Refugees and IDPs in Contemporary World Politics

	Module Descriptor: Refugees and IDPs in Contemporary World Politics
Title:	**Complex Emergency, Displacement and Forced Migration in the Contemporary World**
Description:	This survey course introduces students to issues related to contemporary experiences of forced migration and international humanitarianism, and situates these movements within the broader context of international migration and urbanization
Teaching Hours:	50 hours directed study. 100 hours independent study. 150 hours in total
Rationale:	Students need to gain basic grounding in, and acquire knowledge in refuges and IDPs concerning issues in international relations.
Learning Outcomes:	The module is an interdisciplinary course that aims to provide students with critical knowledge, research methods and analytical skills of current theoretical, legal, political, economic, social, demographic and psychological issues in complex emergency, displacement and forced migration that leads to IDPs and refugee studies

R E F U G E E A N D F O R C E D M IG R AT IO N S T U D I E S

Who a refugee is and how we can define and understand forced migration are central questions to studies of displacement and the multidisciplinary field of Refugee and Forced Migration Studies. While research often begins with these questions, answers usually remain elusive. Academics and practitioners alike continue to debate the contours of the field. Inter alia, they ask whether studies should focus on those crossing international borders in flight from persecution and who are therefore entitled to claim legal status as refugees, or whether the field should stretch to encompass the internally displaced, the trafficked, irregular migrants, second- and third-generation diasporas, and those at risk of deportation. If the latter is favoured, how far can Refugee and Forced Migration Studies stretch before its focus becomes too diffuse to be meaningful, blurring into the broader fields of Migration Studies, Human Rights, Development Studies, or International Politics? There is no definitive consensus among researchers about where the boundaries of Refugee and Forced Migration Studies should be drawn, and the 52 chapters in this volume clearly demonstrate this, offering 52 different perspectives on this field of studies. However, they also vividly illustrate the vibrant and engaging debates that characterize what is a rapidly expanding field.

A Brief History of Refugee and Forced Migration Studies

Although the field of Refugee and Forced Migration Studies itself emerged in the 1980s,

there is a long and important history of research into refugees and forced displacement across the Humanities and Social and Political Sciences. During the interwar and post-Second World War eras, for instance, historians examined refugee movements and the role of international organizations established to protect and assist refugees during this period (see Elie's chapter in this volume). While these early assessments were insufficiently critical of either the states or intergovernmental agencies, during the 1970s and early 1980s researchers became increasingly frank in their analyses (e.g. Tolstoy 1977; de Zayas 1979).

Legal scholars were also active during this time, principally focusing on the provisions of national and international refugee instruments pertaining to refugee definitions, asylum and protection (see Goodwin-Gill, this volume). In the early 1980s legal scholars adopted a broader policy-oriented approach examining the domestic and foreign policy influences on Western refugee determination procedures (Martin 1982; Avery 1984), providing important insights into the effectiveness of refugee decision-making proce - dures, the role of UNHCR, and the impact of domestic and foreign policy factors on the implementation of refugee legal instruments.

Although Malkki notes that researchers positioned within geography and anthropology started to conduct research on 'Refugee Studies' more recently than historians and legal scholars (1995: 507), throughout these and later decades, research from across the social and political sciences explored individual, familial, and collective experiences of persecution, internment, and mass displacement in diverse contexts (see Chatty, this volume).2 Most notably, perhaps, this includes Elizabeth Colson's political-anthropological research in Japanese-American internment camps in the 1940s and her analysis of colonized populations' experiences of displacement and forced resettlement in the 1950s and 1960s (Colson 1971).

By the early 1980s refugee and forced migration issues had become a globally salient issue, in part as a result of major protracted refugee situations in South-East Asia, Pakistan and Iran, the Horn of Africa, Southern Africa, and Mexico and Central America, as well as a substantial increase in the numbers of asylum seekers in Europe and North America. In response to these developments, organizations such as the Ford

Foundation funded a number of research organizations and individuals to undertake projects dealing with these issues. The result was a growing body of work document - ing the causes of refugee flows; emergency assistance programmes for refugees; trans - national networks to assist refugees; and policy responses of particular states to refugee movements.

Arguably one of the key scholarly contributions from this period was Barbara Harrell-Bond's ground-breaking Imposing Aid (1986). This research was influential not least because it reflected Harrell-Bond's conviction that research about refugees should be used for refugees, to uphold refugees' rights and agency throughout processes of dis- placement. Indeed, what is now often referred to as researchers' 'dual imperative' to pro- mote academic knowledge and undertake ethical action (Jacobsen and Landau 2003) is closely tied to the assertion that there can be no 'justification for conducting research into situations of extreme human suffering if one does not have the alleviation of suffer- ing as an explicit objective of one's research' (Turton 1996: 96).

Consequently, one of the most important developments during the 1980s was the emer- gence of Refugee and Forced Migration Studies as a distinct field of study and policy analysis (also see Malkki 1995), and the establishment of new research and teaching centres and policy institutes. These included the Refugee Studies Programme at the University of Oxford, the refugee programme at York University in Toronto, and the Refugee Policy Group in Washington DC; in addition, existing policy centres such as the US Committee for Refugees, the Lawyers Committee for Human Rights, and the European Council on Refugees and Exiles considerably strengthened their coverage and advocacy efforts for refugees and asylum seekers. Finally, two new academic journals, the Journal of Refugee Studies and the Journal of International Refugee Law were established in 1988 and 1989 respectively, and The International Research and Advisory Panel on Refugees and Other Displaced Persons (IRAP), which was the precursor to the International Association for the Study of Forced Migration (IASFM), was formed in 1990.
Over the last thirty years Refugee and Forced Migration Studies has grown from being a concern of a relatively small number of scholars and policy researchers to a global field of interest with thousands of students worldwide studying displace - ment either from traditional disciplinary perspectives or as a core component of

newer programmes across the Humanities and Social and Political Sciences. Today the field encompasses both rigorous academic research which may or may not ulti - mately inform policy and practice as well as action-research focused on advocating in favour of refugees' needs and rights. This Handbook draws on an ever-expanding global network of scholars in Refugee and Forced Migration Studies, bringing together contributions from leading academics, practitioners, and policymakers working in universities, research centres, think tanks, NGOs, and international organizations around the world.

Defining the Field: Key DebatesSince the 1980s, Refugee and Forced Migration Studies has evolved beyond its original close ties to advocacy and policymaking, developing a more distinct identity as an independent field worthy of scholarly research. Increasingly, many researchers electto use forced migration as a lens through which to contribute to a range of philosophi - cal, political, and interpretative theory. Yet there can be little doubt that the study of forced migration is as relevant to the 'real world' as ever, with 7.6 million people hav - ing been newly displaced due to conflict or persecution in 2012 alone: an average of 23,000 people a day (UNHCR 2013). New and ongoing humanitarian crises continue to erupt, most recently—and with terrible consequences—across the Middle East and North Africa, with the conflict in Syria described in April 2013 by the United Nations High Commissioner for Refugees, Antonio Guterres, as 'the most dramatic humanitar - ian crisis that we [UNHCR] have ever faced' (Chulov 2013). Meanwhile, two-thirds of refugees and displaced persons continue to wait in exile for over five years, in some for generations, with no solutions in sight for millions of Palestinians, Somalis, Afghans, or Colombians among others.

One of the great contemporary debates in Refugee and Forced Migration Studies is the extent to which research should be framed by urgent policy questions to respond to these and other crises. Policymakers frequently decry what they perceive to be a shift towards more abstract, intellectual concerns, while academics argue that more theoreti- cal approaches contribute to important disciplinary debates and that completing pol - icy relevant research is no substitute for rigorous intellectual analysis. This Handbook not only documents these different approaches to research, but shows how they can be complementary when used in combination. Indeed, there is a real and continuing need

to collect accurate, representative, and meaningful qualitative and quantitative data in order to carefully map and better understand the scope, scale, causes, and consequences of forced migration. In addition to informing policymaking, evaluation and development, new concepts, methodological and interpretative frameworks, and theoretical modelling are equally fundamental to the wider framing of forced migrations, be they crises of conflict, citizenship, or capitalism.

Integral to the debate regarding policy-relevant and 'policy-irrelevant' research (Bakewell 2008) is an interrogation of the methods of data collection and analysis which have characterized a significant proportion of studies undertaken by scholars in the field to date, and whether such research is in fact well situated to inform policy. With much, if not most, research in the field having been primarily qualitative in nature, and often framed around detailed analyses of single case-studies (as is the classical ethnographic approach underpinning anthropology), the challenges of completing research which is simultaneously meaningful for displaced persons and communities, academics, practitioners, and policymakers are complex (Jacobsen and Landau 2008). Many of the Handbook's contributions represent and critically reflect upon these diverse methodological and interpretative frameworks, ranging from archival research and institutional history;4 micro-, meso-, and macro-levels of analysis; 5 large-N statistical data sets and top-down research;6 and technological tools such as remote sensing and Geographical Information Systems.7 In turn, interpretative frameworks represented in the Handbook include normative approaches8 and critical perspectives grounded in feminist, gender, and post-colonial theories.

Just as the contested relationship between research, policy, and practice in Research and Forced Migration studies is in evidence in many of the Handbook's chapters, 10 so too is the connection between definitions and experiences of forced versus voluntary migration, and how Forced Migration Studies relates to and complement the wider field of Migration Studies. Some contributors, such as Bakewell, Van Hear, and Long, argue that it is often more appropriate to focus on processes of migration in and from conflict, and that in defending Refugee and Forced Migration Studies as a separate field, there is a risk that scholars are legitimizing labels that are—as Zetter (1991) warns us—deliberately constructed to exclude and to disempower. In contrast, others, including

Gibney, Milner, and Goodwin-Gill point out that because being a refugee is qualitatively different from being a migrant (as it reflects a breakdown of a basic relationship between state and citizen), it is essential that we recognize this. What few on either side would dispute, however, is that the two areas of study are closely connected. Particularly at the edges of what is conventionally recognized as forced migration—when dealing with topics like diasporas and transnationalism, irregular migration, or economic livelihoods11—attempting to draw clear boundaries is unhelpful, and the most exciting research in these areas reflects the best insights from both the Migration Studies and Forced Migration Studies traditions.

Despite these contests and caveats, which have fuelled considerable debate in recent years (see e.g. Hathaway 2007; Martin 2004), in practice, most researchers can nonetheless readily identify work that belongs to the field of Refugee and Forced Migration Studies. Most clearly, such research can be broadly considered to cover the study of those who have been identified by the international community as asylum seekers, refugees, internally displaced persons (IDPs), development-induced displaced persons, or trafficked persons,12 as well as all those whose claim to such labels may have been denied, but who have been forced to move against their will as a result of persecution, conflict, or insecurity. Interest in studying government, institutional, and international responses to such forced migrations reflects the extent to which law has influenced the development of the field. 13 Concurrently, detailed ethnographic studies and concern with documenting lived experiences of forced migration reflect the crucial contributions of anthropologists and sociologists to the field.

In addition to direct lived experiences of being forced to flee, a related set of studies centralize direct and inherited experiences of forcedimmobility and forced sedentarization.14 These studies include research with individuals and groups born into protracted displacement who may not have personally experienced migration (forced or otherwise) and those who are ‘internally stuck’ or otherwise prevented from safely returning to their own or their families’ places of origin in spite of a desperate desire to do so, including stateless persons and communities. Indeed, with reference to the latter, the causes, experiences, and implications of borders moving over people—as in the cases of the partition of India and the dissolution of the Former-Yugoslavia and the former

Soviet Union15—in addition to people moving over borders, have gained increasing attention over the past few years.

Uniting the diverse disciplinary perspectives, methodologies, and areas of analy - sis outlined above—as aptly illustrated in this Handbook—is that Refugee and Forced Migration Studies is a subject focused on understanding and addressing human expe- riences of displacement and dispossession. Most explicitly, perhaps, scholars working within the traditions of anthropology and sociology have highlighted the heterogene- ity of these human experiences, according for instance to age, gender, sexual orienta - tion, health and disability status, or religious identity. Understanding this diversity is highly significant for political and institutional analyses of the nature and implications of state and non-state responses to forced migration which can variously aim to alleviate human suffering and uphold the rights of displaced persons, or to control and protect borders and territories by limiting and/or forcing the removal of certain bodies from

Approaches:

Exploring Refugee and Forced Migration Studies and the particular insights they bring to the study of displacement.The part opens with Jérôme Elie's chapter on the history of Refugee and ForcedMigration Studies, an essay that asks why this field is so often considered 'ahistorical' and subject to neglect by historians, and makes a powerful case for more historical research. Guy Goodwin-Gill's chapter on the international law of refugee protection then discusses the legal tools, treaties, and national laws which prescribe or implement the obligations of states to refugees as well as the core protection functions and responsibilities of the Office of the United Nations High Commissioner for Refugees (UNHCR). In turn, Matthew Gibney's chapter on the ethical and normative questions that studying refugees and forced migration raise for political theorists underlines why studying displacement can offer important lessons for those interested in trying to understand much broader political theories of citizenship, nationality, and power. Alexander Betts further explores the position of refugees and other groups of forced migrants in the international political system, outlining the most prominent body of academic work on the international politics of forced migration and arguing that the discipline of International Relations has an important role to play in understanding the challenges

that transnational population movements play in the world today. Turning to lived experiences of forced migration, Dawn Chatty argues that Anthropology's unique contributions to the field of Refugee and Forced Migration Studies include carefully documenting what happens to people, their culture, and society when they are forcibly displaced and wrenched from their territorial moorings, or, indeed, when they are dispossessed through processes of forced sedentarization and involuntary immobility. Stepputat and Sørensen then examine the role of sociological methods, concepts, and theories in advancing our understanding of the causes, experiences, and impacts of forced migration on micro-, meso-, and macro-levels, in addition to highlighting the extent to which studies of forced migration can push disciplines such as Sociology to adapt and develop new lenses and explanatory models.

Subsequently, Karen Jacobsen's chapter examines the pursuit of livelihood opportunities by refugees and other forced migrants outside of camps. In addition to outlining how the livelihoods of the forcibly displaced are different from those of other migrants, she argues that traditionally conceived and targeted refugee programmes should be reconceptualized and restructured as programmes that support both refugees and their hosts. Drawing the disciplinary part to a close, Michael Collyer notes that although geographical research into forced migration is dominated by subdisciplines ofhuman geography, a growing body of literature examines relationships between forced migration and the physical environment; furthermore, he notes that developments in the range of research tools such as remote sensing and Geographical Information Systems (GIS) applications have reached a level of sophistication that has led to their widespread use in emergency response planning.

Shifting Spaces and Scenarios of Displacement

Part II of the Handbook considers how displacement can be experienced in different ways over space and time, focusing in particular on deconstructing the labels that define and limit research agendas and international responses to displacement, and challenging the idea that Refugee and Forced Migration Studies should be primarily concerned with refugees in camps in the developing world. It begins with Oliver Bakewell's chapter exploring tensions between the international community's interest in fixing refugee populations in camps and refugees' own practices of (often irregular) self-settlement in

towns and cities. Loren Landau then examines the new interest in researching urban displacement, arguing that what has changed in the past decade is not displacement itself, but who we—as academics, policymakers, and practitioners—choose to see as displaced. In turn, James Milner's chapter considers the changing time scale of dis - placement, outlining the growing numbers of refugees and other forced migrants who spend years—if not decades—in exile and the need for researchers to adjust their focus to incorporate these protracted displacements. Returning to the question of physical spaces of displacement, Walter Kälin then traces the development of an international protection regime for internally displaced populations who have not crossed a border to become refugees, as well as the protection gaps that remain. In contrast, Nick Van Hear writes about the transnational and diasporic links that connect refugees, asylum seek - ers, and other migrants from conflict across countries and continents. The final chapter in the part, by Stephan Scheel and Vicki Squire, explores how many of those refugees and asylum seekers making transnational journeys are labelled as 'irregular migrants' by states who are anxious to make such movements illegitimate.

Legal and Institutional Responses to Forced Migration

The third part of the Handbook explores many of the legal, political, and institutional responses to forced migration, considering how practice, policy, and research in this area variously connect. Jane McAdam's chapter on human rights and forced migration traces the growing connections between human rights, human rights law, and forced migration. This chapter examines the ways in which human rights law can assist and protect forced migrants who cross an international border but do not satisfy the legal definition of 'refugee' under the 1951 Refugee Convention or its regional counterparts. The part then examines the development of the two UN organizations with specific mandates for refugee protection and relief—UNHCR and UNRWA. Gil Loescher's chapter discusses UNHCR's normative agenda as well as the effectiveness of the Office's work for refugee protection within the context of a changing international political system, and expanding global mobility regime, and a growing and diverse group of dis- placed people in need of assistance and protection. Susan Akram's chapter on UNRWA considers, from a legal perspective, whether the situation of Palestinian refugees is dif- ferent from other refugees in the world and whether these differences affect Palestinians' rights to a durable solution to their plight. Michael Barnett's chapter examines the inter- twined history of the international refugee regime and the international humanitarian

order. From its origins in the late eighteenth century, humanitarianism has expanded today to protect more kinds of people affected by forced migration including those displaced by natural disasters.

Other chapters in this part examine state responses to forced migration and the connections made between refugee flight and post-Cold War securitization discourses. Randall Hansen's chapter discusses the relationship between the nation state, borders, refugees, and citizenship while Anne Hammerstad's chapter on the securitization of forced migration underlines how the relatively recent growth in interest of the security dimensions of forced migration has coincided with the widening of the security agenda during the post-Cold War era. Several UNHCR staff members and their academic colleagues conclude this part with chapters on gaps in existing protection regimes for refugees, the problem of statelessness, and the challenges of humanitarian reform within the international system. In their chapter, Volker Türk and Rebecca Dowd point to a number of critical gaps or shortcomings in the existing international refugee protection regime and propose a series of suggestions to states to fill these protection gaps. Subsequently, Alice Edwards' and Laura van Waas's chapter explores the historical development of the international legal regime for the protection of stateless persons, its relationship with the international refugee regime, contemporary challenges to the prevention and reduction of statelessness, and points toward a number of promising developments for progress in this field. In the final chapter of this section part of the Handbook, Simon Russell and Vicky Tennant present the recent history of humani - tarian reform within the international system. In particular, the chapter analyses the changes in the architecture for addressing internal displacement and ongoing debates on institutional mandates and responsibilities, and assesses the implementation and practice of these reforms.

Root Causes of Displacement Part IV critically evaluates the ways in which the 'drivers' of forced migration are identified by academics, policymakers, and affected persons, whilst simultaneously problematizing notions of mono-causality in favour of more complex and dynamic understandings of the multiple reasons which may underpin individual, familial, and collective experiences of forced (im)mobility. Sarah Lischer's chapter traces the devel - opment of research into mass flight caused by conflict and political or economic crisis,

questioning the validity of quantitative and qualitative methods used to trace causal - ity in such complex contexts of mass flux, and arguing in favour of mixed-methods,OUP

Fertility

Fertility is the natural capability to produce offspring. As a measure, fertility rate is the number of offspring born per mating pair, individual or population. Fertility differs from fecundity, which is defined as the potential for reproduction (influenced by gamete production, fertilization and carrying a pregnancy to term) A lack of fertility is infertility while a lack of fecundity would be called sterility.

Human fertility depends on factors of nutrition, sexual behavior, consanguinity, culture, instinct, endocrinology, timing, economics, way of life, and emotions.

Demography

In demographic contexts, fertility refers to the actual production of offspring, rather than the physical capability to produce which is termed fecundity. While fertility can be measured, fecundity cannot be. Demographers measure the fertility rate in a variety of ways, which can be broadly broken into "period" measures and "cohort" measures. "Period" measures refer to a cross-section of the population in one year. "Cohort" data on the other hand, follows the same people over a period of decades. Both period and cohort measures are widely used.

Period measures

- **Crude birth rate** (CBR) - the number of live births in a given year per 1,000 people alive at the middle of that year. One disadvantage of this indicator is that it is influenced by the age structure of the population.
- **General fertility rate** (GFR) - the number of births in a year divided by the number of women aged 15–44, times 1000. It focuses on the potential mothers only, and takes the age distribution into account.
- **Child-Woman Ratio** (CWR) - the ratio of the number of children under 5 to the number of women 15–49, times 1000. It is especially useful in historical data as it does not require counting births. This measure is actually a hybrid, because it involves deaths as well as births. (That is, because of infant mortality some of the births are not included; and because of adult mortality, some of the women who gave birth are not counted either.)
- **Coale's Index of Fertility** - a special device used in historical research

Cohort measures

- **Total fertility rate** (TFR) - the total number of children a woman would bear during her lifetime if she were to experience the prevailing age-specific fertility rates of women. TFR equals the sum for all age groups of 5 times each ASFR rate.
- **Gross Reproduction Rate** (GRR) - the number of girl babies a synthetic cohort will have. It assumes that all of the baby girls will grow up and live to at least age 50.
- **Net Reproduction Rate** (NRR) - the NRR starts with the GRR and adds the realistic assumption that some of the women will die before age 49; therefore they will not be alive to bear some of the potential babies that were counted in the GRR. NRR is always lower than GRR, but in countries where mortality is very low, almost all the baby girls grow up to be potential mothers, and the NRR is practically the same as GRR. In countries with high mortality, NRR can be as low as 70% of GRR. When NRR = 1.0, each generation of 1000 baby girls grows up and gives birth to exactly 1000 girls. When NRR is less than one, each generation is smaller than the previous one. When NRR is greater than 1 each generation is larger than the one before. NRR is a measure of the long-term future potential for growth, but it usually is different from the current population growth rate.

Social and economic determinants of fertility

A parent's number of children strongly correlates with the number of children that each person in the next generation will eventually have. Factors generally associated with increased fertility include religiosity, intention to have children and maternal support. Factors generally associated with decreased fertility include wealth, education, female labor participation, urban residence, intelligence, increased female age and (to a lesser degree) increased male age.

The "Three-step Analysis" of the fertility process was introduced by Kingsley Davis and Judith Blake in 1956 and makes use of three proximate determinants: The economic analysis of fertility is part of household economics, a field that has grown out of the New Home Economics. Influential economic analyses of fertility include Becker (1960), Mincer (1963), and Easterlin (1969). The latter developed the Easterlin hypothesis to account for the Baby Boom.

Bongaarts' model of components of fertility

Bongaarts proposed a model where the total fertility rate of a population can be calculated from four proximate determinants and the total fecundity (TF). The index of marriage (Cm), the index of contraception (Cc), the index of induced abortion (Ca) and the index of postpartum infecundability (Ci). These indices range from 0 to 1. The higher the index, the higher it will

make the TFR, for example a population where there are no induced abortions would have a Ca of 1, but a country where everybody used infallible contraception would have a Cc of 0.

$TFR = TF \times Cm \times Ci \times Ca \times Cc$

These four indices can also be used to calculate the total marital fertility (TMFR) and the total natural fertility (TN).

$TFR = TMFR \times Cm$

$TMFR = TN \times Cc \times Ca$

$TN = TF \times Ci$

Intercourse

The first step is sexual intercourse, and an examination of the average age at first intercourse, the average frequency outside marriage, and the average frequency inside.

Conception

Certain physical conditions may make it impossible for a woman to conceive. This is called "involuntary infecundity." If the woman has a condition making it possible, but unlikely to conceive, this is termed "subfecundity." Venereal diseases (especially gonorrhea, syphilis, and chlamydia) are common causes. Nutrition is a factor as well: women with less than 20% body fat may be subfecund, a factor of concern for athletes and people susceptible to anorexia. Demographer Ruth Frisch has argued that "It takes 50,000 calories to make a baby". There is also subfecundity in the weeks following childbirth, and this can be prolonged for a year or more through breastfeeding. A furious political debate raged in the 1980s over the ethics of baby food companies marketing infant formula in developing countries. A large industry has developed to deal with subfecundity in women and men. An equally large industry has emerged to provide contraceptive devices designed to prevent conception. Their effectiveness in use varies. On average, 85% of married couples using no contraception will have a pregnancy in one year. The rate drops to the 20% range when using withdrawal, vaginal sponges, or spermicides. (This assumes the partners never forget to use the contraceptive.) The rate drops to only 2 or 3% when using the pill or an IUD, and drops to near 0% for implants and 0% for tubal ligation (sterilization) of the woman, or a vasectomy for the man.

Gestation

After a fetus is conceived, it may or may not survive to birth. "Involuntary fetal mortality" involves natural abortion, miscarriages and stillbirth (a fetus born dead).

Human intervention intentionally causing abortion of the fetus is called "therapeutic abortion".

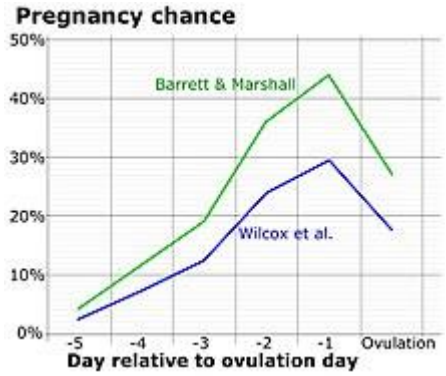
Fertility biology

Women have hormonal cycles which determine when they can achieve pregnancy. The cycle is approximately twenty-eight days long, with a fertile period of five days per cycle, but can deviate greatly from this norm. Men are fertile continuously, but their sperm quality is affected by their health, frequency of ejaculation, and environmental factors.

Fertility declines with age in both sexes. In women the decline is more rapid, with complete infertility normally occurring around the age of 50.

Pregnancy rates for sexual intercourse are highest when it is done every 1 or 2 days, or every 2 or 3 days. Studies have shown no significant difference between different sex positions and pregnancy rate, as long as it results in ejaculation into the vagina.

Menstrual cycle



Chance of fertilization by menstrual cycle day relative to ovulation.

A woman's menstrual cycle begins, as it has been arbitrarily assigned, with menses. Next is the follicular phase where estrogen levels build as an ovum matures (due to the follicular stimulating hormone, or FSH) within the ovary. When estrogen levels peak, it spurs a surge of luteinizing hormone (LH) which finishes the ovum and enables it to break through the ovary wall. This is ovulation. During the luteal phase, which follows ovulation LH and FSH cause the post-ovulation ovary to develop into the corpus luteum which produces progesterone. The production of progesterone inhibits the LH and FSH hormones which (in a cycle without pregnancy) causes the corpus luteum to atrophy, and menses to begin the cycle again.

Peak fertility occurs during just a few days of the cycle: usually two days before and two days after the ovulation date. This fertile window varies from woman to woman, just as the ovulation date often varies from cycle to cycle for the same woman. The ovule is usually capable of being

fertilized for up to 48 hours after it is released from the ovary. Sperm survive inside the uterus between 48 and 72 hours on average, with the maximum being 120 hours (5 days).

These periods and intervals are important factors for couples using the rhythm method of contraception.

Female fertility

The average age of menarche in the United States is about 12.5 years. In postmenarchal girls, about 80% of the cycles are anovulatory in the first year after menarche, 50% in the third and 10% in the sixth year.

Menopause occurs during a woman's midlife (between ages 48 and 55). During menopause, hormonal production by the ovaries is reduced, eventually causing a permanent cessation of the primary function of the ovaries, particularly the creation of the uterine lining (period). This is considered the end of the fertile phase of a woman's life.

The following effects of age and female fertility have been found in women trying to get pregnant, without using fertility drugs or in vitro fertilization:

- At age 30
    - 75% will have a conception ending in a live birth within one year
    - 91% will have a conception ending in a live birth within four years.
- At age 35
    - 66% will have a conception ending in a live birth within one year
    - 84% will have a conception ending in a live birth within four years.
- At age 40
    - 44% will have a conception ending in a live birth within one year
    - 64% will have a conception ending in a live birth within four years.

Studies of actual couples trying to conceive have come up with higher results: one 2004 study of 770 European women found that 82% of 35- to 39-year-old women conceived within a year, while another in 2013 of 2,820 Danish women saw 78% of 35- to 40-year-olds conceive within a year.

The use of fertility drugs and/or invitro fertilization can increase the chances of becoming pregnant at a later age. Successful pregnancies facilitated by fertility treatment have been documented in women as old as 67. Studies since 2004 now show that mammals may continue to produce new eggs throughout their lives, rather than being born with a finite number as previously thought. Researchers at the Massachusetts General Hospital in Boston, US, say that if eggs are newly created each month in humans as well, all current theories about the aging of the

female reproductive system will have to be overhauled, although at this time this is simply conjecture.

According to the March of Dimes, "about 9 percent of recognized pregnancies for women aged 20 to 24 ended in miscarriage. The risk rose to about 20 percent at age 35 to 39, and more than 50 percent by age 42". Birth defects, especially those involving chromosome number and arrangement, also increase with the age of the mother. According to the March of Dimes, "At age 25, your risk of having a baby with Down syndrome is 1 in 1,340. At age 30, your risk is 1 in 940. At age 35, your risk is 1 in 353. At age 40, your risk is 1 in 85. At age 45, your risk is 1 in 35."

Male fertility[edit]

Some research suggest that increased male age is associated with a decline in semen volume, sperm motility, and sperm morphology. In studies that controlled for female age, comparisons between men under 30 and men over 50 found relative decreases in pregnancy rates between 23% and 38%. It is suggested that sperm count declines with age, with men aged 50–80 years producing sperm at an average rate of 75% compared with men aged 20–50 years and that larger differences are seen in how many of the seminiferous tubules in the testes contain mature sperm:

- In males 20–39 years old, 90% of the seminiferous tubules contain mature sperm.
- In males 40–69 years old, 50% of the seminiferous tubules contain mature sperm.
- In males 80 years old and older, 10% of the seminiferous tubules contain mature sperm.

Decline in male fertility is influenced by many factors, including lifestyle, environment and psychological factors. It has been proposed that foreplay might have a role increasing fertility rates and sperm quality in men, but more research needs to be conducted.

Some research also suggests increased risks for health problems for children of older fathers, but no clear association has been proven. A large scale in Israel study suggested that the children of men 40 or older were 5.75 times more likely than children of men under 30 to have an autism spectrum disorder, controlling for year of birth, socioeconomic status, and maternal age. Increased paternal age is suggested by some to directly correlate to schizophrenia but it is not proven.

Australian researchers have found evidence to suggest overweight obesity may cause subtle damage to sperm and prevent a healthy pregnancy. They say fertilization was 40% less likely to succeed when the father was overweight.

The American Fertility Society recommends an age limit for sperm donors of 50 years or less, and many fertility clinics in the United Kingdom will not accept donations from men over 40 or 45 years of age.

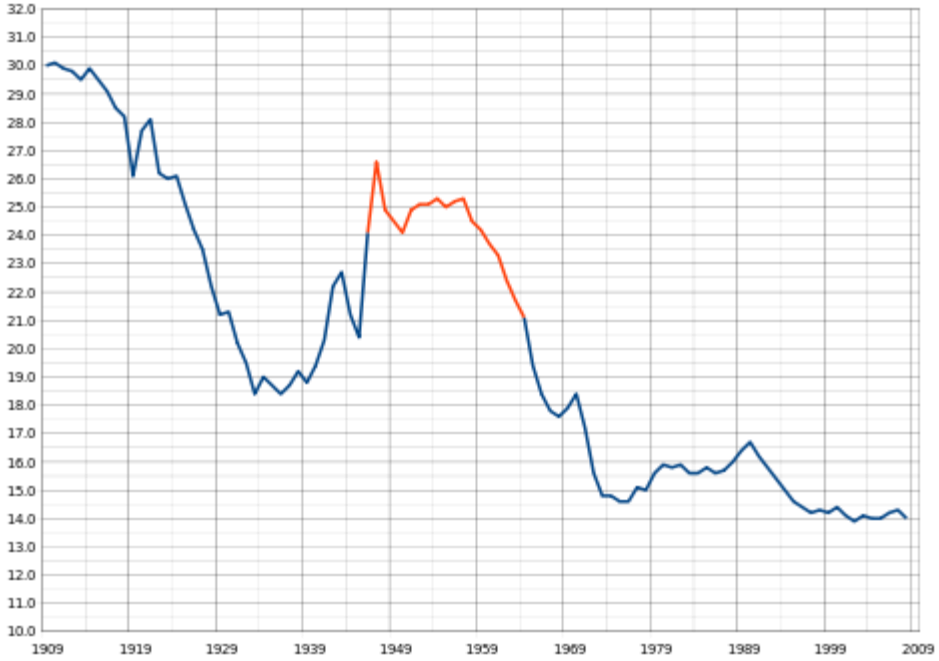
Historical trends by country

France

The French pronatalist movement from 1919–1945 failed to convince French couples of having a patriotic duty to help increase their country's birthrate. Even the government was reluctant in its support to the movement. It was only between 1938 and 1939 that the French government became directly and permanently involved in the pronatalist effort. Although the birthrate started to surge in late 1941, the trend was not sustained. Falling birthrate once again became a major concern among demographers and government officials beginning in the 1970s.

United States

From 1800 to 1940, fertility fell in the US. There was a marked decline in fertility in the early 1900s, associated with improved contraceptives, greater access to contraceptives and sexuality information and the "first" sexual revolution.



United States crude birth rate (births per 1000 population); Baby Boom years in red.

After 1940 fertility suddenly started going up again, reaching a new peak in 1957. After 1960, fertility started declining rapidly. In the Baby Boom years (1946–1964), women married earlier and had their babies sooner; the number of children born to mothers after age 35 did not increase.

Sexual revolution

After 1960, new methods of contraception became available, ideal family size fell, from 3 to 2 children. Couples postponed marriage and first births, and they sharply reduced the number of third and fourth births.

Infertility

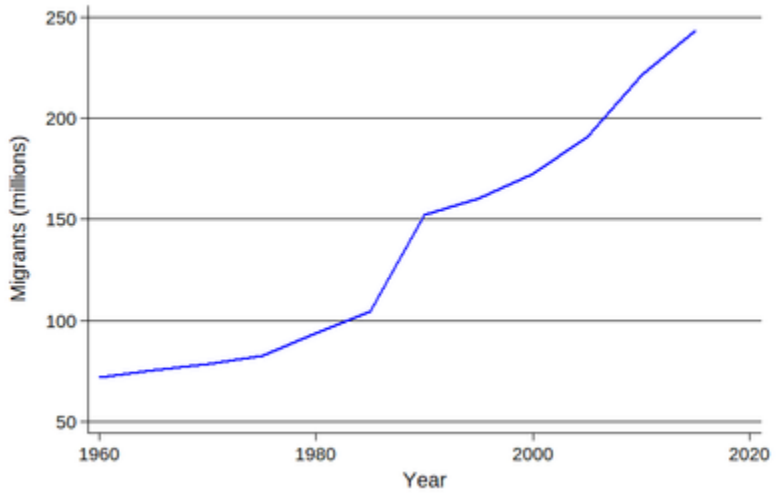
Infertility primarily refers to the biological inability of a person to contribute to conception. Infertility may also refer to the state of a woman who is unable to carry a pregnancy to full term. There are many biological causes of infertility, including some that medical intervention can treat.

Human migration

Human migration is the movement by people from one place to another with the intentions of settling, permanently or temporarily in a new location. The movement is often over long distances and from one country to another, but internal migration is also possible; indeed, this is the dominant form globally. People may migrate as individuals, in family units or in large groups. A person who moves from their home to another place because of natural disaster or civil disturbance may be described as a refugee or, especially within the same country, a displaced person. A person seeking refuge from political, religious or other forms of persecution is usually described as an asylum seeker.

Nomadic movements are normally not regarded as migrations as there is no intention to settle in the new place and because the movement is generally seasonal. Only a few nomadic people have retained this form of lifestyle in modern times. Also, the temporary movement of people for the purpose of travel, tourism, pilgrimages, or the commute is not regarded as migration, in the absence of an intention to live and settle in the visited places.

The share of migrants in each country of the world in 2015.



The number of migrants in the world 1960–2015.

Many estimates of statistics in worldwide migration patterns exist.

The World Bank has published its Migration and Remittances Factbook annually since 2008. The International Organisation for Migration (IOM) has published a yearly World Migration Report since 1999. The United Nations Statistics Division also keeps a database on worldwide migration Recent advances in research on migration via the Internet promise better understanding of migration patterns and migration motives.

Substantial internal migration can also take place within a country, either seasonal human migration (mainly related to agriculture and to tourism to urban places), or shifts of population into cities (urbanisation) or out of cities (suburbanisation). Studies of worldwide migration patterns, however, tend to limit their scope to international migration.

The World Bank's Migration and Remittances Factbook of 2011 lists the following estimates for the year 2010: total number of immigrants: 215.8 million or 3.2% of world population. In 2013, the percentage of international migrants worldwide increased by 33% with 59% of migrants targeting developed regions. Almost half of these migrants are women, which is one of the most significant migrant-pattern changes in the last half century. Women migrate alone or with their family members and community. Even though female migration is largely viewed as associations rather than independent migration, emerging studies argue complex and manifold reasons for this.

Often a distinction is made between voluntary and involuntary migration, or between refugees fleeing political conflict or natural disaster vs. economic or labor migration, but these distinctions are difficult to make and partially subjective, as the motivators for migration are often correlated. The World Bank's report estimates that, as of 2010, 16.3 million or 7.6% of

migrants qualified as refugees. At the end of 2012, approximately 15.4 million people were refugees and persons in refugee-like situations - 87% of them found asylum in developing countries.

Structurally, there is substantial South-South and North-North migration, i.e., most emigrants from high-income O.E.C.D. countries migrate to other high-income countries, and a substantial part (estimated at 43%) of emigrants from developing countries migrate to other developing countries. The United Nations Population Fund says that "[while the North has experienced a higher absolute increase in the migrant stock since 2000 (32 million) compared to the South (25 million), the South recorded a higher growth rate. Between 2000 and 2013 the average annual rate of change of the migrant population in the developing regions (2.3%) slightly exceeded that of the developed regions (2.1%).

The Global Commission on International Migration (GCIM), launched in 2003, published a report in 2005. International migration challenges at the global level are addressed through the Global Forum on Migration and Development and the Global Migration Group, both established in 2006.

The United Nations reported that 2014 had the highest level of forced migration on record: 59.5 million individuals, caused by "persecution, conflict, generalized violence, or human rights violations", as compared with 51.2 million in 2013 (an increase of 8.3 million) and with 37.5 million a decade prior. As of 2015 one of every 122 humans is a refugee, internally displaced, or seeking asylum. National Geographic has published 5 maps showing human migrations in progress in 2015 based on the UN report.

Theories for migration for work in the 21st century

There are countless of reasons why immigrants choose to migrate to another country. For instance, globalization has increased the demand for workers from other countries in order to sustain national economies. Known as "economic migrants," these individuals are generally from impoverished developing countries migrating to obtain sufficient income for survival. This income is usually sent home to family members in the form of remittances and has become an economic staple in a number of developing countries. People also move or are forced to move as a result of conflict, human rights violations, violence, or to escape persecution. In 2013, it was estimated that around 51.2 million people fell into this category. Another reason people move is to gain access to opportunities and services or to escape extreme weather. This type of movement is usually from rural to urban areas and is known as "internal migration." Socio-cultural and geo-historical factors also play a major role. In North Africa, for example, being an immigrant in

Europe is considered a sign of social prestige. Moreover, there are many countries which were former European colonies. This means that many have relatives that live legally in Europe, who often constitute an important help for immigrants who have just arrived in a European country. Relatives might help with job research and accommodation. The geographical proximity of Africa to Europe and the long historical ties between Northern and Southern Mediterranean countries also prompt many to migrate.

There are a number of theories to explain the international flow of capital and people from one country to another.

Neoclassical economic theory

This theory of migration states that the main reason for labor migration is wage difference between two geographic locations. These wage differences are usually linked to geographic labor demand and supply. It can be said that areas with a shortage of labor but an excess of capital have a high relative wage while areas with a high labor supply and a dearth of capital have a low relative wage. Labor tends to flow from low-wage areas to high-wage areas. Often, with this flow of labor comes changes in the sending as well as the receiving country. Neoclassical economic theory is best used to describe transnational migration, because it is not confined by international immigration laws and similar governmental regulations.

Dual labor market theory

Dual labor market theory states that migration is mainly caused by pull factors in more developed countries. This theory assumes that the labor markets in these developed countries consist of two segments: the primary market, which requires high-skilled labor, and the secondary market, which is very labor-intensive requiring low-skilled workers. This theory assumes that migration from less developed countries into more developed countries is a result of a pull created by a need for labor in the developed countries in their secondary market. Migrant workers are needed to fill the lowest rung of the labor market because the native laborers do not want to do these jobs as they present a lack of mobility. This creates a need for migrant workers. Furthermore, the initial dearth in available labor pushes wages up, making migration even more enticing.

New economics of labor migration

This theory states that migration flows and patterns can't be explained solely at the level of individual workers and their economic incentives, but that wider social entities must be considered as well. One such social entity is the household. Migration can be viewed as a result of risk aversion on the part of a household that has insufficient income. The household, in this

case, is in need of extra capital that can be achieved through remittances sent back by family members who participate in migrant labor abroad. These remittances can also have a broader effect on the economy of the sending country as a whole as they bring in capital. Recent research has examined a decline in U.S. interstate migration from 1991 to 2011, theorizing that the reduced interstate migration is due to a decline in the geographic specificity of occupations and an increase in workers' ability to learn about other locations before moving there, through both information technology and inexpensive travel. Other researchers find that the location-specific nature of housing is more important than moving costs in determining labour reallocation.

Relative deprivation theory

Relative deprivation theory states that awareness of the income difference between neighbors or other households in the migrant-sending community is an important factor in migration. The incentive to migrate is a lot higher in areas that have a high level of economic inequality. In the short run, remittances may increase inequality, but in the long run, they may actually decrease it. There are two stages of migration for a worker: first, they invest in human capital formation, and then they try to capitalize on their investments. In this way, successful migrants may use their new capital to provide for better schooling for their children and better homes for their families. Successful high-skilled emigrants may serve as an example for neighbors and potential migrants who hope to achieve that level of success.

World systems theory

World systems theory looks at migration from a global perspective. It explains that interaction between different societies can be an important factor in social change within societies. Trade with one country, which causes economic decline in another, may create incentive to migrate to a country with a more vibrant economy. It can be argued that even after decolonization, the economic dependence of former colonies still remains on mother countries. This view of international trade is controversial, however, and some argue that free trade can actually reduce migration between developing and developed countries. It can be argued that the developed countries import labor-intensive goods, which causes an increase in employment of unskilled workers in the less developed countries, decreasing the outflow of migrant workers. The export of capital-intensive goods from rich countries to poor countries also equalizes income and employment conditions, thus also slowing migration. In either direction, this theory can be used to explain migration between countries that are geographically far apart.

Osmosis: the unifying theory of human migration

Old migration theories are generally embedded in geography, sociology or economics. They explain migration in specific periods and spaces. In fact, Osmosis theory explains the whole phenomenon of human migration. Based on the history of human migration, Djelti (2017a) studies the evolution of its natural determinants. According to him, human migration is divided into two main types: the simple migration and the complicated one. The simple migration is divided, in its turn, into diffusion, stabilisation and concentration periods. During these periods, water availability, adequate climate, security and population density represent the natural determinants of human migration. For the complicated migration, it is characterised by the speedy evolution and the emergence of new sub-determinants notably earning, unemployment, networks and migration policies. Osmosis theory (Djelti, 2017b) explains analogically human migration by the biophysical phenomenon of osmosis. In this respect, the countries are represented by animal cells, the borders by the semipermeable membranes and the humans by ions of water. As to osmosis phenomenon, according to the theory, humans migrate from countries with less migration pressure to countries with high migration pressure. In order to measure the latter, the natural determinants of human migration replace the variables of the second principle of thermodynamics used to measure the osmotic pressure.

Historical theories

Ravenstein

Certain laws of social science have been proposed to describe human migration. The following was a standard list after Ravenstein's (1834–1913) proposal in the 1880s. The laws are as follows:

1. every migration flow generates a return or counter migration.
2. the majority of migrants move a short distance.
3. migrants who move longer distances tend to choose big-city destinations.
4. urban residents are often less migratory than inhabitants of rural areas.
5. families are less likely to make international moves than young adults.
6. most migrants are adults.
7. large towns grow by migration rather than natural increase.
8. migration stage by stage.
9. urban rural difference.
10. migration and technology.
11. economic condition.

Lee

Lee's laws divide factors causing migrations into two groups of factors: push and pull factors. Push factors are things that are unfavourable about the area that one lives in, and pull factors are things that attract one to another area.

Push factors

- Not enough jobs
- Few opportunities
- Inadequate conditions
- Desertification
- Famine or drought
- Political fear or persecution
- Slavery or forced labor
- Poor medical care
- Loss of wealth
- Natural disasters
- Death threats
- Desire for more political or religious freedom
- Pollution
- Poor housing
- Landlord/tenant issues
- Bullying
- Mentallity
- Discrimination
- Poor chances of marrying
- Condemned housing (radon gas, etc.)
- War

Pull factors

- Job opportunities
- Better living conditions
- The feeling of having more political or religious freedom
- Enjoyment
- Education
- Better medical care

- Attractive climates
- Security
- Family links
- Industry
- Better chances of marrying

See also article by Gürkan Çelik, in Turkish Review: Turkey Pulls, The Netherlands Pushes? An increasing number of Turks, the Netherlands' largest ethnic minority, are beginning to return to Turkey, taking with them the education and skills they have acquired abroad, as the Netherlands faces challenges from economic difficulties, social tension and increasingly powerful far-right parties. At the same time Turkey's political, social and economic conditions have been improving, making returning home all the more appealing for Turks at large. (pp. 94–99)

Climate cycles

The modern field of climate history suggests that the successive waves of Eurasian nomadic movement throughout history have had their origins in climatic cycles, which have expanded or contracted pastureland in Central Asia, especially Mongolia and the Altai. People were displaced from their home ground by other tribes trying to find land that could be grazed by essential flocks, each group pushing the next further to the south and west, into the highlands of Anatolia, the Pannonian Plain, into Mesopotamia or southwards, into the rich pastures of China. Bogumil Terminski uses the term "migratory domino effect" to describe this process in the context of Sea People invasion.

Other models

- Migration occurs because individuals search for food, sex and security outside their usual habitation. Idyorough is of the view that towns and cities are a creation of the human struggle to obtain food, sex and security. To produce food, security and reproduction, human beings must, out of necessity, move out of their usual habitation and enter into indispensable social relationships that are cooperative or antagonistic. Human beings also develop the tools and equipment to enable them to interact with nature to produce the desired food and security. The improved relationship (cooperative relationships) among human beings and improved technology further conditioned by the push and pull factors all interact together to cause or bring about migration and higher concentration of individuals into towns and cities. The higher the technology of production of food and security and the higher the cooperative relationship among human beings in the production of food and security and in the reproduction of the human species, the higher

would be the push and pull factors in the migration and concentration of human beings in towns and cities. Countryside, towns and cities do not just exist but they do so to meet the human basic needs of food, security and the reproduction of the human species. Therefore, migration occurs because individuals search for food, sex and security outside their usual habitation. Social services in the towns and cities are provided to meet these basic needs for human survival and pleasure.

- Zipf's inverse distance law (1956)
- Gravity model of migration and the friction of distance
- Radiation law for human mobility
- Buffer theory
- Stouffer's theory of intervening opportunities (1940)
- Zelinsky's Mobility Transition Model (1971)
- Bauder's regulation of labour markets (2006) "suggests that the international migration of workers is necessary for the survival of industrialised economies...[It] turns the conventional view of international migration on its head: it investigates how migration regulates labour markets, rather than labour markets shaping migration flows

Case fatality rate

In epidemiology, a **case fatality rate** (**CFR**)—or **case fatality risk**, **case fatality ratio** or just **fatality rate**—is the proportion of deaths within a designated population of "cases" (people with a medical condition) over the course of the disease. A CFR is conventionally expressed as a percentage and represents a measure of risk. CFRs are most often used for diseases with discrete, limited time courses, such as outbreaks of acute infections.

For example: Assume 9 deaths among 100 people in a community all diagnosed with the same disease. This means that among the 100 people formally diagnosed with the disease, 9 died and 91 recovered. The CFR, therefore, would be 9%. If some of the cases have not yet resolved (either died or recovered) at the time of analysis, this could lead to bias in estimating the CFR.

A mortality rate—often confused with a CFR—is a measure of the number of deaths (in general, or due to a specific cause) in a population, scaled to the size of that population, per unit of time. (For example, a rate of 50 deaths per 10,000 population in a year resulting from diabetes. The mortality rate, therefore, would be 50:10,000 or 5:1,000.)

Technically, CFRs are actually risks (or "incidence proportions") and take values between 0 and 1. They are not rates, incidence rates, or ratios (none of which are limited to the range 0-1). If one wants to be very precise, the term "case fatality rate" is incorrect, because the time from disease onset to death is not taken into account. Nevertheless, the term case fatality rate (and the abbreviation "CFR") is often used in the scientific literature.

Examples

The following examples will suggest the range of possible CFRs for diseases in the real world:

- The CFR for the Spanish (1918) flu was >2.5%, about 0.1% for the Asian (1956-58) and Hong Kong (1968-69) flus,[2] and <0.1% for other influenza pandemics.[1]
- Legionnaires' disease has a CFR of about 15%.
- The CFR for yellow fever, even with good treatment, ranges from 20 to 50%.
- Bubonic plague, left untreated, will have a CFR of as much as 60%.
- Zaïre Ebola virus is among the deadliest viruses with a CFR as high as 90%.
- Naegleriasis (also known as primary amoebic meningoencephalitis), caused by the unicellular Naegleria fowleri (a.k.a.the brain-eating amoeba), nearly always results in death, with a case fatality rate greater than 95%.
- Rabies virus, if infecting an unvaccinated individual who does not seek treatment, is also extremely deadly, with a CFR of almost 100%.

- Prion diseases are progressive and always fatal (CFR=100%).

Cause of death.

In law, medicine, and statistics, **cause of death** is a term which refers to an official determination of conditions resulting in a human's death. In modern times, such determinations usually become an essential data point of an official death certificate.

History

In contemporary times and in most parts of the world, a cause of death is determined by a medical examiner.

Accuracy concerns

A study published in Preventing Chronic Disease found that only one-third of New York City resident physicians reported believing that the present system of documentation was accurate. Half reported the inability to record "what they felt to be the correct cause of death", citing reasons such as technical limitation and instruction to "put something else". Nearly four-fifths reported being unaware that determinations of "probable", "presumed", or "undetermined" could be made, and fewer than three percent reported ever updating a death certificate when conflicting lab results or other new information became available, and cardiovascular disease was indicated as "the most frequent diagnosis inaccurately reported".

Causes of death are sometimes disputed by relatives or members of the public, particularly when some degree of uncertainty or ambiguity exists in relation to the cause of death. On occasion, such disputes may result from, or sometimes instigate, a conspiracy theory.

Age

"Old age" in of itself is not a direct cause of death; the direct cause can always in theory be attributed to a specific disease or failed organ system. However, over time, in most (but not all) organisms, many critical biological systems experience chemical or physical damage which eventually accumulate enough to cause failure. This is a significant problem in humans; it is estimated that of the roughly 150,000 people who die each day across the globe, about two thirds—100,000 per day—die of age-related causes. In industrialized nations the proportion is much higher, reaching 90%. Thus as an indirect cause, biological aging is by far the leading cause of death.

An alternative view of mortality is to consider the estimated loss in life-years from causes of death other than age-related. An infographic prepared by Thomas Porostocky and published in 2013 compares 2005 to 2010 in this "life-years lost annually" dimension.

Death caused by emotional state

There are also popular notions that someone can be "scared to death" or die of loneliness or heartbreak. Death caused by fear or stress can indeed have direct physiological effects. For example, it has been proposed that overstimulation of the Vagus nerve—which suppresses heart rate in a mechanism related to the behavior of apparent death or "playing possum"—is the cause of documented cases of psychogenic death. The flight or fight response to fear or stress has the opposite effect, increasing heart rate through stress hormones, and can cause cardiovascular problems (especially in those with pre-existing conditions). This is the proposed mechanism for the observed increase in the death rate due to cardiac arrest after widely experienced acutely stressful events such as terrorism, military attacks, and natural disasters (even among those who are not in the affected area) and for documented deaths in muggings and other frightening events which caused no traumatic physical harm. The proximal medical cause of death in these cases is likely to be recorded as cardiac failure or vagal inhibition (which also has other potential causes such as blows to certain parts of the body and nerve injuries).

One specific condition observed to result from acute stress, takotsubo cardiomyopathy, is nicknamed "broken heart syndrome", but the stress need not be relationship-related and need not be negative.

Legal implication

United States

Some insurance contracts, such as life insurance policies, have special rules for certain causes of death. Intentional injuries, for example, may invalidate claims under terms of such a contract.

List of causes of death by rate

The following is a **list of the causes of human deaths** worldwide for the year 2002, arranged by their associated mortality rates. There were 57,029,933 deaths tabulated for that year. Some causes listed include deaths also included in more specific subordinate causes (as indicated by the "Group" column), and some causes are omitted, so the percentages do not sum to 100. According to the World Health Organization, about 58 million people died in 2005, using the International Statistical Classification of Diseases and Related Health Problems (ICD). According to the Institute for Health Metrics and Evaluation, 52.77 million people died in 2010.

By frequency

The table below uses data from 2002 and is out of date. Data is now available for 2010.

Note: Tinted backgrounds indicate items that also appear in the subsequent table. Percentage figures add to more than 100% because some deaths appear in both broadly-defined and

narrowly defined categories; for example, Cardiovascular Deaths includes deaths from both Ischaemic Heart Disease and Stroke.

Mortality rates (death rate per year, from data for 2002						
Group	**Cause**	**Percent of deaths**		**Deaths per 100,000**		
		Group	**Subgroup**	**All**	**Male**	**Female**
–	All causes	100.0	100.0	916.1	954.7	877.1
A	Cardiovascular diseases	29.34		268.8	259.3	278.4
B	Infectious and parasitic diseases	23.04		211.3	221.7	200.4
A.1	Coronary artery disease		12.64	115.8	121.4	110.1
C	Malignant neoplasms (cancers)	12.49		114.4	126.9	101.7
A.2	Cerebrovascular disease (Stroke)		9.66	88.5	85.4	95.6
B.1	Respiratory infections		6.95	63.7	63.5	63.8
B.1.1	Lower respiratory tract infections		6.81	62.4	62.2	62.6
D	Respiratory diseases	6.49		59.5	61.1	57.9
E	Unintentional injuries	6.23		57.0	73.7	40.2
B.2	HIV/AIDS		4.87	44.6	46.2	43.0
D.1	Chronic obstructive pulmonary disease		4.82	44.1	45.1	43.1
–	Perinatal conditions	4.32	4.32	39.6	43.7	35.4
F	Digestive diseases	3.45		31.6	34.9	28.2
B.3	Diarrhea diseases		3.15	28.9	30.0	27.8
G	Intentional injuries (Suicide, Violence, War, etc.)	2.84		26.0	37.0	14.9
B.4	Tuberculosis		2.75	25.2	32.9	17.3
B.5	Malaria		2.23	20.4	19.4	21.5
C.1	Lung cancer		2.18	20.0	28.4	11.4
E.1	Road traffic accidents		2.09	19.1	40.8	10.4
B.6	Childhood diseases		1.97	18.1	18.0	18.2

Mortality rates (death rate per year, from data for 2002						
Group	**Cause**	**Percent of deaths**		**Deaths per 100,000**		
		Group	**Subgroup**	**All**	**Male**	**Female**
H	Neuropsychiatric disorders	1.95		17.9	18.4	17.3
–	Diabetes mellitus	1.73	1.73	15.9	14.1	17.7
A.3	Hypertensive heart disease		1.60	14.6	13.4	15.9
G.1	Suicide		1.53	14.0	17.4	10.6
C.2	Stomach cancer		1.49	13.7	16.7	10.5
I	Diseases of the genitourinary system	1.49		13.6	14.1	13.1
F.1	Cirrhosis of the liver		1.38	12.6	16.1	9.1
I.1	Nephritis/nephropathy		1.19	10.9	11.0	10.7
C.3	Colorectal cancer		1.09	10.0	10.3	9.7
C.4	Liver cancer		1.08	9.9	13.6	6.2
B.6.1	Measles		1.07	9.8	9.8	9.9
G.2	Violence		0.98	9.0	14.2	3.7
–	Maternal conditions	0.89	0.89	8.2	0.0	16.5
–	Congenital abnormalities	0.86	0.86	7.9	8.1	7.7
J	Nutritional deficiencies	0.85		7.8	6.9	8.7
C.5	Breast cancer		0.84	7.7	0.1	15.3
C.6	Esophageal cancer		0.78	7.2	9.1	5.2
A.4	Inflammatory heart disease		0.71	6.5	6.7	6.2
H.1	Alzheimer's disease and other dementias		0.70	6.4	4.7	8.1
E.2	Falls		0.69	6.3	7.5	5.0
E.3	Drowning		0.67	6.1	8.4	3.9
E.4	Poisoning		0.61	5.6	7.2	4.0
C.7	Lymphomas, multiple myeloma		0.59	5.4	5.4	5.4
A.5	Rheumatic heart disease		0.57	5.3	4.4	6.1

Mortality rates (death rate per year, from data for 2002						
Group	**Cause**	**Percent of deaths**		**Deaths per 100,000**		
		Group	**Subgroup**	**All**	**Male**	**Female**
C.8	Oral and oropharynx cancers		0.56	5.1	7.1	3.1
E.5	Fires		0.55	5.0	3.8	6.2
B.6.2	Pertussis		0.52	4.7	4.7	4.8
C.9	Prostate cancer		0.47	4.3	8.6	0.0
C.10	Leukemia		0.46	4.2	4.7	3.8
F.2	Peptic ulcer disease		0.46	4.2	5.0	3.5
J.1	Protein-energy malnutrition		0.46	4.2	4.2	4.2
–	Endocrine/nutritional disorders	0.43	0.43	3.9	3.4	4.4
D.2	Asthma		0.42	3.9	3.9	3.8
C.11	Cervical cancer		0.42	3.8	0.0	7.7
C.12	Pancreatic cancer		0.41	3.7	3.9	3.5
B.6.3	Tetanus		0.38	3.4	3.4	3.5
B.7	Sexually transmitted diseases excluding HIV/AIDS		0.32	2.9	2.9	2.9
C.13	Bladder cancer		0.31	2.9	4.0	1.7
B.8	Meningitis		0.30	2.8	2.9	2.7
G.3	War		0.30	2.8	5.0	0.5
B.7.1	Syphilis		0.28	2.5	2.7	2.3
–	Neoplasms other than malignant	0.26	0.26	2.4	2.4	2.4
J.2	Iron deficiency anemia		0.24	2.2	1.5	2.9
C.14	Ovarian cancer		0.24	2.2	0.0	4.4
B.9	Tropical diseases excluding malaria		0.23	2.1	2.5	1.6
H.2	Epilepsy		0.22	2.0	2.2	1.8
–	Musculoskeletal diseases	0.19	0.19	1.7	1.2	2.2

Mortality rates (death rate per year, from data for 2002						
Group	**Cause**	**Percent of deaths**		**Deaths per 100,000**		
		Group	**Subgroup**	**All**	**Male**	**Female**
B.10	Hepatitis B		0.18	1.7	2.3	1.0
H.3	Parkinson's disease		0.17	1.6	1.6	1.6
H.4	Alcohol use disorders		0.16	1.5	2.5	0.4
H.5	Drug use disorders		0.15	1.4	2.2	0.5
B.1.2	Upper respiratory infections		0.13	1.2	1.2	1.2
C.15	Uterine cancer		0.12	1.1	0.0	2.3
–	Skin diseases	0.12	0.12	1.1	0.8	1.4
C.16	Melanoma and other skin cancers		0.12	1.1	1.1	1.0
B.11	Hepatitis C		0.09	0.9	1.1	0.6
B.9.1	Leishmaniasis		0.09	0.8	1.0	0.7
B.9.2	Trypanosomiasis		0.08	0.8	1.0	0.5
I.2	Benign prostatic hyperplasia		0.06	0.5	1.0	0.0

Malnutrition

Malnutrition can be identified as an underlying cause for shortened life. 70% of childhood deaths (age 0-4) are reportedly due to diarrheal illness, acute respiratory infection, malaria and immunizable disease. However, of these childhood deaths, 56% can be attributed to the effects of malnutrition as an underlying cause. The effects of malnutrition include increased susceptibility to infection, musculature wasting, skeletal deformities and neurologic development delays. According to the World Health Organization, malnutrition is named as the biggest contributor to child mortality with 36 million deaths in 2005 related to malnutrition.

Developed vs. developing economies

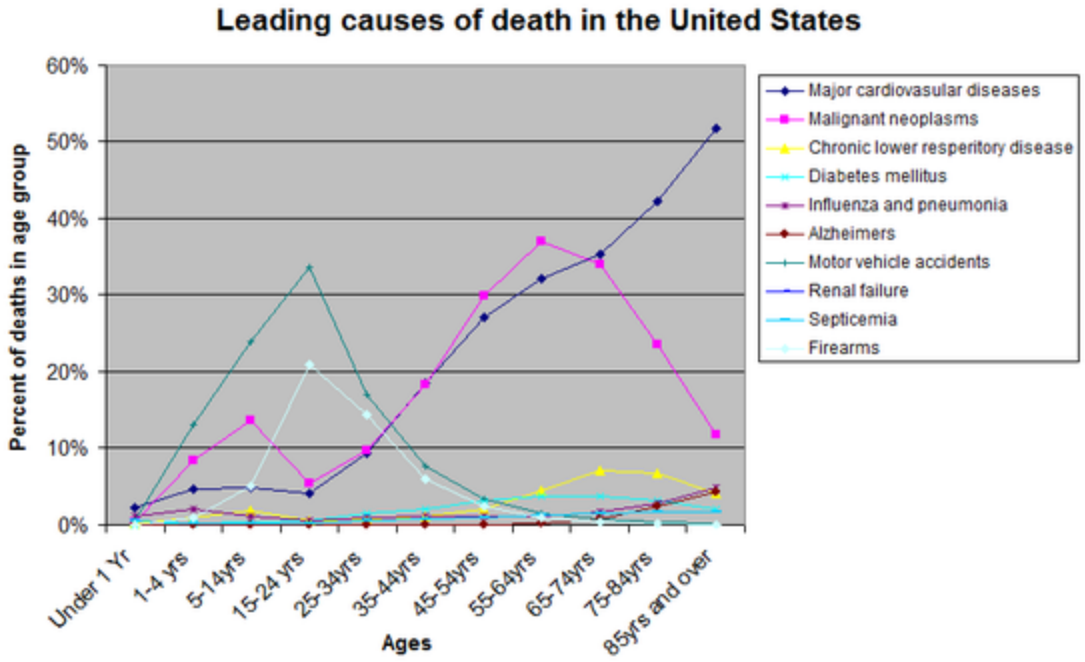
Top causes of death, according to the World Health Organization report for the calendar year 2001:

Causes of death in developing countries	**Number of deaths**	**Causes of death in developed countries**	**Number of deaths**
HIV-AIDS	2,678,000	Ischaemic heart disease	3,512,000

Lower respiratory infections	2,643,000	Cerebrovascular disease	3,346,000
Ischaemic heart disease	2,484,000	Chronic obstructive pulmonary disease	1,829,000
Diarrhea	1,793,000	Lower respiratory infections	1,180,000
Cerebrovascular disease	1,381,000	Lung cancer	938,000
Childhood diseases	1,217,000	Car crash	669,000
Malaria	1,103,000	Stomach cancer	657,000
Tuberculosis	1,021,000	Hypertensive heart disease	635,000
Chronic obstructive pulmonary disease	748,000	Tuberculosis	571,000
Measles	674,000	Suicide	499,000

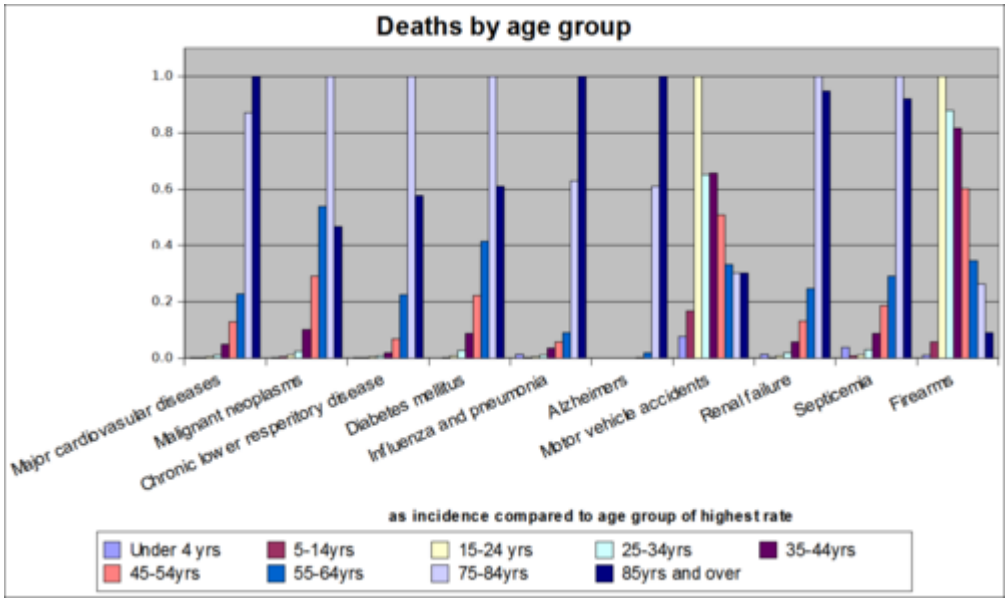
By age group

Leading causes of death in the United States by age group.



Leading causes of death in the United States, as percentage of deaths in each age group.

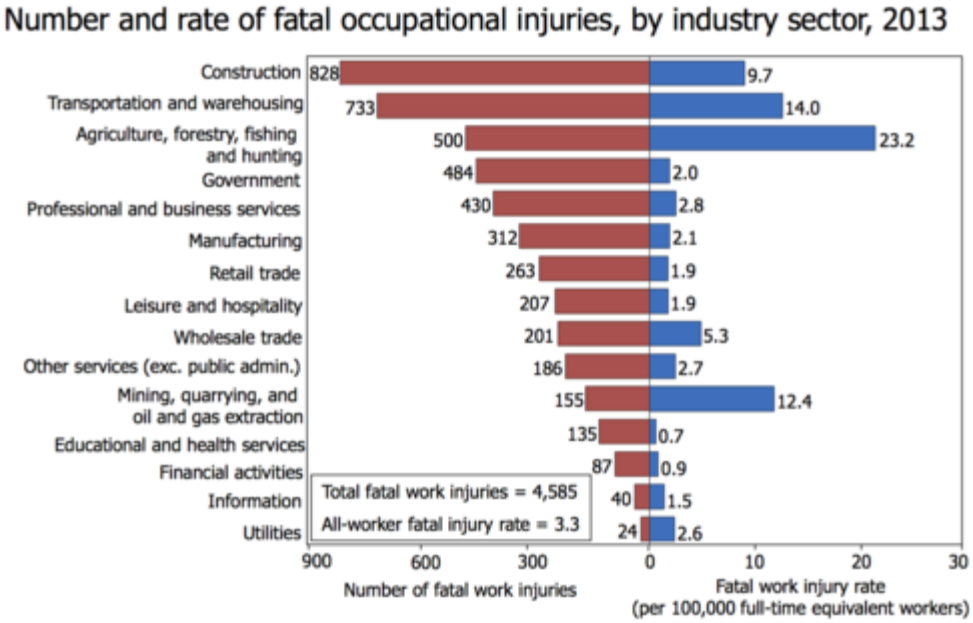
Perinatal mortality (<1yrs of age) seldom falls in any of these causes.



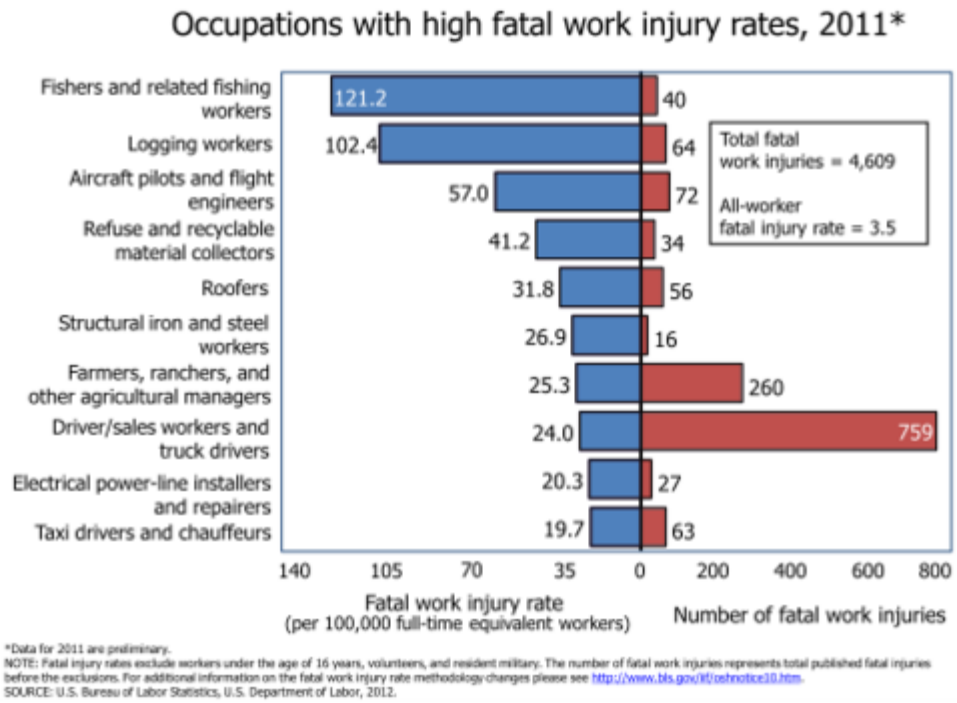
Death by age group as rate compared to the age group with highest rate.

By occupation

With an average of 123.6 deaths per 100,000 from 2003 through 2010 the most dangerous occupation in the United States is the cell tower construction industry.



Number and rate of fatal occupational injuries, by industry sector, 2006 in the United States.[15]



Selected occupations with high fatality rates, 2011, in the United States.

Preventable causes of death

The World Health Organization has traditionally classified death according to the primary type of disease or injury. However, causes of death may also be classified in terms of preventable risk factors—such as smoking, unhealthy diet, sexual behavior, and reckless driving—which contribute to a number of different diseases. Such risk factors are usually not recorded directly on death certificates, although they are acknowledged in medical reports.

Worldwide

It is estimated that of the roughly 150,000 people who die each day across the globe, about two thirds—100,000 per day—die of age-related causes because they have aged. In industrialized nations the proportion is much higher, reaching 90%. Thus, albeit indirectly, biological aging (senescence) is by far the leading cause of death. Whether senescence as a biological process itself can be slowed down, halted, or even reversed is a subject of current scientific speculation and research.

2001 figures

Leading causes of preventable death worldwide as of the year 2001, according to researchers working with the Disease Control Priorities Network (DCPN) and the World Health Organization (WHO). (The WHO's 2008 statistics show very similar trends.)

Cause	**Number of deaths resulting (millions per year)**

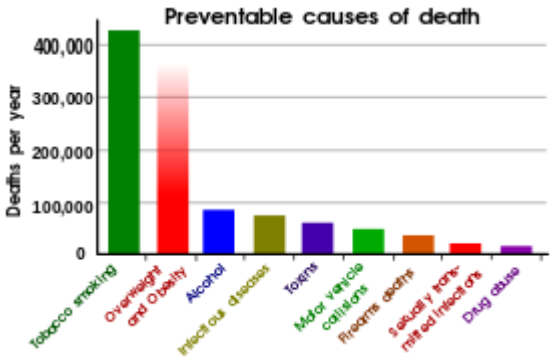
Hypertension	7.8
Smoking tobacco	5.4
Malnutrition	3.8
Sexually transmitted diseases	3.0
Poor diet	2.8
Overweight and obesity	2.5
Physical inactivity	2.0
Alcohol	1.9
Indoor air pollution from solid fuels	1.8
Unsafe water and poor sanitation	1.6

In 2001, on average 29,000 children died of preventable causes each day (that is, about 20 deaths per minute). The authors provide the context:

> " About 56 million people died in 2001. Of these, 10.6 million were children, 99% of whom lived in low-and-middle-income countries. More than half of child deaths in 2001 were attributable to acute respiratory infections, measles, diarrhea, malaria, and HIV/AIDS. "

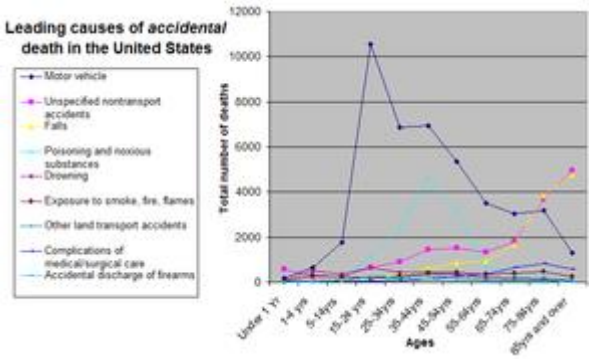
United States

The three most common preventable causes of death in the population of the United States are smoking, high blood pressure, and being overweight.[5]

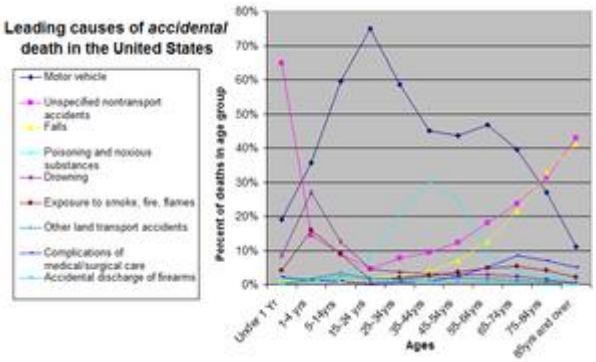
- 

  Leading preventable causes of death in the United States in the year 2000.[6] Note: This data is outdated and has been significantly revised, especially for obesity-related deaths.

Accidental death



- Leading causes of accidental death in the United States by age group as of 2002.[7]



- Leading causes of accidental death in the United States as of 2002, as a percentage of deaths in each group.

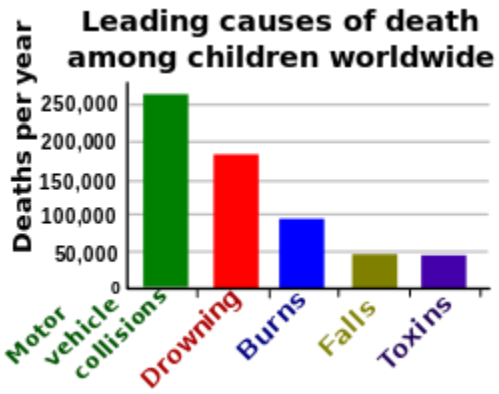
Annual number of deaths and causes

Cause	Number	Percent of total	Notes
Smoking tobacco	435,000	18.1%	
Preventable medical errors in hospitals	210,000 to 448,000	23.1%	Estimates vary, significant numbers of preventable deaths also result from errors outside of hospitals.
Being overweight and obesity	111,909	4.6%	There was considerable debate about the differences in the numbers of obesity-related diseases. The numbers reported in the referenced article have been found to be the most accurate.
Alcohol	85,000	3.5%	
Infectious diseases	75,000	3.1%	

Toxic agents including toxins, particulates and radon	55,000	2.3%	
Traffic collisions	43,000	1.8%	
Preventable colorectal cancers	41,400	1.7%	Colorectal cancer (bowel cancer, colon cancer) caused 51,783 deaths in the US in 2011. About 80 percen of colorectal cancers begin as benign growths, commonly called polyps, which can be easily detected and removed during a colonoscopy. Accordingly, the tabulated figure assumes that 80% of the fatal cancers could have been prevented.
Firearms deaths	31,940	1.3%	Suicide: 19,766; homicide: 11,101; Accidents: 852; Unknown: 822
Sexually transmitted infections	20,000	0.8%	
Drug abuse	17,000	0.7%	

Among children worldwide

Various injuries are the leading cause of death in children 9–17 years of age. In 2008, the top five worldwide unintentional injuries in children are as follows



Leading causes of death by injury among children worldwide.

Cause	Number of deaths resulting
Traffic collision	260,000 per year
Drowning	175,000 per year
Burns	96,000 per year
Falls	47,000 per year
Toxins	45,000 per year

Mortality displacement

Mortality displacement denotes a temporal or temporary increase in the mortality rate (number of deaths) in a given population, also known as **excess mortality** or **excess mortality rate**. It is usually attributable to environmental phenomena such as heat waves, cold spells, epidemics and pandemics, especially influenza pandemics, famine or war.

During heat waves, for instance, there are often additional deaths observed in the population, affecting especially older adults and those who are sick. After some periods with excess mortality, however, there has also been observed a decrease in overall mortality during the subsequent weeks. Such short-term forward shift in mortality rate is also referred to as **harvesting effect**. The subsequent, compensatory reduction in mortality suggests that the heat wave had affected especially those whose health is already so compromised that they "would have died in the short term anyway".

Death marches can also lead to a significant mortality displacement, such as in the Trail of Tears, the Armenian Genocide, and the Bataan death march, wherein the oldest, weakest, and sickest died first

Mortality salience

Mortality salience is the awareness by an individual that his or her death is inevitable.The term derives from terror management theory, which proposes that mortality salience causes existential anxiety that may be buffered by an individual's cultural worldview and/or sense of self-esteem.

Terror management theory

Mortality salience engages the conflict that humans have to face both their instinct to avoid death completely, and their intellectual knowledge that avoiding death is ultimately futile. According to terror management theory, when human beings begin to contemplate their mortality and their vulnerability to death, feelings of terror emerge because of the simple fact that humans want to avoid their inevitable death. Mortality salience comes into effect, because humans contribute all

of their actions to either avoiding death or distracting themselves from the contemplation of it. Thus, terror management theory asserts that almost all human activity is driven by the fear of death.

Most research done on terror management theory revolves around the mortality salience paradigm. It has been found that religious individuals as well as religious fundamentalists are less vulnerable to mortality salience manipulations, and so religious believers engage in cultural worldview defense to a lesser extent than nonreligious individuals.

Self-esteem

Mortality salience is highly manipulated by one's self-esteem. Individuals with low self-esteem are more apt to experience the effects of mortality salience, whereas individuals with high self-esteem are better able to cope with the idea that their death is uncontrollable. As an article states, "according to terror management theory, increased self-esteem should enhance the functioning of the cultural anxiety buffer and thereby provide protection against death concerns".

Potential to cause worldview defense

Mortality salience has the potential to cause worldview defense, a psychological mechanism that strengthens people's connection with their in-group as a defense mechanism. Studies also show that mortality salience can lead people to feel more inclined to punish minor moral transgressions. One such study divided a group of judges into two groups—one that was asked to reflect upon their own mortality, and one group that was not. The judges were then asked to set a bond for an alleged prostitute. The group that had reflected on mortality set an average bond of $455, while the control group's average bond was $50.

Another study found that mortality salience could cause an increase in support for martyrdom and military intervention. It found that students who had reflected on their mortality showed preference towards people who supported martyrdom, and indicated they might consider martyrdom themselves. They also found that, especially among students who were politically conservative, mortality salience increased support for military intervention, but not among students who were politically liberal.

Gender, emotion and sex

A study tested "the hypothesis that mortality salience intensifies gender differences in reactions to sexual and emotional infidelity". In the study, participants were asked to work through packets that had mortality salience manipulation questions in each. In the results, they found that "sex is more relevant to the self-esteem of men than women and being in a committed relationship is relatively more important to women than for men". Therefore, when linking mortality salience to

gender, emotion, and sex, men are more likely to suffer from sexual infidelity, and women are more likely to suffer from emotional infidelity. The results of this study showed that there is a logistic regression revealing a significant three-way interaction between gender, sex value, and mortality salience for the item pitting "passionate sex" against "emotional attachment".

Individuals exposed to near-death experiences

With mortality salience, humans who have encountered near-death experiences develop a greater sense of self and meaning to life. It has been shown that individuals who face these experiences tend to invest more into relationships, political beliefs, religious beliefs, and other beliefs over material things. As a patient with AIDS shared, "Because of my illness I have nothing to hide. It has freed me because now I am completely honest".Developing a cultural worldview provides humans with comfort from the thought of their own inevitable death. This coping mechanism has shown to highly improve the self-worth of humans and highly alleviates existential anxiety.

Mortality rate, or **death rate**, is a measure of the number of deaths (in general, or due to a specific cause) in a particular population, scaled to the size of that population, per unit of time. Mortality rate is typically expressed in units of deaths per 1,000 individuals per year; thus, a mortality rate of 9.5 (out of 1,000) in a population of 1,000 would mean 9.5 deaths per year in that entire population, or 0.95% out of the total. It is distinct from "morbidity", which is either the prevalence or incidence of a disease, and also from the incidence rate (the number of newly appearing cases of the disease per unit of time).

In the generic form, mortality rates are calculated as:

where d represents the deaths occurring within a given time period and p represents the size of the population in which the deaths occur.

Related measures of mortality

Other specific measures of mortality include:

Measures of Mortality

Crude death rate – the total number of deaths per year per 1,000 people. As of 2017 the crude death rate for the whole world is 8.33 per 1,000 (up from 7.8 per 1,000 in 2016) according to the current CIA World Factbook.

Perinatal mortality rate – the sum of neonatal deaths and fetal deaths (stillbirths) per 1,000 births.

Maternal mortality ratio – the number of maternal deaths per 100,000 live births in same time period.

Maternal mortality rate – the number of maternal deaths per 1,000 women of reproductive age in the population (generally defined as 15–44 years of age).

Infant mortality rate – the number of deaths of children less than 1 year old per 1,000 live births.
Child mortality rate: the number of deaths of children less than 5 years old per 1,000 live births.
Standardized mortality ratio (SMR) – a proportional comparison to the numbers of deaths that would have been expected if the population had been of a standard composition in terms of age, gender, etc.[5]
Age-specific mortality rate (ASMR) – the total number of deaths per year per 1,000 people of a given age (e.g. age 62 last birthday).
Cause-specific mortality rate – the mortality rate for a specified cause of death.
Sun, Hongbing, "Temperature Dependence of Multiple Sclerosis in the United States." Multiple Sclerosis Journal. Vol. 23, no. 14, Dec. 2017
In this study the research found that Patients with MS are sensitive to heat temperatures which cause remains unknown. This study finds that the mortality rate in the USA in areas of the northern states is higher than the southern states. This study finds that MS caused 55,129 deaths within the 48 states between 1999 and 2014. The study was unable to find a clear correlation between temperature and MS deaths, however, it is suggested that more deaths are seen in the northern, low-temperature states due to an increased use of heat within homes themselves. This infers that due to the increased home temperatures people suffering from MS could be more sensitive to that opposed to the actual environmental temperatures.
Cumulative death rate: a measure of the (growing) proportion of a group that die over a specified period (often as estimated by techniques that account for missing data by statistical censoring).
Case fatality rate (CFR) – the proportion of cases of a particular medical condition that lead to death.
Tuner, Paul J., et al. "Fatal Anaphylaxis: Mortality Rate and Risk Factors." The Journal of Allergy and clinical Immunology: In practice, vol. 5, no. 5, 2017. According to this research, only 5% of the US Population experiences anaphylactic reactions, but less than 1% of them end up fatal. With the increased education and research of anaphylaxis, health-care providers have been distributing auto-injectors of epinephrine to patients that experience anaphylaxis, which is a factor in preventing fatal anaphylaxis.

Benson, Michael D. "Amniotic Fluid Embolism Mortality Rate." Journal of Obstetrics and Gynecology Research: vol. 43, no. 11, 2017. Nine studies were combined to measure over 17 million births with a recorded Amniotic Fluid Embolism Mortality Rate of 20.4%. One of the risk factors involved with AFE was a maternal age of 35 or greater. An important factor to note

is that this particular topic has not been researched extensively and there are multiple different definitions of AFE and what is needed to diagnose it depending on the country or physician. Further research on this topic overall is necessary to provide more accurate data.

Sex-specific mortality rate - Total number of deaths in a population of a specific sex within a given time interval

Use in epidemiology

In most cases, there are few ways, if at all possible to obtain exact mortality rates, so epidemiologists use estimation to predict correct mortality rates. Mortality rates are usually difficult to predict due to language barriers, health infrastructure related issues, conflict, and other reasons. Maternal mortality has additional challenges, especially as they pertain to stillbirths, abortions, and multiple births. In some countries, during the 1920's a stillbirth was defined as ‘a birth of at least twenty weeks; gestation in which the child shows no evidence of life after complete birth.' In most countries, however, a stillbirth was defined as ‘the birth of a fetus, after 28 weeks of pregnancy, in which pulmonary respiration does not occur.'

Census data and vital statistics

Ideally, all mortality estimation would be done using vital statistics and census data. Census data will give detailed information about the population at risk of death. The vital statistics provide information about live births and deaths in the population. Often, either census data and vital statistics data is not available. This is especially true in developing countries, countries that are in conflict, areas where natural disasters have caused mass displacement, and other areas where there is a humanitarian crisis

Household surveys]

Household surveys or interviews are another way in which mortality rates are often assessed. There are several methods to estimate mortality in different segments of the population. One such example is the sisterhood method. This technique involves researchers estimating maternal mortality by contacting women in populations of interest and asking whether or not they have a sister, if the sister is of child-rearing age (usually 15) and conducting an interview or written questions about possible deaths among sisters. The sisterhood method, however, does not work in cases where sisters may have died before the sister being interviewed was born.

Orphanhood surveys estimate mortality by questioning children are asked about the mortality of their parents. It has often been criticized as an adult mortality rate that is very biased for several reasons. The adoption effect is one such instance in which orphans often do not realize that they are adopted. Additionally, interviewers may not realize that an adoptive or foster parent is not the

child's biological parent. There is also the issue of parents being reported on by multiple children while some adults have no children, thus are not counted in mortality estimates.

Widowhood surveys estimate adult mortality by responding to questions about the deceased husband or wife. One limitation of the widowhood survey surrounds the issues of divorce, where people may be more likely to report that they are widowed in places where there is the great social stigma around being a divorcee. Another limitation is that multiple marriages introduce biased estimates, so individuals are often asked about first marriage. Biases will be significant if the association of death between spouses, such as those in countries with large AIDS epidemics.

Sampling

Sampling refers to the selection of a subset of the population of interest to efficiently gain information about the entire population. Samples should be representative of the population of interest. Cluster sampling is an approach to non-probability sampling; this is an approach in which each member of the population is assigned to a group (cluster), and then clusters are randomly selected, and all members of selected clusters are included in the sample. Often combined with stratification techniques (in which case it is called multistage sampling), cluster sampling is the approach most often used by epidemiologists. In areas of forced migration, there is more significant sampling error. Thus cluster sampling is not the ideal choice.

Mortality statistics.

World historical and predicted crude death rates (1950–2050) UN, medium variant, 2012 rev.

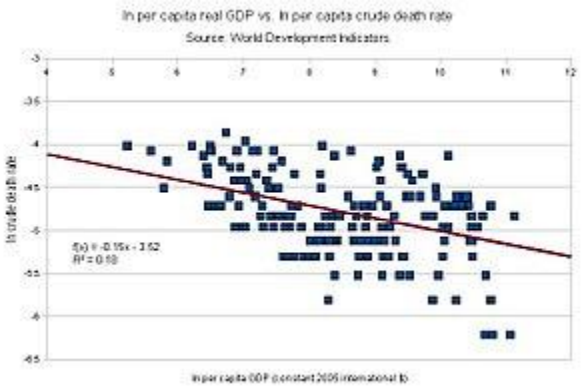
Years	**CDR**	**Years**	**CDR**
1950–1955	19.1	2000–2005	8.4
1955–1960	17.3	2005–2010	8.1
1960–1965	16.2	2010–2015	8.1
1965–1970	12.9	2015–2020	8.1
1970–1975	11.6	2020–2025	8.1
1975–1980	10.6	2025–2030	8.3
1980–1985	10.0	2030–2035	8.6
1985–1990	9.4	2035–2040	9.0

1990–1995	9.1	2040–2045	9.4
1995–2000	8.8	2045–2050	9.7

According to the World Health Organization, the ten leading causes of death in 2015 (ranked by death per 100,000 population) were:

1. Ischaemic heart disease (119 per 100,000 population)
2. Stroke (85 per 100,000 population)
3. Lower respiratory infections (43 per 100,000 population)
4. Chronic obstructive pulmonary disease (43 per 100,000 population)
5. Trachea/bronchus/lung cancers (23 per 100,000 population)
6. Diabetes mellitus (22 per 100,000 population)
7. Alzheimer's disease and other dementias (21 per 100,000 population)
8. Diarrhoeal diseases (19 per 100,000 population)
9. Tuberculosis (19 per 100,000 population)
10. Road traffic accidents (10 per 100,000 population)

Causes of death vary greatly between developed and less developed countries. See list of causes of death by rate for worldwide statistics.



Scatter plot of the natural logarithm of the crude death rate against the natural log of per capita real GDP. The slope of the trend line is the elasticity of the crude death rate with respect to per capita real income. It indicates that a 10% increase in per capita real income is associated with a 1.5% decrease in the crude death rate. Source: World Development Indicators.

According to Jean Ziegler (the United Nations Special Rapporteur on the Right to Food for 2000 to March 2008), mortality due to malnutrition accounted for 58% of the total mortality in 2006: "In the world, approximately 62 millions people, all causes of death combined, die each year. In 2006, more than 36 million died of hunger or diseases due to deficiencies in micronutrients".

Of the roughly 150,000 people who die each day across the globe, about two thirds—100,000 per day—die of age-related causes. In industrialized nations, the proportion is much higher, reaching 90%.

Maximum life span

Maximum life span (or, for humans, **maximum reported age at death**) is a measure of the maximum amount of time one or more members of a population have been observed to survive between birth and death. The term can also denote an estimate of the maximum amount of time that a member of a given species could survive between birth and death, provided circumstances that are optimal to that member's longevity.

Most living species have at least one upper limit on the number of times the cells of a member can divide. This is called the Hayflick limit, although number of cell divisions does not strictly control lifespan.

Definition

In animal studies, maximum span is often taken to be the mean life span of the most long-lived 10% of a given cohort. By another definition, however, maximum life span corresponds to the age at which the oldest known member of a species or experimental group has died. Calculation of the maximum life span in the latter sense depends upon initial sample size.

Maximum life span contrasts with mean life span (average life span, life expectancy), and longevity. Mean life span varies with susceptibility to disease, accident, suicide and homicide, whereas maximum life span is determined by "rate of aging".[2] Longevity refers only to the characteristics of the especially long lived members of a population, such as infirmities as they age or compression of morbidity, and not the specific life span of an individual.

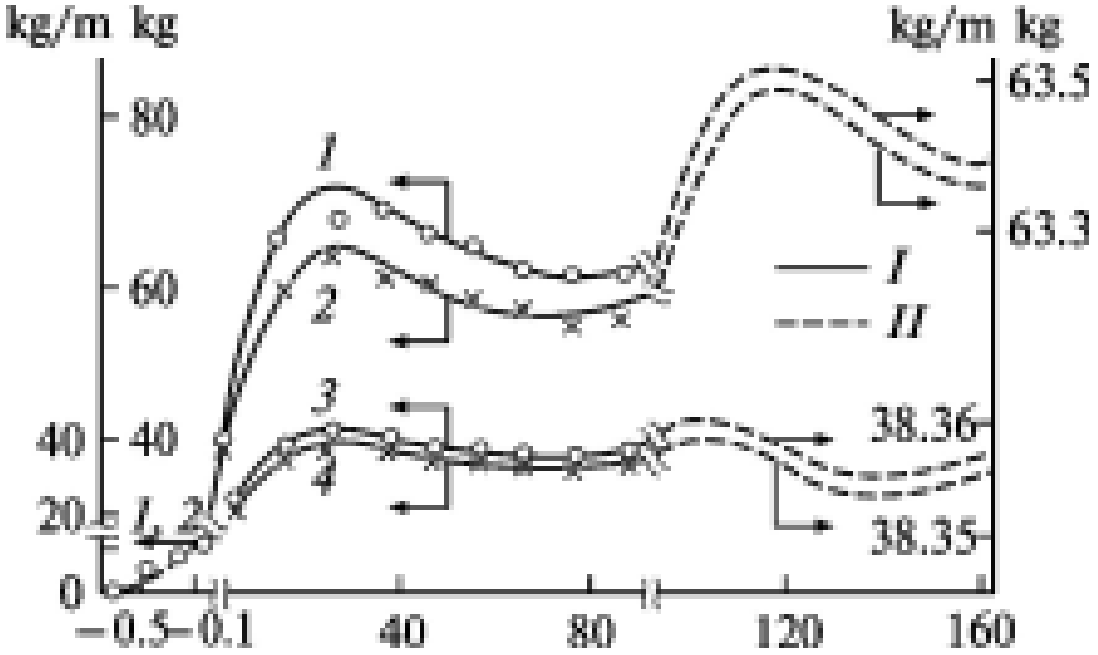
In humans

The longest-living person whose dates of birth and death were verified to the modern norms of Guinness World Records and the Gerontology Research Group was Jeanne Calment (1875-1997), a French woman who lived to 122. Reduction of infant mortality has accounted for most of the increased average life span longevity, but since the 1960s mortality rates among those over 80 years have decreased by about 1.5% per year. "The progress being made in lengthening lifespans and postponing senescence is entirely due to medical and public-health efforts, rising standards of living, better education, healthier nutrition and more salubrious lifestyles." Animal studies suggest that further lengthening of human lifespan could be achieved through "calorie restriction mimetic" drugs or by directly reducing food consumption. Although calorie restriction has not been proven to extend the maximum human life span, as of 2014, results in ongoing

primate studies have demonstrated that the assumptions derived from rodents are valid in primates as well [Reference: Nature 1 April 2014].

No fixed theoretical limit to human longevity is apparent today. "A fundamental question in aging research is whether humans and other species possess an immutable life-span limit." "The assumption that the maximum human life span is fixed has been justified, [but] is invalid in a number of animal models and ... may become invalid for humans as well." Studies in the biodemography of human longevity indicate a late-life mortality deceleration law: that death rates level off at advanced ages to a late-life mortality plateau. That is, there is no fixed upper limit to human longevity, or fixed maximal human lifespan. This law was first quantified in 1939, when researchers found that the one-year probability of death at advanced age asymptotically approaches a limit of 44% for women and 54% for men.

Scientists have observed that a person's VO_2max value (a measure of the volume of oxygen flow to the cardiac muscle) decreases as a function of age. Therefore, the maximum lifespan of a person could be determined by calculating when the person's VO_2max value drops below the basal metabolic rate necessary to sustain life, which is approximately 3 ml per kg per minute. On the basis of this hypothesis, athletes with a VO_2max value between 50 and 60 at age 20 would be expected "to live for 100 to 125 years, provided they maintained their physical activity so that their rate of decline in VO_2max remained constant".



Average and commonly accepted maximum lifespans correspond to the extremums of the body mass (1, 2) and mass normalized to height (3, 4) of men (1, 3) and women (2, 4).

A theoretical study suggested the maximum human lifespan to be around 125 years using a modified stretched exponential function for human survival curves. The analysis of dynamics of the body mass in human population indicates extremums, which correspond to mean (70-75 years), the commonly accepted maximum (100–110 years) and maximum known (140–160 years) lifespan. In another study, researchers claimed that there exists a maximum lifespan for humans, and that the human maximal lifespan has been declining since the 1990s. This study is now disputed on the basis of simple coding errors and biased sampling. This study also supports a continuing increase in both theoretical and observed upper human lifespan, based on observed data from 200 national populations. However, a theoretical study also suggested that the maximum human life expectancy at birth is limited by the human life characteristic value δ, which is around 104 years.

A religious reference to a maximum life span is found in Genesis 6:3, and can be translated as, "And the Lord said, "Let My spirit not quarrel forever concerning adam (man), because he is also flesh, and his days shall be a hundred and twenty years." This pronouncement closely matches the Gompertz-Makeham law of mortality. Empirically, Jeanne Calment of France did live beyond this religious red line.

There is currently no known law anywhere in the world known to restrict maximum lifespan, aside from that which may be legally applicable from religious belief within religious states. The United Nations has undertaken an important Bayesian sensitivity analysis of global population burden based on life expectancy projection at birth in future decades. The 2017 95% prediction interval of 2090 average life expectancy rises as high as +6 (106, in Century Representation Form) by 2090, with dramatic, ongoing, layered consequences on world population and demography should that happen. The prediction interval is extremely wide, and the United Nations can not be certain. Organizations like the Methuselah Foundation are working toward an end to senescence and practically unlimited human lifespan. If successful, the demographic implications for human population will be greater in effective multiplier terms than any experienced in the last five centuries if maximum lifespan remains unlimited by law.

In other animals

Small animals such as birds and squirrels rarely live to their maximum life span, usually dying of accidents, disease or predation.

The maximum life span of most species is documented in the Anage repository.

Maximum life span is usually longer for species that are larger or have effective defenses against predation, such as bird flight, chemical defenses or living in social groups.

The differences in life span between species demonstrate the role of genetics in determining maximum life span ("rate of aging"). The records (in years) are these:

- for common house mouse, 4
- for Brown rat, 3.8
- for dogs, 29 (See List of oldest dogs)
- for cats, 38[25]
- for polar bears, 42 (Debby)
- for horses, 62
- for Asian elephants, 86

The longest-lived vertebrates have been variously described as

- Large parrots (Macaws and cockatoos can live up to 80–100 years in captivity)
- Koi (A Japanese species of fish, allegedly living up to 200 years, though generally not exceeding 50 – A specimen named Hanako was reportedly 226 years old upon her death)[29][30]
- Tortoises (Galápagos tortoise) (190 years)
- Tuataras (a New Zealand reptile species, 100–200+ years)
- Eels, the so-called Brantevik Eel (Swedish: Brantevikså len) is thought to have lived in a water well in southern Sweden since 1859, which makes it over 150 years old. It was reported that it had died in August 2014 at an age of 155.
- Whales (Bowhead Whale) (Balaena mysticetus about 200 years) Although this idea was unproven for a time, recent research has indicated that bowhead whales recently killed still had harpoons in their bodies from about 1890, which, along with analysis of amino acids, has indicated a maximum life span, stated as "the 211 year-old bowhead could have been from 177 to 245 years old".
- Greenland Sharks are currently the vertebrate species with the longest known lifespan. An examination of 28 specimens in one study published in 2016 determined by radiocarbon dating that the oldest of the animals that they sampled had lived for about 392 ± 120 years (a minimum of 272 years and a maximum of 512 years). The authors further concluded that the species reaches sexual maturity at about 150 years of age.

Invertebrate species which continue to grow as long as they live (e.g., certain clams, some coral species) can on occasion live hundreds of years:

- A bivalve mollusc (Arctica islandica) (aka "Ming", lived 507±2 years.)

Exceptions

- Some jellyfish species, including Turritopsis dohrnii, Laodicea undulata, and Aurelia sp.1, are able to revert to the polyp stage even after reproducing (so called life cycle reversal), rather than dying as in other jellyfish. Consequently, these species are considered biologically immortal and have no maximum lifespan.
- There may be no natural limit to the Hydra's life span, but it is not yet clear how to estimate the age of a specimen.
- Flatworms, or Platyhelminthes, are known to be "almost immortal" as they have a great regeneration capacity, continuous growth and binary fission type cellular division.
- Lobsters are sometimes said to be biologically immortal because they don't seem to slow down, weaken, or lose fertility with age. However, due to the energy needed for moulting, they cannot live indefinitely.

In plants

Plants are referred to as annuals which live only one year, biennials which live two years, and perennials which live longer than that. The longest-lived perennials, woody-stemmed plants such as trees and bushes, often live for hundreds and even thousands of years (one may question whether or not they may die of old age). A giant sequoia, General Sherman is alive and well in its third millennium. A Great Basin Bristlecone Pine called Methuselah is 4,848 years old (as of 2017) and the Bristlecone Pine called Prometheus was a little older still, at least 4,844 years (and possibly as old as 5,000 years), when it was cut down in 1964. The oldest known plant (possibly oldest living thing) is a clonal Quaking Aspen (Populus tremuloides) tree colony in the Fishlake National Forest in Utah called Pando at about 80,000 years. Lichen, a symbiotic algae and fungal proto-plant, such as Rhizocarpon geographicum can live upwards of 10,000 years.

Increasing maximum life span

"Maximum life span" here means the mean life span of the most long-lived 10% of a given cohort. Caloric restriction has not yet been shown to break mammalian world records for longevity. Rats, mice, and hamsters experience maximum life-span extension from a diet that contains all of the nutrients but only 40–60% of the calories that the animals consume when they can eat as much as they want. Mean life span is increased 65% and maximum life span is increased 50%, when caloric restriction is begun just before puberty.[47] For fruit flies the life extending benefits of calorie restriction are gained immediately at any age upon beginning calorie restriction and ended immediately at any age upon resuming full feeding.

A few transgenic strains of mice have been created that have maximum life spans greater than that of wild-type or laboratory mice. The Ames and Snell mice, which have mutations in

pituitary transcription factors and hence are deficient in Gh, LH, TSH, and secondarily IGF1, have extensions in maximal lifespan of up to 65%. To date, both in absolute and relative terms, these Ames and Snell mice have the maximum lifespan of any mouse not on caloric restriction (see below on GhR). Mutations/knockout of other genes affecting the GH/IGF1 axis, such as Lit, Ghr and Irs1 have also shown extension in lifespan, but much more modest both in relative and absolute terms. The longest lived laboratory mouse ever was a Ghr knockout mouse, which lived to ≈1800 days in the lab of Andrzej Bartke at Southern Illinois University. The maximum for normal B6 mice under ideal conditions is 1200 days.

Most biomedical gerontologists believe that biomedical molecular engineering will eventually extend maximum lifespan and even bring about rejuvenation. Anti-aging drugs are a potential tool for extending life.

Aubrey de Grey, a theoretical gerontologist, has proposed that aging can be reversed by Strategies for Engineered Negligible Senescence. De Grey has established The Methuselah Mouse Prize to award money to researchers who can extend the maximum life span of mice. So far, three Mouse Prizes have been awarded: one for breaking longevity records to Dr. Andrzej Bartke of Southern Illinois University (using GhR knockout mice); one for late-onset rejuvenation strategies to Dr. Stephen Spindler of the University of California (using caloric restriction initiated late in life); and one to Dr. Z. Dave Sharp for his work with the pharmaceutical rapamycin.

Correlation with DNA repair capacity

Accumulated DNA damage appears to be a limiting factor in the determination of maximum life span. The theory that DNA damage is the primary cause of aging, and thus a principal determinant of maximum life span, has attracted increased interest in recent years. This is based, in part, on evidence in human and mouse that inherited deficiencies in DNA repair genes often cause accelerated aging. There is also substantial evidence that DNA damage accumulates with age in mammalian tissues, such as those of the brain, muscle, liver and kidney (reviewed by Bernstein et al. and see DNA damage theory of aging and DNA damage (naturally occurring)). One expectation of the theory (that DNA damage is the primary cause of aging) is that among species with differing maximum life spans, the capacity to repair DNA damage should correlate with lifespan. The first experimental test of this idea was by Hart and Setlow who measured the capacity of cells from seven different mammalian species to carry out DNA repair. They found that nucleotide excision repair capability increased systematically with species longevity. This correlation was striking and stimulated a series of 11 additional experiments in different

laboratories over succeeding years on the relationship of nucleotide excision repair and life span in mammalian species (reviewed by Bernstein and Bernstein). In general, the findings of these studies indicated a good correlation between nucleotide excision repair capacity and life span. The association between nucleotide excision repair capability and longevity is strengthened by the evidence that defects in nucleotide excision repair proteins in humans and rodents cause features of premature aging, as reviewed by Diderich.

Further support for the theory that DNA damage is the primary cause of aging comes from study of Poly ADP ribose polymerases (PARPs). PARPs are enzymes that are activated by DNA strand breaks and play a role in DNA base excision repair. Burkle et al. reviewed evidence that PARPs, and especially PARP-1, are involved in maintaining mammalian longevity. The life span of 13 mammalian species correlated with poly(ADP ribosyl)ation capability measured in mononuclear cells. Furthermore, lymphoblastoid cell lines from peripheral blood lymphocytes of humans over age 100 had a significantly higher poly(ADP-ribosyl)ation capability than control cell lines from younger individuals.

Research data

- A comparison of the heart mitochondria in rats (7-year maximum life span) and pigeons (35-year maximum life span) showed that pigeon mitochondria leak fewer free-radicals than rat mitochondria, despite the fact that both animals have similar metabolic rate and cardiac output
- For mammals there is a direct relationship between mitochondrial membrane fatty acid saturation and maximum life span
- Studies of the liver lipids of mammals and a bird (pigeon) show an inverse relationship between maximum life span and number of double bonds
- Selected species of birds and mammals show an inverse relationship between telomere rate of change (shortening) and maximum life span
- Maximum life span correlates negatively with antioxidant enzyme levels and free-radicals production and positively with rate of DNA repair
- Female mammals express more Mn−SOD and glutathione peroxidase antioxidant enzymes than males. This has been hypothesized as the reason they live longerHowever, mice entirely lacking in glutathione peroxidase 1 do not show a reduction in lifespan.
- The maximum life span of transgenic mice has been extended about 20% by overexpression of human catalase targeted to mitochondria

- A comparison of 7 non-primate mammals (mouse, hamster, rat, guinea-pig, rabbit, pig and cow) showed that the rate of mitochondrial superoxide and hydrogen peroxide production in heart and kidney were inversely correlated with maximum life span
- A study of 8 non-primate mammals showed an inverse correlation between maximum life span and oxidative damage to mtDNA (mitochondrial DNA) in heart & brain
- A study of several species of mammals and a bird (pigeon) indicated a linear relationship between oxidative damage to protein and maximum life span
- There is a direct correlation between DNA repair and maximum life span for mammalian species
- Drosophila (fruit-flies) bred for 15 generations by only using eggs that were laid toward the end of reproductive life achieved maximum life spans 30% greater than that of controls
- Overexpression of the enzyme which synthesizes glutathione in long-lived transgenic Drosophila (fruit-flies) extended maximum lifespan by nearly 50%
- A mutation in the **age−1** gene of the nematode worm Caenorhabditis elegans increased mean life span 65% and maximum life span 110%. However, the degree of lifespan extension in relative terms by both the age-1 and daf-2 mutations is strongly dependent on ambient temperature, with ≈10% extension at 16 °C and 65% extension at 27 °C.
- Fat-specific Insulin Receptor KnockOut (FIRKO) mice have reduced fat mass, normal calorie intake and an increased maximum life span of 18%.
- The capacity of mammalian species to detoxify the carcinogenic chemical benzo(a)pyrene to a water-soluble form also correlates well with maximum life span.
- Short-term induction of oxidative stress due to calorie restriction increases life span in Caenorhabditis elegans by promoting stress defense, specifically by inducing an enzyme called catalase. As shown by Michael Ristow and co-workers nutritive antioxidants completely abolish this extension of life span by inhibiting a process called mitohormesis

Risk adjusted mortality rate

The **risk adjusted mortality rate (RAMR)** is a mortality rate that is adjusted for predicted risk of death. It is usually utilized to observe and/or compare the performance of certain institution(s) or person(s), e.g., hospitals or surgeons.

It can be found as:

RAMR = (Observed Mortality Rate/Predicted Mortality Rate)* Overall (Weighted) Mortality Rate

In medical science, RAMR could be a predictor of mortality that takes into account the predicted risk for a group of patients. For example, for a group of patients first we need to find the observed mortality rates for all the hospitals of interest. Then we can build/construct a model or use an existing model to predict mortality rates for each of the hospitals. It is expected that the number of patients in each hospital will be different and hence we need an overall (weighted) mortality rate for all these hospitals. Once we have the above three rates, then we can utilize the above formula to find the risk adjusted mortality rate which will reflect the actual mortality rate of a particular hospital without being biased from the observed mortality.

In the English NHS the Summary Hospital-level Mortality Indicator, the Hospital Standardised Mortality Rate and the Risk Adjusted Mortality Index are all used. The BBC produced a table in 2011 comparing mortality on various measures across all NHS acute trusts

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