

Demography: Scope, Perspectives and Theory

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The term “demography” has been widely used in English-speaking countries only from the mid-twentieth century. Earlier, “population studies” or, revealingly, “population problems” had been the common usage. There is still an inclination to restrict “demography” to the analytical methods used to analyze population data while employing “population studies” or “population science” for wider subject matter covering, in addition, the causes and consequences of demographic change.

Interest in the size and growth of populations is as old as the first state formations in the ancient Middle East and some attempts to count or estimate population numbers go back millennia. State strength was dependent on population numbers, especially those males of military age, and a good government was one under which numbers increased because of the suppression of violence and success in averting famine. There have long been attempts to place a figure on the number of deaths during severe epidemics. Censuses and the recording of deaths were carried out in some of the city-states of Renaissance Italy. Birth rates were treated as either constant or meaningless and little attempt was made to measure them until shortly before the recent fertility transition.

Modern demography had to await the development of a scientific outlook and counts of population and vital events that were reasonably complete. These conditions began to be realized during the second half of the seventeenth century in Britain, where the Royal Society was founded in 1660 with two of the fathers of demography, John Graunt (1620-74) and William Petty (1623-87) as members. Graunt was a merchant and used bookkeeping principles to construct the first life table, drawing data on

mortality from the records of deaths in London, which had been compiled since the previous century. Petty described this activity as “political arithmetic” (Kreager 1988: 134), a term regarded as being so appropriate by Lancelot Hogben that in 1938 he published a book under that title on the demography of contemporary Britain. Edmond Halley (1656-1742) constructed in 1693 a life table much closer to the modern model with more complete data on the deaths and population of the German city, Breslau. Kreager (1991: 209) identifies Graunt, Petty and Halley as the first persons to apply scientific principles to the study of society. All were consciously influenced by the work and scientific principles of Francis Bacon (1561-1626) and were well aware of the value of scientific laws as evidenced by the work of their fellow Royal Society member, Isaac Newton (1642-1727) in his *Principia Mathematica* (1687) (edited by and published at the cost of Halley).

These demographic pioneers’ work bore the same characteristics as those of their successors today.

1. It was dependent on data having come into existence at the whim of others, usually governments, for other purposes (e.g. the London Bills of Mortality were a means of detecting epidemics, principally plague).
2. Much of the labor was spent not on making immediate deductions from the numbers but on suspiciously testing the data and trying to improve them. This central assumption that the raw data are almost certainly imperfect sets demographers apart from most social, medical and statistical scientists.
3. Demographers are deeply sensitive to the fact that crude numbers or measures may be misleading, owing to such factors as the age and sex structure of the population, and they are given to devising measures that will overcome the distortions and allow valid comparisons.
4. There is a concept of a population, a large body of people constituting some kind of definable unit to which the measurements pertain.
5. That attention to large populations, often national ones, explains why demographic “arithmetic” is political. Often, indeed, its practitioners wanted to gauge the health of the body politic and even to point the direction of improvement. Such policy involvement did not become controversial until the

twentieth century when controversy arose, first over focusses on migrants and differential fertility in response to the eugenics movement, and later over research appearing to support the call for a curb on Third World fertility (cf. Hodgson 1983; Szreter 1993).

6. Demographers are suspicious of the study of individuals and small groups, feeling that such persons are significant only when it can be shown what fraction of a larger population they constitute and even then that the fraction is of a considerable size.
7. Demographers look for regularities in populations or subpopulations and for contrasts between subpopulations: Graunt showed urban-rural differentials in mortality, as well as male-female differentials in both numbers born and subsequent mortality.
8. From the beginning there has also been an interest in causation (Graunt examined the causes of death), but there has, at the same time, been a suspicion that measures of causes were more likely to be in error than measures of population or death.
9. Until the nineteenth century in France and the twentieth century elsewhere mortality and population growth dominated demographers' interests; fertility became of interest only when birth rates began to decline and the major concern only during the 1960s-1980s, when interest focussed on the beginning of fertility decline in developing countries (Caldwell 1996: 324).
10. Demography has always been an empirical discipline maintaining almost uniquely nineteenth-century positivist attitudes throughout the twentieth century. Most demographers have been happy to carry out analyses within a minimalist theoretical framework and have been deeply suspicious of disciplines which built theoretical structures upon unproven, theoretical bases (Caldwell 1996: 310-314). They have preferred intermediate or short-range theory to grand theory.
11. Nevertheless, the population field has also given birth to grand theory, associated with such names as Thomas Robert Malthus, Arsène Dumont, Frank W. Notestein, Thomas McKeown, Ester Boserup and Philippe Ariès. They have set up frameworks which have consciously or unconsciously generated much of

the shorter-range research, and have made the subject known beyond its practitioners.

12. Once demographers had established the usual levels of mortality and fertility they became interested in change, especially once the demographic transition was under way. Modern demography has not only a population base but also a time dimension. There is hardly a major demographic study in the twentieth century in which change over a period (usually of years) is not important.
13. Demographers, in contrast to epidemiologists, are usually concerned with total mortality decline, and are suspicious of approaches singling out advances in treating specific diseases, and of any attempt to treat total mortality decline as the sum of individual medical breakthroughs. When they do trace mortality changes from one cause, they usually want to see what has also happened to mortality from other causes.

On the empirical side, demography made only limited progress during the eighteenth century. The reason was the failure of national censuses or vital registration systems to appear. The foremost demographic thinker of the age was Johann Peter Süßmilch (1707-1767), who, in his search for the divine order (not very different from later concepts of the natural order, or from ideas embedded in the work of Adam Smith and Malthus), examined masses of demographic data searching for regularities, discerned the balance of births and deaths (later to be termed “homeostasis”), and produced a life table which was used for actuarial purposes well into the nineteenth century (Schubnell 1959; Hecht 1987).

Sweden set up a system of population registers in the mid-eighteenth century, mandated by a 1748 Act. This allowed Per Wargentin to produce the first data-based national life table in the world for the years 1755-57 (Dorn 1959: 437-438). The United States decennial census, necessitated by its constitution for electoral purposes, was first taken in 1790. Britain followed in 1801, and in 1837 the registration of births and deaths was made compulsory in England and Wales.

The stage was being set for the rapid growth of demographic studies in Britain and other parts of Northern Europe in the second half of the nineteenth century. The most important single body of research was that on differential mortality by socio-economic class inaugurated by William Farr (1807-1883) in a supplementary report on the 1851 census and continued over six decennial censuses. Such work was not paralleled in the United States because of State responsibility for vital registration, with the result that the US Death Registration area, covering those states with satisfactory complete registration, expanded from 1880 until national coverage was achieved in 1933 for both births and deaths. Population registers, or, more commonly, the combination of censuses and registration systems, have remained the central mechanisms for studying demographic change. For contemporary studies they have been supplemented by sample surveys, facilitated by the computer revolution, and for historical studies by the painstaking examination and linking of parish church records, especially in France and Britain. In France and Geneva village studies have yielded data from as far back as the seventeenth century while E.A. Wrigley and R.S. Schofield (1981) have reconstructed English population history from 1541 to 1871.

Demography has maintained its primary focus on population, births and deaths. All are definable within a fairly high degree of precision, a criterion about which demographers feel strongly. Interest has swung from mortality to fertility largely in accord with how the levels of each are changing. There has not been the same attention to health or morbidity. In fact, when demographers purport to write on health, most of their output is usually on mortality change. One reason is that these conditions cannot be defined exactly, a situation which has been worsened by WHO's all-inclusive definition of "good health". Another reason is the source of data. If demographers work alone through censuses or surveys, they must depend upon self-diagnosis or the reporting of symptoms by respondents, and such reporting is often inaccurate and varies by such characteristics of the respondents as education. Surveys can sometimes coopt medically trained persons but diagnosis in the field is difficult and the employment of pathology testing usually limits the size of the survey. The alternative of using data from hospitals or doctors' surgeries goes far toward destroying the concept of a "population" which is basic to the way demographers see

the world. Similarly, migration has remained a specialist, and somewhat marginal, concern, even though, in an open population, it is the additional process to fertility and mortality that explains population change. There is no simple measurement, and indices of migration are affected by definitions of the number of movements to count and the distance and timing of movements. Marriage, too, has not been enthusiastically embraced, partly because definitions can be questionable. It has been employed mostly in the explanation of fertility levels, as in the Princeton European Fertility Project and in John Bongaart's formulae. These procedures are simplest when nearly all fertility occurs within marriage as in the Princeton Project's work on historic Europe or in contemporary studies of much of Asia and North Africa.

This paper will discuss the contribution of demographers to understanding demographic change and propounding theory based on those changes, mostly in terms of mortality, but there will also be passing reference to fertility.

Demographic change

Demographers' interests and theories are dependent not only on data but on clear patterns or changes revealed by the data. Mortality data revealed two different kinds of phenomena. The first was a pattern of mortality differentials existing long before mortality transition and assumed to be stable. The British seventeenth-century investigators found differences in death rates by age, sex and urban-rural residence. During the eighteenth century, observers became increasingly convinced that there were also socioeconomic differentials: the poor, especially during early childhood, being more likely to die than the rich. It had also always been known that mortality evidenced periodic surges as epidemics or famines ravaged populations. Indeed, that was the original reason for attempting to collect death statistics. It was also known that these factors interacted: the fourteenth-century story-tellers in Boccaccio's *Decameron* had left Florence to lessen their chance of being infected by the plague.

Wrigley and Schofield (1981: end pullout) show that in England the great mortality peaks did not recur after the middle of the eighteenth century. This is not synonymous with mortality decline, and it was to be generations before there was

certainty about the existence of a secular trend toward lower mortality and higher life expectancy. In England life expectancy was fairly constant from 1826 to 1871 at just over 40 years, around 1.5 years above the level during the first quarter of the century or the level in the late sixteenth century. There was no proof here of major change (Wrigley and Schofield 1981: 528-529). Greater change did come during the last three decades of the nineteenth century so that by century's end life expectancy was 47 years and there was a realization that mortality was falling and an expectation that it would continue to do so. Neither Tom Paine, writing toward the end of the eighteenth century, nor Karl Marx, writing up until the early 1880s, saw a major mortality decline as an aspect of mankind's future experience. In contrast, Alfred Marshall's *Principles of Economics*, published in 1890, took the decline very seriously (Caldwell 1986a: 31).

The mortality transition had, at least until two-thirds of the way through the twentieth century, certain striking characteristics. In Sweden, for which there is the longest series of reliable statistics, the marked declines occurred among the younger population, although they were by no means confined to infancy. By 1965 age-specific death rates among infants were six percent of the level in 1780, one percent among 1-4 year-olds, three percent among both 5-9 and 10-14-year-olds, ten percent among 30-34-year-olds but over 40 percent among those over 60 years of age (P. Caldwell 1996: 610). During this 185-year period both male and female life expectancies doubled, females' expectancies remaining 67 percent greater than males, although, in absolute terms, increasing from 2.5 to 4.4 years. Alter and Riley (1989) claimed that in England morbidity rose as mortality fell, and offered a "frailty" explanation.

Mortality transition is classically pictured as occurring decisively before fertility transition begins. In the West the picture is less clear than this. Except in France, and possibly the United States, marital fertility decline began in the last third of the nineteenth century. In England and Wales mortality fell by about one-sixth between 1870 and 1900 and so did the total fertility rate. Other Western countries were not dissimilar. It is clearer that fertility transition theory was to achieve a robustness that

mortality transition theory did not attain. Part of the explanation is that the fertility decline was seen as a solely behavioral phenomenon.

By the 1970s a new stage in the mortality transition was becoming evident. It became clear that significant gains against mortality among older populations were being achieved (Myers 1996:87). In 1982 Lopez and Hanada (p. 218) looked at mortality change among populations over 60 years of age in developed countries, and, dividing each country into separate male and female groups, showed that in almost one-third of groups, the 25 years, 1950 to 1975, had witnessed greater mortality decline than the 50 years from 1900 to 1950. In Australia, Canada and Sweden a decline in mortality from heart disease was mainly responsible, but in Japan and France a greater decline was attributed to stroke. The two diseases explained around 80 percent of the decline in old-age mortality. Explanations were slow in coming, as were quantitative descriptions of what exactly was happening; Myers (1996: 110) commented: “Whether this prolongation [of life] results from delayed onset of diseases or postponed case fatality is a major research issue facing demographers, epidemiologists, and health scientists”. Attempts to gather demographic and other data on aging were quicker to start; the Duke, Seattle and Baltimore Longitudinal Studies began recording cohort experience in 1955, 1956 and 1958 respectively (Krausler and Krausler 1996).

The final success of the mortality transition has aggravated but not caused the problem of high aged-dependency levels. The main engine in increasing the proportion of the aged has been the fertility decline. If we take the case of a representative English-speaking overseas-settlement country attaining a stable population structure at 1870 levels of vital rates and again at present-day rates, we get the following picture (calculations from Coale and Demeny 1966, West Model). In 1870 with a gross reproduction rate of 3.0 and life expectancy at birth of 47.5 years, then only 2.8 percent of the population would be over 65 years of age. If stable population structure were to be achieved at present levels, a gross reproduction rate of 1.0 and life expectancy of 77.5 years, 19.0 percent of the population would be over 65 years. Four-fifths of the rise in the proportion of old population is explained by the

fertility decline and only one-fifth by the mortality decline. If fertility had remained constant over those 130 years but the same conquest of death had been achieved, the proportion of the population over 65 years of age would have risen only from 2.8 to 5.2 percent.

It might also be noted that demographers are very good at working with defined categories. But they tend to regard such categories as equating with reality, and they are usually poor at discerning underlying reality. They can accept Otto von Bismarck's 1889 definition (for pension purposes) of "old" meaning 65 and over years of age, without worrying that the same definition today might not mean the same socially, physiologically or actuarially. They know (but often do not appreciate that their readers do not understand) that life expectancy is a cross-sectional annual measure, a good index but saying little about actual life experience. Dublin *et al.* (1949: 174-182) calculated that the life expectancy of persons born in Massachusetts in 1890, according to the usual way of computing life expectancy from 1890 vital rates, was 42.5 years for males and 44.5 years for females, but, in the real world with improving health during subsequent years, males actually averaged 46.7 years and females 50.3 years.

What explanations, then, do demographic theorists have to offer for this stupendous event, a doubling of life expectancy in the West since the beginning of the nineteenth century? How does the theory relate to the analytical work performed by most demographers?

The theory of mortality transition

For most of human history the chief explanation for mortality decline has been good government in the sense of strong governments that kept the peace, suppressed internal disorder and violence, avoided or mitigated famine, and attempted to mitigate the worst excesses of epidemics. In much of the world this explanation is even now not completely redundant. Early attempts to record mortality were aimed partly at providing an index of good government.

Much of the world believes that the whole mortality transition is little more than the victory of modern medicine, a view seemingly receiving support from spectacular mortality declines in developing countries during the second half of the twentieth century. Colin Clark maintained this view as late as 1967: “the significant decline in mortality...clearly began about 1759 [and] was due to medical improvements, due to better knowledge and application of medical science” (Clark 1967: 49). There is a gray area in the arguments of Clark and others, and that is an ambiguity about the extent to which they include sanitary engineering in their definition of modern medicine.

In contrast most demographic and social theory attributes a good deal to economic and social change, often downplaying the role of modern medicine even in recent decades. Most demographic theory of mortality decline can be divided into two camps: those emphasizing rises in living standards, especially nutrition, and those placing a significant emphasis on social and behavioral change. The latter group can again be subdivided according to the extent that a key factor in behavioral change is thought to be cooperation with modern medicine.

Resource theory

Malthus (1959), in his 1798 *Essay*, and its subsequent editions, succinctly stated the resource hypothesis. Population tends to grow faster than additional food can be supplied for it, and hence, unless reproduction is held down to the rate of growth of food by late or forgone marriage, some members of society will have lives shortened by starvation or more commonly by maladies arising from malnutrition. In a class society this will occur mostly among the children of the poorest class that is inclined to aggravate the situation by imprudent marriage (cf. Malthus 1960 [1830]: 32-36). Malthus's theory as first postulated was an explanation not of mortality decline but of long-term population homeostasis, and the concepts of a Malthusian ceiling and a Malthusian equilibrium have been valuable to historical demographers. However, Malthusian theory can be turned into an explanation of secular mortality decline in two ways toward which Malthus moved in later editions of the *Essay*, either by food supplies outstripping population growth (because of an agricultural revolution or the

large-scale import of food) or by even the lowest class exercising greater prudence over marriage as a result of increasing civilization (perhaps one can include education here). Three further points are important. The first is that Malthus appeared to hold that mortality as a result of malnutrition tended to rise only among the very poor and not that better nutrition could cause a mortality decline across most of society. The second is that, no matter how much Malthus detested the practice of contraception, his theory provided an excellent framework for arguing that the poor could reduce their children's mortality by marrying and deliberately thereafter limiting family size. The third is that Malthus's theory is also one of behavioral change in that deliberate decisions about marriage and reproduction could reduce the population pressure on food supplies with the consequence of declining mortality.

Thomas McKeown's theory (for its final form, see McKeown 1976) is a direct descendant of that of Malthus. In a series of papers from the 1950s to the 1970s he argued that modern medicine had little potential for reducing mortality until the mid-1930s and hence that the earlier mortality decline must have been the result of rising living standards, mainly nutritional ones. He argued that mortality had declined most in the case of tuberculosis and other airborne diseases and hence that water purification must have played only a small role. Most demographers writing on McKeown's ideas have done so critically, arguing that his method of emphasizing nutrition as the residual category was unscientific, that his grouping of causes of death was faulty, and that he underemphasized the impact of sanitary interventions and of housing and fresh-air legislation (cf. Szreter 1988). A.R. Omran's 1971 paper, "The epidemiologic transition: a theory of the epidemiology of population change", completely adopted McKeown's explanation for the decline in "pandemics of infection".

Somewhat surprisingly, at least to demographers, the improved-nutrition explanation for the mortality transition has received a powerful boost during the 1990s from the work of R.W. Fogel and his colleagues. Fogel (1997), drawing heavily on Wrigley and Schofield (1981), and amassing statistical data as he did for *Time on the Cross*, argues that the mortality decline was a product not of the elimination of the great

mortality crises, which explained only six percent of all historic mortality, but of general mortality. He uses food consumption figures starting with France in 1785 and England in 1790 to compute average calorie consumption in an approach called “energy cost accounting”. This approach supports Malthus by showing that in both countries the per capita calorie consumption of the lowest decile of the population was a little over one-third of that of the highest decile. He points out that the average French intake in the late eighteenth century (about 85 percent of that of the English) was above that of contemporary Pakistan (and, he could have added, Sri Lanka), Rwanda and Algeria. He concludes that “Improvements in the average nutritional status (as indicated by stature and body mass indexes) appear to explain about 90 percent of the decline in the mortality rates in England and France between the last quarter of the eighteenth century and the third quarter of the nineteenth century, but only about half of the mortality decline between the third quarter of the nineteenth century and the third quarter of the twentieth century” (Fogel 1997: 470-471). He argues further that much of the impact of malnutrition has occurred by three years of age with the result of higher mortality over the rest of the lifetime and concludes that the better infant and toddler feeding that the baby boom generation received in the 1950s and 1960s, compared with the cohorts born during two world wars and the economic depression of the 1930s, means that we can project future old-age mortality to fall sharply (Fogel 1997: 472).

Demographers have not yet had time to dissect Fogel’s work, and indeed most of his detailed research is not yet published. The findings do give cause for some misgivings. They imply for England that of the 6.5 years gain in life expectancy between 1787 and 1887 only two-thirds of a year can be attributed to vaccination, better clothing and housing, improved sanitation and rises in educational levels. They imply that Pakistan’s and Sri Lanka’s contemporary diets would warrant them a life expectancy of only 35 years and that the additional 23 and 37 years respectively are almost entirely a product of modern medicine. They imply that in 1962 English life expectancy would have only been 57 years but for the development of sulfa drugs, penicillin and other medical advances, and that, without them, it probably would now be 60 instead of 77 years of age.

The complete negation of Malthus's views is provided by Ester Boserup (1965). She argued in her *Conditions of Agricultural Growth* that the Malthusian collision between population and food did not exist. Population burst through every food-imposed ceiling by adapting the means of food production to a more intensive system of cultivation. She regarded mortality levels as being capriciously determined by the accidental presence of disease or epidemics. A much more likely scenario would seem to be that populations were usually at the Malthusian ceiling, with malnutrition keeping up mortality levels, but that occasionally and in some places innovations in cultivation allowed a breakthrough in population numbers to a higher ceiling.

Social and behavioral theory

The idea that human beings do not merely play a passive role in determining their own and others' health and survival has a long history. The Mother and Child movements of the beginning of the twentieth century were based upon that belief. Classic demographic transition theory, as epitomized by the writings of Notestein (1945, 1953) regarded fertility choice as being impossible until the fatalism and control structures of the traditional family were eroded, and much the same postulate can be made about health or mortality choice. This field has come to be called "health transition" (Caldwell and Santow 1989; Caldwell *et al.* 1990a).

In traditional agrarian families the psychological and social context of decision-making is radically different from that found in the modern market economy. The family was so structured that emotional and economic flows went upward from the young to the old as described in "wealth flows theory" (Caldwell 1976, 1982a, b). During the mortality transition, child mortality fell much more rapidly than did old-age mortality, doubtless chiefly the result of the conquest of childhood infectious disease, but probably owing something to the priorities in family attention changing from the old to the young (cf. on this change, although with fertility as its focus, Ariès 1962). The traditional agrarian family was organized like a firm so as to maximize production and stability. The daughter-in-law was discouraged from giving too much attention to the health of her children (although she was blamed if they died) and

forbidden from harnessing her husband into a dyad to focus on their children (Caldwell and Caldwell 1992).

Simons (1989) has argued that, as modern individualistic and secular society developed, two health-relevant processes intensified. The first was a conviction that death was qualitatively different from all other experience, and should be avoided at all cost. The second was the growth of a commitment to survival: a belief in personal responsibility for taking all possible action to ensure the survival of one's children, one's spouse and oneself. In traditional families it was presumptuous for the younger generation to take such actions even with regard to themselves or their own children. Such theory developed from findings that societies fashioned parents to have very different levels of child mortality even when they had equal access to health facilities. The first discovery was that child mortality in developing countries fell steeply as the education of parents, especially mothers, rose. This finding proved to be true in practically every society in which World Fertility Surveys and Demographic and Health Surveys had been conducted (Caldwell 1979; Farah and Preston 1982; Hobcraft *et al.* 1984; Cleland and van Ginneken 1988; Cleland 1990; Bicego and Boerma 1991; Hobcraft 1993; Sandiford *et al.* 1995). The second discovery was that the different cultures in plural societies had very different levels of child mortality even when income, parental education and access to health services were controlled (Mensch *et al.* 1985). Clearly there were strong social and behavioral influences on survival. The picture was rendered more complex by Preston and Haines (1991: 201-202) establishing that maternal education in the United States around the end of the nineteenth century had only one-quarter to one-half the impact on child mortality that it does in the contemporary Third World. One reason may be that medicine had less to offer a century ago, but another reason may well be that modern medicine works best when the patients or their parents cooperate most fully with it. Such cooperation needs a belief in science and modern medicine which was part of turn-of-the-century America but is imparted to Third World populations in proportion to their exposure to imported Western education (Caldwell 1991: 224-227).

These findings have been extended in two ways. The first is the demonstration that an individual's own survival in both developing and developed countries is strongly influenced by his or her education. Adequate data sources are not easy to find, but The International Centre for Diarrhoeal Disease Control, Bangladesh has at Matlab a Demographic Surveillance System suited to the task. Employing these data, Duffy and Menken (no date) showed that there were three significant factors determining the survival of females over a 20-year period: their age, health status and education at the beginning of the period. We also now know for a range of countries in Europe and for America that mortality falls as education rises (Valkonen 1989; Vågerö and Lundberg 1995; Preston and Elo 1995; Rogers *et al.* 2000). This is particularly the case with regard to deaths by violence, but is also marked with regard to circulatory ailments (which contribute most of the decline on a population basis) and respiratory disease. However, even in the case of cancer, and even in Norway with its national health service, mortality is 15 percent lower among those with post-secondary education than those with incomplete secondary schooling (Kravdal 2000). The second is the argument that female education was merely the most easily measured aspect of a larger concept, female empowerment, and that it was the relative position of women that allowed mothers to reduce the mortality of their children (cf. Caldwell 1986b).

Modifying the attack on health interventions

Razzell (1974) argued that McKeown had underestimated the impact on eighteenth-century mortality of the introduction of smallpox immunization, long used in the Ottoman Empire. He also believed that a richer, more sophisticated and more individualistic society had become cleaner and perhaps more hygiene-conscious, and he related increasing per capita soap consumption in the period 1800-1840 to a decline in mortality from "dirt diseases": gastroenteritis, typhoid fever, dysentery, relapsing and trench fever, and typhus.

McKeown had not always been clear whether he treated the sanitary revolution as part of medical intervention or as important, but, if not, it certainly had a claim to be treated as a rival to nutrition for explaining late nineteenth-century mortality decline.

The problem was that perhaps 60 percent of the nineteenth-century Western European mortality decline had occurred during its final three decades, 1870-1900. By 1870 the treatment of water supplies was well under way and there were some improvements in sewage disposal. Preston and van de Walle (1978) showed that the advent of treatment for water supplies in French urban areas was associated with falls in the death rate. Szreter (1988) argued that in Britain the contribution of housing and crowding laws, building regulations and municipal water and sewerage programs had been greatly underestimated. He concluded that “the decline in mortality, which began to be noticeable in the national aggregate statistics in the 1870s, was due more to the politically and ideologically negotiated movement for public health than to any other positively identifiable factor” (Szreter 1988: 26). Johansson and Mosk (1987) showed that Japan in the last decades of the nineteenth century had made the policy decision to import the new Western public health policies and technology with the result that by 1900 its life expectancy had almost caught up with that of Britain and Italy. They argued that the Japanese had demonstrated that “above a certain minimum standard of living threshold, the ‘right’ to live to old age can be secured for the average citizen, even in low-income developing countries, if the government is dedicated to the efficient exploitation of existing public health technology and the population is educated and cooperative” (Johansson and Mosk 1987: 235).

McKeown had made it clear that he was addressing the period before sulfa drugs and antibiotics. Nevertheless, there have been those who saw the thesis as relevant to the contemporary Third World, arguing that modern medicine was too unsuited to conditions in those countries to have had much of an impact on mortality. Caldwell (1986b) examined three “great-leap-forwards” in health: 1946-1953 when life expectancy in Sri Lanka rose by 12 years over seven elapsed years; 1956-1971 when it rose 12 years in Kerala over 15 years; and 1970-1980 in Costa Rica when it rose seven years over 10 years. The three experiences had much in common. At the beginning of the period women as well as men were, by Third World standards, well educated. Nevertheless, the previous rise in life expectancies ranged only between 0.24 and 0.58 years per elapsed year, not particularly fast in comparison with other developing countries. The marked advances occurred after sulfa drugs, antibiotics,

DDT and new malaria prophylactics became available, and probably could not have occurred without them. The mass vaccination programs had not yet begun. But the advances did coincide with periods of radicalism when universal democratic health systems were established, even in urban slums and remote rural regions, with free or cheap services. Those involved gave great credit for the success to the eager, cooperative, educated clients. The paper showed that in countries like some of the oil producers, where much money had been spent on health facilities but where women were neither educated nor independent, similar health advances had not been made. In Sri Lanka, Kerala and Costa Rica, the universal health services were based on health centers or small hospitals. There was little in the way of high-tech medical services, but the services were not strictly primary health care in that they were centered on doctors and were largely curative. The conclusion was that the fastest mortality declines in contemporary conditions were achieved by a collaboration between the democratic provision of modern medicine and a populace that was educated and where women enjoyed considerable independence. A similar conclusion had earlier been drawn from a comparison of two areas in Nigeria (Orubuloye and Caldwell 1975). Later studies showed how more-educated women could gain for their children greater benefits from the health system than could less-educated women (Caldwell *et al.* 1990b: 538-539).

The stages of mortality transition

Demographers had found it useful to divide the demographic transition into stages (Thompson 1929; Notestein 1945; Blacker 1947). Omran (1971) did the same for mortality transition, dividing it into three stages: (1) the age of pestilence and famine, prior to the transition; (2) the age of receding pandemics, as mortality fell consistently with the reduction of death from infectious disease; and (3) the age of degenerative and man-made diseases, when mortality was dominated by heart disease, stroke and cancer. Although he wrote of the degenerative diseases replacing the infectious ones as if they were a new arrival, the central theme of his paper was really the conquest of infectious disease, with the result that most people lived longer with little else ultimately to kill them than degenerative disease. Fifteen years later, Olshansky and Ault (1986), followed by Rogers and Hackenberg (1987), furnished with new

American mortality data, added a fourth stage, that of delayed mortality from degenerative disease.

The demographic approach: theory and analysis

The foregoing discussion outlines some of the major demographic frameworks within which demographers work. Some of the theorists would not describe themselves as demographers, but all approach demographic change in an essentially demographic way, and not in a medical or epidemiological way. High demographic theory employs a broad population base and is usually concerned with changes in mortality and/or fertility over time. It usually starts with at least some empirical data but often then soars far beyond them. Nevertheless, demographers – in contrast with many anthropologists, sociologists or even economists – are usually apprehensive of building further pyramids of theory on existing theory. Their instincts are to substantiate at least part of the high theory by developing intermediate-range theories which can be tested empirically. Few empirical demographers do not somewhere in their papers make reference to some theoretical postulates.

Some demographic analysis is so broad that it inevitably implies theoretical constructs. In the mortality area there are studies such as Stolnitz's (1955, 1956) "A century of international mortality trends", Preston and Nelson's (1974) "Structure and change in the causes of death: an international summary", and Preston's (1975) paper, "The changing relationship between mortality and level of economic development". What distinguishes these from most epidemiological papers is first that they usually deal with all mortality, even if they later subdivide by individual causes. Indeed, demographers often draw attention to parallel movements in the reduction of mortality from a variety of causes (e.g. Preston and Taubman 1994: 313), thus throwing doubt on the epidemiological analyses of the efficacy of interventions affecting a single disease. Secondly, demographic analysis tends to seek background or fundamental influences – using social and economic data – not on the individual but on whole societies. Thirdly, their population base is frequently the whole society. Finally, demographic and epidemiological papers tend to orient themselves to different audiences, as any glance at their respective journals shows. Demographic

studies are usually written by social scientists for social scientists, while the authors of most epidemiological papers have medical training. Epidemiological studies are the most population-based of all medical research, but nevertheless, they are not usually embedded in whole populations seen over long periods of time in their social and economic context.

Attempts have been made to meld the demographic and epidemiological approaches. Perhaps the most successful was that by Mosley and Chen (1984) which they accomplished by using “social science” and “medical” measures as different levels of explanation, the former as “background variables” and the latter as “intermediate variables”. Preston (1996: 535) has pointed out that demographers use “quasi-biological material”, such as duration of birth-spacing, parity and age, but “analyses with more biological data are not likely to be undertaken by demographers, nor published in demographic journals”.

Finally, does demographic theory have anything to say about the recent decline in old-age mortality? The fact that heart disease and stroke account for about 80 percent of mortality decline, while cancer’s contribution is negligible (Myers 1996: 101), suggests that medical interventions should receive most credit. Yet the greater importance of a decline in stroke mortality in Japan and France, in contrast, to the predominant significance of lowered heart disease in Australia, Canada and Sweden, suggests that cultural and behavioral factors should not be ignored. Certainly the rising levels of education among the old, reflecting advances in schooling from the 1920s onward, must have had an impact. Preston and Taubman (1994: 284-287) reported that between 1960 and 1971-84 in the United States large educational differentials in mortality opened up among 65-84-year-olds (with differentials being negligible above 85 years). Males with the most education exhibited mortality levels only 58 percent of those with the least education while the figure among females was 66 percent. Furthermore, the differentials were similar for all causes of death (Preston and Taubman 1994: 290). Fogel’s (1997) work on nutrition among the very young may also be part of the explanation. He believes that the greatest old-age mortality declines are yet to come as the baby boom generation which in developed countries

suffered no malnutrition during childhood begins to reach old age in the second decade of the twenty-first century. Treas (1995: 16-17) argued that there would be continuing falls in old-age mortality because of younger people becoming increasingly conscious of the need for healthier lifestyles and the dangers associated with smoking, obesity, high blood pressure and high levels of cholesterol.

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References

- Alter, George and James C. Riley. 1989. Frailty, sickness and death: models of morbidity and mortality in historical populations. *Population Studies* 43, 1: 25-45.
- Ariès, Philippe. 1962. *Centuries of Childhood*. London: Jonathan Cape.
- Bicego, G.T. and J.T. Boerma. 1991. Maternal education and child survival: a comparative analysis of DHS data. Pp. 177-204 in *Proceedings of the Demographic and Health Surveys World Conference, Washington, D.C., 1990*, vol. 1.
- Blacker, C.P. 1947. Stages in population growth. *Eugenics Review* 39, 3: 88-101.
- Boserup, Ester. 1965. *The Conditions of Agricultural Growth: The Economics of Agrarian Change under Population Pressure*. Chicago: Aldine.
- Caldwell, John C. 1976. Towards a restatement of demographic transition theory. *Population and Development Review* 2, 3-4: 321-366.
- Caldwell, John C. 1979. Education as a factor in mortality decline: an examination of Nigerian data. *Population Studies* 33, 3: 395-413.
- Caldwell, John C. 1982a. *Theory of Fertility Decline*. London: Academic Press.
- Caldwell, John C. 1982b. The wealth flows theory of fertility. Pp. 169-188 in *Determinants of Fertility Trends: Theories Re-examined*, ed. C. Höhn and R. Mackensen. Liège: Ordina.

- Caldwell, John C. 1986a. The role of mortality decline in theories of social and demographic transition. Pp. 31-42 in *Consequences of Mortality Trends and Differentials*. Population Studies no. 95. New York: United Nations.
- Caldwell, John C. 1986b. Routes to low mortality in poor countries. *Population and Development Review* 12, 2: 171-220.
- Caldwell, John C. 1991. Major new evidence on health transition and its interpretation. *Health Transition Review* 1, 2: 221-229.
- Caldwell, John C. 1996. Demography and social science. *Population Studies* 50, 3: 305-333.
- Caldwell, John C. and Pat Caldwell. 1992. Family systems: their viability and vulnerability. A study of intergenerational relations and their demographic implications. Pp. 46-66 in *Family Systems and Cultural Change*, ed. Elsa Berquo and Peter Xenos. Oxford: Clarendon Press.
- Caldwell, John C., Sally Findley, Pat Caldwell *et al.* (eds). 1990a. *What We Know about Health Transition: The Cultural, Social and Behavioural Determinants of Health*. Canberra: Australian National University.
- Caldwell, John C., Pat Caldwell, Indra Gajanayake, I.O. Orubuloye, Indrani Pieris and P.H. Reddy. 1990b. Cultural, social and behavioural determinants of health and their mechanisms: a report on related research programs. Pp. 534-541 in *What We Know about Health Transition*, ed. J.C. Caldwell *et al.* Canberra: Australian National University.
- Caldwell, John C. and Gigi Santow (eds). 1989. *Selected Readings in the Cultural, Social and Behavioural Determinants of Health*. Canberra: Australian National University.
- Caldwell, Pat. 1996. Child survival: physical vulnerability in adversity in the European past and the contemporary Third World. *Social Science and Medicine* 43, 5: 609-619.
- Clark, Colin. 1967. *Population Growth and Land Use*. London: Macmillan.
- Cleland, John G. 1990. Maternal education and child survival: further evidence and explanations. Pp. 400-459 in *What We Know about Health Transition*, ed. J.C. Caldwell *et al.* Canberra: Australian National University.

- Cleland, John G. and Jeroen K. van Ginneken. 1988. Maternal education and child survival in developing countries: the search for pathways of influence. *Social Science and Medicine* 27, 12: 1357-1368.
- Coale, Ansley J. and Paul Demeny. 1966. *Regional Model Life Tables and Stable Populations*. Princeton: Princeton University Press.
- Dorn, Harold F. 1959. Mortality. Pp. 437-471 in *The Study of Population: An Inventory and Appraisal*, ed. P.M. Hauser and O.D. Duncan. Chicago: University of Chicago Press.
- Dublin, Louis I., Alfred J. Lotka and Mortimer Spiegelman. 1949 [1936]. *Length of Life: A Study of the Life Table*. New York: Ronald Press Co.
- Duffy, Linda and Jane Menken. No date. Health, fertility and socioeconomic status as predictors of survival and later health of women: a twenty-year prospective study in rural Bangladesh. Mimeograph.
- Farah, Abdul-Aziz and Samuel H. Preston. 1982. Child mortality differentials in Sudan. *Population and Development Review* 8, 2: 365-383.
- Fogel, Robert William. 1997. New findings on secular trends in nutrition and mortality: some implications for population theory. Pp. 433-481 in *Handbook of Population and Family Economics*, ed. M.R. Rosenzweig and O. Stark, Vol. 1A. Amsterdam: Elsevier.
- Hecht, Jacqueline. 1987. Johann Peter Süßmilch: a German prophet in foreign countries. *Population Studies* 41, 1: 31-58.
- Hobcraft, John. 1993. Women's education, child welfare, and child survival: a review of the evidence. *Health Transition Review* 3, 2: 159-175.
- Hobcraft, J.N., J.W. McDonald and S.O. Rutstein. 1984. Socioeconomic factors in infant and child mortality: a cross-national comparison. *Population Studies* 38, 2: 193-223.
- Hodgson, Dennis. 1983. Demography as a social science and policy science. *Population and Development Review* 9, 1: 1-34.
- Hogben, Lancelot (ed). 1938. *Political Arithmetic*. London: Allen and Unwin.
- Johansson, S. Ryan and Carl Mosk. 1987. Exposure, resistance and life expectancy: disease and death during the economic development of Japan, 1900-1960. *Population Studies* 41, 2: 207-235.

- Krausler, Donald H. and Barry C. Krausler. 1996. *The Graying of America: An Encyclopedia of Aging, Health, Mind and Behavior*. Urbana: University of Illinois Press.
- Kravdal, Øystein. 2000. Social inequalities in cancer survival. *Population Studies* 54, 1: 1-18.
- Kreager, Philip. 1988. New light on Graunt. *Population Studies* 42, 1: 129-140.
- Kreager, Philip. 1991. Early modern population theory: a reassessment. *Population and Development Review* 17, 2: 207-227.
- Lopez, Alan D. and Kyo Hanada. 1982. Mortality patterns and trends among the elderly in developed countries. *World Health Statistical Quarterly* 35: 203-224.
- Malthus, Thomas Robert. 1960 [1830]. A summary view of the principle of population. In *On Population: Three Essays*. New York: New American Library. First published 1830, slightly abridged from an article in the 1824 Supplement to the *Encyclopaedia Britannica*.
- McKeown, Thomas. 1976. *The Modern Rise of Population*. London: Nuffield Hospital Trust.
- Mensch, Barbara, Harold Lentzner and Samuel H. Preston. 1985. *Socioeconomic Differentials in Child Mortality in Developing Countries*. New York: United Nations.
- Mosley, W. Henry and Lincoln C. Chen. 1984. An analytical framework for the study of child survival in developing countries. *Population and Development Review* 10 (Supplement): 25-45.
- Myers, George C. 1996. Comparative mortality trends among older persons in developed countries. Pp. 87-111 in *Health and Mortality among Elderly Populations*, ed. G. Caselli and A.D. Lopez. Oxford: Clarendon.
- Notestein, Frank W. 1945. Population – the long view. Pp. 36-57 in *Food for the World*, ed. T.W. Schultz. Chicago: University of Chicago Press.
- Notestein, Frank W. 1953. Economic problems of population change. Pp. 13-31 in *Proceedings of the Eighth International Conference of Agriculture Economists*. New York: Oxford University Press.

- Olshansky, S. Jay and A. Brian Ault. 1986. The fourth stage of the epidemiologic transition: the age of delayed degenerative diseases. *Milbank Quarterly* 64, 3: 355-391.
- Omran, Abdel R. 1971. The epidemiologic transition: a theory of the epidemiology of population change. *Milbank Memorial Fund Quarterly* 49, 1: 509-538.
- Orubuloye, I.O. and John C. Caldwell. 1975. The impact of public health services on mortality: a study of mortality differentials in a rural area in Nigeria. *Population Studies* 29, 2: 259-272.
- Preston, Samuel H. 1975. The changing relation between mortality and level of economic development. *Population Studies* 29, 2: 231-248.
- Preston, Samuel H. 1996. Population studies of mortality. *Population Studies* 50,3: 525-536.
- Preston, Samuel H. and Irma Elo. 1995. Are educational differences in adult mortality increasing in the limited States? *Journal of Aging and Health* 7: 476-496.
- Preston, Samuel H. and Michael R. Haines. 1991. *Fatal Years: Child Mortality in Late Nineteenth Century America*. Princeton: Princeton University Press.
- Preston, Samuel H. and Verne E. Nelson. 1974. Structure and change in causes of death: an international summary. *Population Studies* 28, 1: 19-51.
- Preston, Samuel H. and Paul Taubman. 1994. Socioeconomic differences in adult mortality and health status. Pp. 279-318 in *Demography of Aging*, ed. L.G. Martin and S.H. Preston. Washington DC: National Academy Press.
- Preston, Samuel H. and Etienne van de Walle. 1978. Urban French mortality in the nineteenth century. *Population Studies* 32, 2: 275-297.
- Razzell, P.E. 1974. "An interpretation of the modern rise of population in Europe" – a critique. *Population Studies* 28, 1: 5-17.
- Rogers, Richard G., Robert A. Hummer and Charles B. Nam. 2000. *Living and Dying in the USA: Behavioral, Health and Social Differentials of Adult Mortality*. New York: Academic Press.
- Sandiford, P., J. Cassel, M. Montenegro and G. Sanchez. 1995. The impact of women's literacy on child health and its interaction with access to health services. *Population Studies* 49, 1: 5-17.

- Schubnell, Hermann. 1959. Demography in Germany. Pp. 203-216 in *The Study of Population: An Inventory and Appraisal*, ed. P.M. Hauser and O.D. Duncan. Chicago: University of Chicago Press.
- Simons, John. 1989. Cultural dimensions of the mother's contribution to child survival. Pp. 132-145 in *Selected Readings in the Cultural, Social and Behavioural Determinants of Health*, ed. J.C. Caldwell and G. Santow. Canberra: Australian National University.
- Stolnitz, George J. 1955. A century of international mortality trends, Part I. *Population Studies* 9, 1: 24-55.
- Stolnitz, George J. 1956. A century of international mortality trends, Part II. *Population Studies* 10, 1: 17-42.
- Szreter, Simon. 1988. The importance of social intervention in Britain's mortality decline c.1850-1914: a reinterpretation of the role of public health. *Social History of Medicine* 1, 1: 1-37.
- Szreter, Simon. 1993. The idea of demographic transition and the study of fertility change: a critical intellectual history. *Population and Development Review* 19, 4: 659-701.
- Thompson, Warren S. 1929. Population. *American Journal of Sociology* 34, 6: 959-975.
- Treas, Judith. 1995. Older Americans in the 1990s and beyond. *Population Bulletin* 50, 2: 1-46.
- Vågerö, Denny and Olle Lundberg. 1995. Socioeconomic differentials among adults in Sweden. Pp. 223-242 in *Adult Mortality in Developed Countries: From Description to Explanation*, ed. A.D. Lopez, G. Caselli and T. Valkonen. Oxford: Clarendon.
- Valkonen, Tapani. 1989. Adult mortality and level of education: a comparison of six countries. Pp. 142-162 in *Health Inequalities in European Countries*, ed. J. Fox. Aldershot: Gower.
- Wrigley, E.A. and R.S. Schofield. 1981. *The Population History of England, 1541-1871: A Reconstruction*. London: Edward Arnold.