

Mortality and lifespan (Major causes of death)

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Introduction

Death is the permanent ending of all bodily functions in an organism. More often, it will be thus a final consequence of more or less long process of damaging (degradation) of vital forces. To specify the factors that determine the rate of mortality, it is necessary to try to follow this process which conducts from health to illness and to death as medical predilection. Certainly, it is possible to count, that human organism is constructed to last in limited time and that each individual is biologically intended to die once in this exhausted time. But this process, guiding to death takes very much different sources, and the death hour can be removed meanwhile because of external events or human behavior.

Individual is not lonely in relation to environment; she/he is a part of a group which characteristics cause simultaneously his conditions of life and type of behavior. This implies a big variety of positions, both between the populations, and between groups that compose each population. Interpretation of these disagreements is complex task. The main reasons of a variety between individuals are distinctions on sex, social and cultural categories, and place of residence. This variety comes to light not only in space, but also in time. From background up to the modern person, epidemiological characteristics completely changed. Conditions of a survival of people have changed with ability of humans to adapt a nature which surrounds them. Human lifespan has increased enormously last century, and relative differences in mortality rates of compared populations vanish with age, and mortality convergence is observed due to the exhaustion of initial differences in redundancy levels. However biologists and demographers are not agreeing among them, because they are uncertain, about the forces that reduce mortality. The poor understanding of the factors driving mortality decline, and the difficulty to forecasting mortality is due in part to the pronounced irregularity of annual to decadal mortality change (Caselli & al.(2003), Dupâquier (1999), Thumerelle (1996), Livi-Bacco (1997), J-C Chesnais (1995)). Analysts have repeatedly thought that death rates were approaching biological limits and could not fall much farther. Even modest increase in the life expectancy requires dramatic biomedical advances.

The correlation between socio-economic and demographic evolutions was first reported by T. Malthus (1798) who considered that mankind was doomed to remain at near-starvation level that can never be truly won by any socio-cultural system as arithmetical

growth in food-production was marched by the geometrical increase in population. Since the researchers study the “demographic transition” of nations paying attention to different rate of mortality, fertility, immigration and economic growth.

1. Indicators of “mortality”, “life expectancy” and “life expectancy in health”

The most satisfying synthesis to empathize the mortality gap between countries consists in constitution of mortality tables and in estimation of indexes such as mortality rate, life expectancy and life expectancy in health. Mortality table is a table that indicates the number of individuals within a specified group of individuals (males, females, children, etc.), starting at a certain age, who are expected to be alive at succeeding ages. For example, a mortality table depicts the destiny of 10 000 individuals observed at birth. Each year the number of deaths and of survivors are registered and thus the time series of death $\{d(t, t+1)\}$ and of survivors $\{S(t)\}$ are constituted. A “mortality rate” is calculated by counting the number of dead persons on a given period and dividing that by the number of persons alive at the beginning of the period. For example, on fifth anniversary, there were 7316 individuals alive and 109 dies, which yields a mortality rate of $109/7316= 0.0149$. The mortality rate at each anniversary measures the risk of death before the next anniversary for persons that compose the given population. Limit age is situated actually between 105 and 110 years, and the mortality rate for this group of persons is equal to 1. The average age of deaths for population of every mortality table gives the “life expectancy at birth” or medium lifespan, equal to:

$$e_0 = \frac{1}{2} + \frac{S_1 + S_2 + \dots}{S_0}$$

One estimates also the “life expectancy at age t” equal to:

$$e_t = \frac{1}{2} + \frac{S_{t+1} + S_{t+2} + \dots}{S_t}$$

Thus an expected age at death is equal to age plus life expectancy at this age.

Accordingly to Gompertz law (1825) mortality rates increase at an exponential rate as age increases is examined (i.e. as an organism gets older, its chance of dying per unit of time increases exponentially). Nowadays, the authors propose to replace exponential adjustment by logistic one (Kannisto and al. (1994)).

Morbidity table shows the number of individuals exposed to the risk of illness, sickness, and disease at each age, and the actual number of individuals who incurred an

illness, sickness, and disease at each age. Health expectancy is a summary measure of the expectation of years of life lived in various health states. Disability free life expectancy summarises the expected number of years to be lived in what might be called the equivalent of “full health”. This indicator requires an analysis of social value choices such as the valuation of time spent in states of health worse than ideal health or the weighting of years of life at different ages. Presently it is the more used synthetic indicator measuring the overall level of health for population in a way that is appropriately sensitive to probabilities of survival and death. It is interesting also to quantify the health gaps that are the differences between the actual health of population and some stated norm, goal or biologically determined state, for example, survival in full health until age 100. The gap between this normative goal and current survival quantifies premature mortality.

2. Empirical evidence of mortality and lifespan

Population groups considered for the heterogeneity of lifespan and mortality are usually discriminated by age and sex and also accordingly to their ethnic, socio-economic and geographic states.

Life tables and overall mortality levels by age and sex were elaborated at the turn of the century for 191 countries by World Health Organisation starting with a systematic review of evidence from surveys, censuses, sample registrations, population laboratories and vital registration on levels and trends of child and adult mortality.

New millennium eve, in overall, 330 millions of people lived in African countries where the child mortality was high and adult mortality was very high. By contrast, 410 millions in Europe and 153 millions in Western Pacific lived in the countries where child mortality was very low and adult mortality low.

In 22 countries or areas, females have an average life expectancy at birth of at least 80 years. Japan (84 years) shows the longest life expectancy for women in the world, followed by China-Hong Kong region (82.6), France and Martinique (82.0), Switzerland (81.9), Sweden (81.8), Spain (81.6), Iceland and Norway (81.3), Australia and Italy (81.0), Canada, Austria and Guadeloupe (80.9), Finland (80.8), Netherlands (80.7), Belgium (80.6), Greece (80.5), Israel (80.4), Malta (80.1), and China-Macao region and Cyprus (80.0).

Fourteen countries or areas of the world reported that men are expected, on the average, to live 75 years or more. Japan and China-Hong Kong region recorded the longest life expectancy for males (77.2) followed by Sweden (76.7), Iceland (76.4), Israel (76.0),

Switzerland (75.7), Martinique and Norway (75.5), Netherlands (75.4), Greece (75.3), Australia and Singapore (75.2), China-Macao region (75.1) and Cyprus (75.0).

Life expectancies reported by countries in Africa remain lower than those reported by countries in other parts of the world. However, females in Algeria, Cape Verde, Libya, Mauritius, Réunion, and Tunisia have an expectation of life at birth in excess of 70 years. Average life expectancy for males is reported to be less than 50 years in 27 African countries or areas, and for females in 19 countries or areas.

Among the 25 largest countries, the gap in average life expectancy between women and men is largest in the Russian Federation (13.4 years), Ukraine (10.8 years) and France (7.8 years). The gap is the smallest in Iran (1.5 years), and India (0.6 years). In Bangladesh life expectancy for males exceeds that for females by 0.4 years.

It is possible to discriminate two basic types of the population reproduction. One of them is characterized by average and even low parameters of birth rate. Both low parameters of mortality rate and stabilization of population growth provoke so called "demographic winter", which characterizes essentially economically advanced countries of the world. There are twenty-eight countries whose fertility is below the level of replacement of the generations. The appreciation of fertility is estimated as "too low" in seven countries Armenia, Austria, Cheque Republic, Italia, Lithuania, Poland, and Spain. All Anglophone countries and all the Scandinavian countries, as well as Belgium, the Netherlands, and three nations of Central and Eastern Europe: Slovenia, Yugoslavia and Moldavia estimate that the level of their fecundity is low, but satisfactory.

Another type of the population reproduction is characterized by very high birth rate, reduction of mortality rate and as consequence by sharp natural increase of population, called "demographic spring" or "population explosion". In the sub Saharan countries the population aged less than 14 years represents 36% and only 17% in the OECD countries. In some cases the state may take measures to reduce the population growth. For example, in China, in the biggest country of the world in terms of population carried out specific demographic policy, and the natural increase has decreased with 28 %? up to 11 %? becoming even lower than world average, equal to 23 %? (in that number developing region average is of 26%?, and in advanced - 11 %?). Birth rates are dissimilar in large regions (continents), but also between the states included in them. For example, in Asia the average birth rate makes 26 %?, including the highest (44%?) in Oman and Yemen and the lowest (10%?) - in Japan. Similar

position is observed in Africa where birth rate is equal to 40 %? with variation between 51%? in Mali and Angola and 17%? in Mauritania.

Regional life healthy life expectancies at birth are ranged from a low 37 years in health for African males to a high at almost 70 years in health for females in the low mortality countries of mainly Western Europe. This is approximately two time difference in healthy life expectancy between two contrasting regional populations in the world. In Russia, healthy life expectancy was 66.4 for females, three years below the European average, but just 56 years for males, seven years below the European average. It is a consequence of increase in adult male mortality in the early 1990s. Indeed from 1987 to 1994 the risk of premature death increased by 70% for Russian males. The bottom ten countries are in sub-Saharan Africa, where the HIV epidemic is increasing dramatically. Life expectancy in this area has been reduced 15-20 years in comparison to life expectancy without HIV.

3. Principal causes of health decline and mortality

Healthy societies are those, where the population benefits of: Physical health, made possible due to genetic predispositions, favourable work conditions, home safety, recreation possibilities; Social health, communication and interaction abilities, support assistance; and Mental health (activities/roles, cognition, emotional status, self-esteem,...)

At the present time the curable causes of death are:

- Diseases and injuries
- Impairments and disabilities
- Physiological and pathophysiological
- Behaviour and environmental
- Structural (Access to health care, for example)

Analysing the disease regional burdens three categories of diseases and injuries are usually distinguished:

- 1) Communicable diseases: infectious and parasitic, respiratory infections, maternal conditions, perinatal conditions and nutritional, bringing about 31% of fatality in the world;
- 2) Noncommunicable diseases: malignant neoplasm, other neoplasm, diabetes mellitus, endocrine, neuro-psychiatric, sense organ, cardiovascular, respiratory, digestive,

genito-urinary, skin disease, musculo-skeletal, congenital abnormalities and oral; explaining nearly 60% of deaths;

- 3) Injuries: unintentional (motor vehicle accidents, poisoning,...) and intentional (war, homicide, self inflicted) causing more than 9% of deaths in the world.

Younger people are most likely to die from infections and acute conditions and older people are most likely to die from chronic and degenerative illnesses and their complications. Therefore the aging of society means that in the population as a whole there is a relative increase in the importance of chronic and degenerative illnesses.

There is discernible contrast in epidemiological patterns between rich and poor regions. Thus in the more developed countries, the share of disease problem due to communicable, maternal, perinatal and nutritional conditions is around 5%, it is 70-75% in Africa. Specially, the leading cause of death in Africa is infectious and parasitic illnesses and first of all HIV diseases, causing in the group of worst situation 28% of deaths, more than all noncommunicable diseases fatal for 20.2% of population in this continent. For more comparison, in this group of countries homicide and violence cause 1.2%, and wars less than 1% of deaths.

By contrast, in the groups of the healthier populations the principal causes of fatality are noncommunicable illnesses such as: cardiovascular diseases (principal cause for Americans (Cuba, USA and Canada) and European countries, with 41.1% of fatality, and countries of Western Pacific with 35.1 % of fatality), and malignant neoplasm (respectively 26% in certain European countries and 30% of fatality in Western Pacific). Remarkably, the fourth leading cause of death in Europe is road traffic accidents.

In the countries of Eastern Mediterranean and in South Asia the principal causes of deaths are cardiovascular diseases, infectious and parasitic, respiratory infections, perinatal conditions and unintentional injuries.

4. Lifespan and health – wage - retirement assignable programs

Over the past century science has made regular progress against disease and death, and given the dramatic biomedical advances for humans in recent years, it would be risky to bet the long-term affects of demographic trends on budgets, on fiscal policy, on Social security, and on Medicare costs.

Policy targets will be differentiated depending on fertility, mortality and immigration trends in populations. The industrialised countries face principally the problem of ageing of

their societies. For seven most economically developed countries the authors (Tuljapurkar and al (2000)) forecast values of the dependency ratio (that is, the ration of people over 65 to working people) in 2050 that are between 6% (UK) and 40% (Japan). In developing countries the main objective is prevention and care of the communicable diseases.

Longer life results in part from genetic factors and from the timeliness and costs of preventive health care. For many years, it was feared that people whose lives were saved by declining mortality might be functionally impaired, so that disability rates at older ages would rise. This stems from Medicare projections which use age as an indicator of health status. Increasing in longevity is assumed to augment demand for health care as individuals survive to older and higher use ages. An alternative approach assumes that the higher Medicare use and costs are associated with the final decade of life at any age. This viewpoint yields significantly lower cost forecasts.

Some troubles come into sight when one analyses the results of self-reported data on health status or perceived health from surveys of particular populations. For example, Sadana & ali (2000) constructed a guess of population health by asking persons if their faculties such as: cognition, communication, dexterity, mobility, pain, vitality, sexual activity, fertility, vision, or speech are satisfactory or not. The study concludes with surprising findings: As per capita GDP *rises*, the average level of self-reported health gets *worse*. For instance, the comparison of France with Russia shows that wealthier country France, spends much more resources on health (2,125 \$ in France and only 251 \$ in Russia), and presents the best figures of disability free life expectancy in Europe 73.1 years (and only 61.3 years in Russia, worse situation in Europe, in 1997), but is in worse situation than Russia according to perceived health level. Indeed, the striking evidence between the two countries is that in France the female health level is only of 58% and 59% for males. In Russia, the levels are respectively of 60% and 63% at the same age. By comparison, the physical condition of surveyed population in China was at the level of 98%. Therefore, it is important to make sure that increase of quantity and quality of health services is growing in a way consistent with individual and social preferences, not simply because of distortions arising from the structures of institutions formed at previous periods. Nowadays, older people become functionally able to prolong their working lives, but capability to do it depends on their perceived health. People may choose to take their additional years of life as retirement years rather than as working years, and consequently societies may need to save more to support those additional years of retirement. The new employment insurance should cover to some extent the risks related to the erosion of

the previously institutionalized employment relationship. Working time preferences are shifting and becoming contingent on phases of life-cycles, family situation, educational plans and disability. The active policy to assume the Transitional retirement regime due to ageing consists in finding at short term institutional responses for three types of types of problems:

- adjustments between taxes and replacement benefits assuming equilibrium of financial system;
- creation of provision funds assuming the transitional way to new system of taxes;
- bargain efficient combination between retirement by capitalisation and by repartition

Yet longer life does not cause a fundamental resource problem at long term. By contrast, lower fertility means there are fewer working-age people in the population relative to the elderly, without altering the health or functional status of the elderly. Population aging due to low fertility does fundamentally alter the resource constraints facing society. To avoid the low fertility cause of ageing process the pro-natalist and pro-immigration policies might be initiated.

5. Premature mortality and cultural – knowledge assignable programs

Traditionally one considers that, survival rate in developing countries reflects the level of nutrition, smoking prevalence rates, infectious diseases, health infrastructure and general poverty and economic deprivation. Although, Amartya Sen (1998) shows that life expectancy has a significantly positive relation with economic growth of nations mainly if this growth is conducive to the incomes of the poor people increase and of public health expenditure increase. More, he points out the defects in basic education, and especially in woman (mothers) education in some developing countries. Indeed, the support-led process without fast economic growth provided remarkable longevity and favourable demographic structure for future development in Cuba than do the people of other Caribbean country Haiti. In Haiti adult literacy keep on 49% and life expectancy is of only 53 years. Age groups repartition is: youth to instruct 40.5% in a charge of active population - 55%, as for population aged 65 and above, it represents 3.5%. In Cuba adult literacy is at the level of 97% and life expectancy of 76 years (23 year more than in Haiti), active population 69%, youth represents 21%, and population aged 65 and above 9.3%. Moreover, Cuban scientific advantage and especially in bio-technology may and certainly will improve the health of other developing countries for

solidarity reasons, and also because relevant social services this country developed, are very labour intensive, and thus are relatively inexpensive in this low-wage economy.

At short run, the international organisations, using, Australian, European and USA experiences, may initiate:

1) Health information management and dissemination toward developing areas, since:

Decline in deaths from coronary heart disease and stroke have resulted from risk-factor modification, such as smoking cessation.

Healthier mothers and babies have resulted from better hygiene and nutrition, availability of antibiotics, greater access to health care and technologic advances in maternal and neonatal medicine.

Access to family planning and contraceptive services has modified social and economic roles of women. Family planning has provided health benefits such as smaller family size and longer interval between the birth of children; increased opportunities for preconception counselling and screening; fewer infant, child, and maternal deaths; and the use of barrier contraceptives to prevent pregnancy and transmission of human immunodeficiency virus and other STDs.

and 2) Research policy and cooperation.

Work-related health problems, such as coal workers' pneumoconiosis (black lung), and silicosis - common at the beginning of the 20th century in Europe - have come under better control in this continent. Severe injuries and deaths related to mining, manufacturing, construction, and transportation must be decreased in developing countries. Empirical evidence is that safer workplaces have resulted in a reduction of approximately 40% in the rate of fatal occupational injuries in Europe, USA and Australia.

Control of infectious diseases has resulted from clean water and improved sanitation. Infections such as typhoid and cholera transmitted by contaminated water, a major cause of illness and death early in the 20th century, have been reduced in healthier countries by improved sanitation. In addition, the discovery of antimicrobial therapy has been critical

to successful public health efforts to control infections such as tuberculosis and sexually transmitted diseases.

Since 1900, safer and healthier foods have resulted from decreases in microbial contamination and increases in nutritional content. Identifying essential micronutrients and establishing food-fortification programs have almost eliminated major nutritional deficiency diseases such as rickets and pellagra.

Finally, the two main responses which have been given to assume healthy lifespan that are: the fighting against degenerative diseases in economically developed part of the world with ageing population, and the monitoring of sanitary programs for the areas of the world with young, but less healthy population, can be questionable for the future. In fact all of us might be faced to a single problem – new pandemic risks. The development of bio-medical researches in this field is the challenge for next years.

See Also:

Community health and medicine; child welfare policy; drug policy; ethnic indigenous persons; health policy; inheritance; occupational health and safety; pensions; preventive health; psychological health and welfare

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