, AND LIFE EXPECTANCY AT BIRTH IN COUNTRIES AND AREAS MOST AFFECTED BY THE HIV/AIDS EPIDEMIC, MEDIUM VARIANT ("WITH AIDS") AND No-AIDS SCENARIO ("WITHOUT AIDS"), 2010-2015

Country	45q15, both sexes combined (probability of dying between exact age 15 and exact age 60, per 1,000)				Under-five mortality, both sexes combined (deaths under age 5 per 1,000 live births)				Life expectancy at birth, both sexes combined (years)			
	With AIDS	Without AIDS	Absolute difference	Percentage difference	With AIDS	Without AIDS	Absolute difference	Percentage difference	With AIDS	Without AIDS	Absolute difference	Percentage difference
Africa												
1. Angola	352	323	29	9	156	153	3	2	51.7	52.8	-1.2	-2
2. Benin	295	278	17	6	121	118	2	2	56.8	57.5	-0.7	-1
3. Botswana	575	160	415	260	46	37	9	25	52.7	69.6	-16.9	-24
4. Burkina Faso	265	239	26	11	147	147	0	0	56.0	57.7	-1.7	-3
5. Burundi	383	315	68	22	152	147	5	3	51.1	53.6	-2.5	-5
6. Cameroon	381	292	90	31	136	128	8	6	52.5	56.1	-3.6	-7
7. Central African Republic	425	320	104	33	155	151	4	3	49.5	53.1	-3.6	-7
8. Chad	336	284	51	18	195	195	0	0	50.1	52.1	-2.0	-4
9. Congo	307	251	56	22	104	99	5	5	58.0	60.3	-2.3	-4
10. Côte d'Ivoire	341	259	82	31	107	103	4	4	56.4	59.5	-3.1	-5
Dem. Republic of the												
11. Congo	375	352	24	7	180	177	3	2	48.9	49.9	-1.0	-2
12. Djibouti	289	273	17	6	104	103	2	2	58.5	59.3	-0.9	-1
13. Equatorial Guinea	365	315	51	16	151	144	6	4	51.5	53.9	-2.3	-4
14. Eritrea	286	276	11	4	62	61	1	1	62.2	62.7	-0.5	-1
15. Ethiopia	268	245	23	9	96	95	1	1	60.0	60.9	-0.9	-1
16. Gabon	269	189	80	43	64	58	6	10	63.3	66.8	-3.5	-5
17. Gambia	264	239	25	11	93	93	0	0	59.0	60.2	-1.2	-2
18. Ghana	230	194	36	18	63	61	2	3	64.7	66.2	-1.5	-2
19. Guinea	318	297	20	7	134	132	2	2	54.7	55.6	-0.8	-2
20. Guinea-Bissau	376	351	24	7	181	177	4	2	48.8	49.9	-1.1	-2
21. Kenya	348	227	121	53	89	83	6	7	58.0	62.7	-4.8	-8
22. Lesotho	576	219	357	163	89	70	19	26	49.1	64.1	-15.0	-23
23. Liberia	313	280	33	12	107	107	0	0	57.5	58.7	-1.2	-2
24. Malawi	384	176	208	118	119	110	9	8	55.1	63.2	-8.1	-13
25. Mali	319	300	20	7	173	172	0	0	52.1	53.5	-1.4	-3
26. Mozambique	454	270	184	68	123	113	10	9	51.0	58.2	-7.2	-12
27. Namibia	341	140	201	143	39	30	9	31	62.7	71.3	-8.6	-12
28. Nigeria	367	301	65	22	141	135	5	4	52.5	55.1	-2.6	-5
29. Rwanda	325	279	46	16	114	111	3	3	55.8	57.5	-1.7	-3

TABLE I.8. ADULT MORTALITY, UNDER-FIVE MORTALITY, AND LIFE EXPECTANCY AT BIRTH IN COUNTRIES AND AREAS MOST AFFECTED BY THE HIV/AIDS EPIDEMIC, MEDIUM VARIANT ("WITH AIDS") AND NO-AIDS SCENARIO ("WITHOUT AIDS"), 2010-2015 (*continued*)

Country	45q15, both sexes combined (probability of dying between exact age 15 and exact age 60, per 1,000)				Under-five mortality, both sexes combined (deaths under age 5 per 1,000 live births)				Life expectancy at birth, both sexes combined (years)			
	With AIDS	Without AIDS	Absolute difference	Percentage difference	With AIDS	Without AIDS	Absolute difference	Percentage difference	With AIDS	Without AIDS	Absolute difference	Percentage difference
Africa (continued)												
30. Sierra Leone	442	423	19	4	157	158	0	0	48.2	49.1	-0.9	-2
31. South Africa	503	232	271	117	64	48	16	33	53.8	65.8	-12.0	-18
32. Swaziland	567	224	343	153	92	72	20	27	49.2	63.7	-14.5	-23
33. Togo	307	253	54	22	104	100	4	4	57.8	60.1	-2.3	-4
34. Uganda	376	263	113	43	114	107	6	6	54.7	59.0	-4.4	-7
35. United Rep. of Tanzania	329	218	111	51	81	77	5	6	59.3	63.7	-4.4	-7
36. Zambia	482	276	206	75	130	117	14	12	49.6	57.7	-8.0	-14
37. Zimbabwe	515	181	334	184	71	54	17	31	53.5	67.5	-14.0	-21
Asia												
1. China	110	108	2	2	24	24	0	0	73.8	73.8	-0.1	0
2. India	198	187	11	6	65	65	0	0	66.0	66.5	-0.5	-1
3. Thailand	148	120	28	23	13	12	1	9	74.4	75.6	-1.2	-2
Europe												
1. Russian Federation	244	229	15	7	16	16	1	4	69.2	69.9	-0.8	-1
Latin America and the Caribbean												
1. Bahamas	103	83	21	25	18	14	3	22	75.9	77.1	-1.2	-2
2. Belize	106	71	35	49	21	18	2	12	76.3	78.3	-1.9	-2
3. Guyana	155	144	11	8	46	46	0	0	70.3	70.8	-0.5	-1
4. Haiti	241	207	34	16	76	76	1	1	62.5	63.9	-1.4	-2
5. Jamaica	149	122	27	22	26	26	0	1	73.4	74.6	-1.2	-2
6. Suriname	172	169	3	2	27	27	0	0	70.9	71.1	-0.2	0
Northern America												
1. United States of America	103	92	11	12	8	7	0	6	78.8	79.3	-0.6	-1

II. ORDERING THE WORLD MORTALITY REPORT 2011
CD-ROM Edition – Datasets in Excel format

The *World Mortality Report 2011*, prepared by the United Nations Population Division, provides a comprehensive set of mortality estimates for the world's countries and their aggregates, along with an inventory of the availability of data for the estimation of adult and child mortality at the national level.

The Excel files in this CD-ROM are organized into two folders: (1) Mortality Indicators and (2) Data Inventory. For a complete listing of the data files included in the CD-ROM and their contents, see tables 1 and 2 below.

All mortality estimates contained in this CD-ROM are based on the results of the *2010 Revision* of *World Population Prospects*[3] and provide an overview of levels and trends of mortality between 1950 and 2015. The CD-ROM contains the following mortality indicators: total deaths; crude death rates; infant mortality; under-five mortality; life expectancy at birth by sex; life expectancy at exact ages 15 and 60; probability of dying between 15 and 60 (45q15) by sex; survival probability between selected exact ages, and life table survivors by sex and age. Estimates for each quinquennium over the period 1950-2015 are provided for total deaths, crude death rates, infant mortality, and life expectancy at birth. Estimates for under-five mortality are provided starting with 1980-1985 and those for the remaining indicators are provided starting with 1995-2000. Data in the Excel files refer to 196 countries or areas that had populations of 100,000 inhabitants or more in 2010. The Excel files also contain estimates for 33 country aggregates, including the world as a whole, the development groups, the major areas and geographical regions. These aggregates were calculated by including estimates for any of the countries or areas with fewer than 100,000 inhabitants in 2010 that belonged to the corresponding group.

The file *WMR2011_DB2_F1_DATA_ INVENTORY.XLS* in the folder labelled "Data Inventory" contains information on the availability of data relevant for the estimation of adult and child mortality for each of the 196 countries or areas with at least 100,000 inhabitants in 2010. The contents of each worksheet in the file are described below.

VITAL REGISTRATION: The worksheet with this label shows, for each country, the years for which data on deaths by age and sex derived from a vital registration system have been reported either to the United Nations Statistics Division or to the World Health Organization (WHO). In a few cases, the list includes years for which vital registration data have been obtained by the United Nations Population Division from other sources.

CENSUS: The worksheet with this label presents, for each country, the years in which a population census was conducted. In countries where data on the population by age and sex are obtained from population registers rather than censuses, this fact is indicated.

OTHER SOURCES: The worksheet with this label presents the list of censuses and nationally representative sample surveys that are known to have collected data relevant for the estimation of mortality. For each census or survey, this worksheet indicates which of the following types of data were collected: maternity histories, deaths by age and sex occurring in a household over a particular period, or the survival of close relatives (children, mothers, fathers, siblings or spouses).

For information on how to order this CD-ROM, please refer to the order form following the tables.

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[3] United Nations, Department of Economic and Social Affairs, Population Division (2011c). *World Population Prospects: The 2010 Revision, DVD Edition - Extended Dataset* (United Nations publication, Sales No. E.11.XIII.7).

Data in Microsoft Excel tabular formats

Table 1. File list of data in MS-Excel formats

EXCEL FILES: DB1_MORTALITY_INDICATORS	
WMR2011_DB1_F1_DEATHS.XLS	Number of deaths for both sexes combined by major area, region and country, 1950-2015 (thousands)
WMR2011_DB1_F2_CRUDE_DEATH_RATE.XLS	Crude death rate by major area, region and country, 1950-2015 (deaths per 1,000 population)
WMR2011_DB1_F3_IMR.XLS	Infant mortality rate for both sexes combined by major area, region and country, 1950-2015 (infant deaths per 1,000 live births)
WMR2011_DB1_F4_Q5.XLS	Under-five mortality for both sexes combined by major area, region and country, 1980-2015 (deaths under age five per 1,000 live births)
WMR2011_DB1_F5_LIFE_EXPECTANCY_AT_BIRTH_BY_SEX.XLS	Life expectancy at birth for both sexes combined by major area, region and country, 1950-2015 Male life expectancy at birth by major area, region and country, 1950-2015 (years) Female life expectancy at birth by major area, region and country, 1950-2015 (years)
WMR2011_DB1_F6_LIFE_EXPECTANCY_AT_15_60.XLS	Life expectancy at exact age x, e(x), for both sexes combined, by major area, region and country, 1995-2015
WMR2011_DB1_F7_PROBABILITY_OF_DYING_45Q15.XLS	Probability of dying between 15 and 60, 45q15, by sex, major area, region and country, 1995-2015
WMR2007_DB1_F8_SURVIVAL_PROBABILITY.XLS	Survival probability between selected exact ages x and x+n for both sexes combined, by major area, region and country, 1995-2015
WMR2011_DB1_F9_LIFE_TABLE_SURVIVORS_BY_SEX.XLS	Life table survivors at exact age x, lx, for both sexes combined by major area, region and country, 1995-2015 Male life table survivors at exact age x, lx, by major area, region and country, 1995-2015 Female life table survivors at exact age x, lx, by major area, region and country, 1995-2015
EXCEL FILES: DB2_DATA_INVENTORY	
WMR2011_DB2_F1_DATA_INVENTORY.XLS	Deaths from vital registration Population censuses Other sources of data relevant for mortality estimation

Table 2. Contents of MS-Excel datasets

	Indicator	Number of countries or areas		Periods covered	Age groups
EXCEL FILES: Dataset 1. Mortality indicators, five-year periods [WMR2011_DB1_Mortality_Indicators]
F1.	Total number of deaths	196		1950-1955,….2010-2015	---
F2.	Crude death rate	196		1950-1955,….2010-2015	---
F3.	Infant mortality, q(1)	196		1950-1955,….2010-2015	---
F4.	Under-five mortality, q(5)	196		1980-1985,….2010-2015	---
F5.	Life expectancy at birth by sex	196		1950-1955,….2010-2015	---
F6.	Life expectancy at exact ages 15 and 60	196		1950-1955,….2010-2015	---
F7.	Probability of dying between 15 and 60, (45q15), by sex	196		1995-2000,….2010-2015	45q15
F8.	Survival probability between selected exact ages	196		1995-2000,….2010-2015	15p0, 45p15, 60p0
F9.	Life table survivors at exact age x, l(x), by sex	196		1995-2000,….2010-2015	0, 1, 5, 10,….80, 85
EXCEL FILES: Dataset 2. Data Inventory [WMR2011_DB2_Data_Inventory]
F1.	Data inventory: Deaths from vital registration	196		1950, 1951,….2009, 2010	---
F1.	Data inventory: Population censuses	196		1945, 1946,….2010, 2011	---
F1.	Data inventory: Other sources of data relevant for mortality estimation	196		1948, 1949,….2010, 2011	---

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III. REFERENCES

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