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How a Population Ages or Grows Younger

ANSLEY J. COALE

The age of the whole human population could, I suppose, be measured from the moment the species originated, and the age of a national population could be measured from the country's "birthday." The age (in this sense) of the human population has been estimated as at least 100,000 and no more than a million years, and the age of national populations ranges from several thousand years for Egypt or China to a year or so for some of the emerging nations of Africa.

In this chapter, however, when we speak of the age of a population we refer to the age of its members, and to be precise we should use the term *age distribution* of a population—how many persons there are at each age—rather than the age of a population. The only way a single age can be given for a group of persons is by using some sort of average. A *young* population, then, is one that contains a large proportion of young persons, and has a low average age, while an *old* population has a high average age and a large proportion of old people.

The ages of various national populations in the world today are very different, and in many countries the present age distribution differs markedly from the past.

The oldest populations in the world are found in Northwestern Europe. In France, England, and Sweden, for example, 12 percent of the population is over 65, and half of the population in these countries is over 33, 36, and 37 respectively. The youngest population are found in the underdeveloped countries—those that have not incorporated modern industrial technology in their economies—the population of Asia, Africa and Latin America. Half of the population of Pakistan is under 18 years, of the Congo under 20 years, and of Brazil under 19 years. The proportion over 65 in Brazil is less than one-fourth what it is in France. The proportion of children under 15 is twice as great in Pakistan as in England. Paradoxically enough, the oldest nations—China, India and Egypt—have very young populations.

The highly industrialized countries all have older populations than the underdeveloped countries, and also older populations than they did fifty to a hundred years ago. Since 1900 the median age has risen in England from 24 to 36, in the United States from 23 to 30, in Japan from 23 to 26, and in Russia from 21 to 27. In the underdeveloped countries, however, the age distributions have changed only slightly, and they have, if anything, become slightly younger. In Taiwan, for example, the median age has declined from 21 to 18 since 1915.

What accounts for these differences and these trends in the age distribution of populations? One obvious factor to consider is migration. A famous spa has an old population because old people come there for the cure, and university towns like Princeton have young populations because young people come there to study. But the age distribution of most national populations is not much affected by migration, especially today when almost everywhere international migration is restricted.

Whether a national population is young or old is mainly determined by the number of children women bear. When women bear many children, the population is young; when they bear few, the population is old.

The effect of fertility (as the rate of childbearing can be called) on the age distribution is clearest when a population continuously subject to high fertility is compared to one continuously subject to low fertility. The high-fertility population has a larger proportion of children relative to adults of parental age as a direct consequence of the greater frequency of births. Moreover, by virtue of high fertility a generation ago, today's parents are numerous relative to *their* parents, and hence the proportion of old people is small. Conversely, the population experiencing a prolonged period of low fertility has few children relative to its current parents, who in turn are not numerous re-

lative to *their* parents. Prolonged high fertility produces a large proportion of children, and a small proportion of the aged—a population with a low average age. On the other hand, prolonged low fertility produces a small proportion of children and a large proportion of the aged—a high average age.

It is the small number of children born per woman that explains the high average age now found in industrialized western Europe, and the high birth rate of the underdeveloped countries that accounts for their young populations. The increase in average age and the swollen proportion of old people in the industrialized countries are the product of the history of falling birth rates that all such countries have experienced.

Most of us would probably guess that populations have become older because the death rate has been reduced, and hence people live longer on the average. Just what is the role of mortality in determining the age distribution of a population? The answer is surprising—mortality affects the age distribution much less than does fertility, and in the opposite direction from what most of us would think. Prolongation of life by reducing death rates has the perverse effect of making the population somewhat younger. Consider the effect of the reduction in death rates in the United States, where the average duration of life has risen from about 45 years under the mortality conditions of 1900 to about 70 years today. Had the risks of death prevailing in 1900 continued unchanged, and the other variables—rates of immigration and rates of childbearing per mother—followed the course they actually did, the average age of the population today would be greater than it is: the proportion of children would be less and the proportion of persons over 65 would be greater than they are. The reduction of the death rate has produced, in other words, a younger American population.

These statements seem scarcely credible.

Does not a reduction in the death rate increase the average age at death? Are there not more old people as a result of reduced mortality than there would be with the former high death rates? How then can it be said that a reduction in the death rate makes a population younger?

It is true that as death rates fall, the average age at which people die is increased. But the average age of a population is the average age of living persons, not their average age at death. It is also true, as we all immediately realize, that as death rates fall, the number of old persons in a population increases. What we do not so readily realize is that reduced mortality increases the number of *young* persons as well. More survive from birth to ages 1, 10, 20, and 40, as well as more living to old age. Because more persons survive to be parents, more births occur.

The reason that the reduced death rates, which prolong man's life, make the population younger is that typical improvements in health and medicine produce the greatest increases in survivorship among the young rather than the old.

There is one kind of reduction in death rates that would not affect the age distribution of the population at all, that would lead to the same proportion of population at every age as if mortality had not changed. This particular form of reduced mortality is one that increases the chance of surviving one year by a certain amount—say one-tenth of 1 percent—at every age. The result would be one-tenth of a percent more persons at age 1, 5, 10, 60, and 80—at every age—than there would have been had death rates been unaltered. Because there would be one-tenth percent more parents, there would also be one-tenth percent more births. Therefore the next year's population would be one-tenth percent larger than it would otherwise have been, but the proportion of children, of young adults, of the middle-aged, and of the aged would not be altered—there would be one-tenth percent more of each.

Reductions in mortality of this singular sort that would not affect the age of the population at all are not found in actual human experience. However, there has been a tendency for persons at all ages to share some of the increased chances of survival, and the effect of reduced death rates on the age distribution has consequently been small—much smaller than the effect of reduced birth rates—in countries where both fertility and mortality have changed markedly.

As the average duration of life has risen from lower levels to 65 or 70 years, the most conspicuous advances in survivorship seem always to have occurred in infancy and early childhood. It is for this reason that reduced mortality has had the effect of producing a younger population, although the effect has usually been obscured by the much more powerful force of a falling birth rate that has occurred at the same time. Thus the population of the United States has actually become *older* since 1900, because of falling fertility; but falling mortality (with its tendency to produce a younger population) has prevented it from becoming older still.

The younger-population effect of reduced mortality is not an inevitable feature of all increases in length of life. The countries with the greatest average duration of life have by now about exhausted the possibility of increasing survivorship in a way that makes for a younger population. In Sweden today 95 percent survive from birth to age 30, compared to 67 percent in 1870. At best, survivorship to age 30 in Sweden could approach 100 percent. No important increase in population at younger ages would result if there are further major gains in the chances of prolonged life in Sweden, they must occur at older ages, and if they occur, will make the population older.

Every individual inexorably gets older as time passes. How old he gets depends on how long he avoids death. President Eisenhower remarked after his retirement that he was glad to be old, because at his age, if he were not old, he would be dead.

Populations, on the other hand, can get older or younger. They get older primarily as the result of declining fertility, and younger primarily as the result of rising fertility.

The most highly industrialized countries have all experienced a decline of fertility of about 50 percent since their preindustrial phase, and they all have older populations than they used to have. In France and the United States, for example, the number of children each woman bore declined for more than a century, reaching a minimum just before World War II. In each country during this period the population became progressively older. In fact, the "aging" of the population continued for a time after fertility had passed its minimum. Between 1800 and 1950 the median age of the French population rose from 25 to 35 years, and in the United States in the same interval the median age increased from 16 to 30. In both countries there has been a substantial recovery in fertility during the past 25 years from the low point reached in the 1930s. This rise in fertility has produce the first decrease in median age recorded in the statistics of either nation. Between 1950 and 1960 the median age in France fell from 35 to 33, and in the United States from 30.2 to 29.6.

This reversal in the trend toward an older population in the United States has been accompanied by a more pronounced reversal in the way proportions of children were changing. The long-term decline in fertility in the United States meant that the proportion of children to adults steadily shrank from about 0.85 children (under 15) per adult (over 15) in 1800 to 0.33 per adult in 1940. By 1960 the proportion had rebounded to 0.45 children per adult. In fact, the increase in the *number* of children in the population between 1950 and 1960—more than 15 million—was greater than the increase between 1900 and 1950.

The abrupt reversal of the long-term trend toward an older population has meant the first increase in the relative burden of child dependency in the history of the United States. The very productive American economy can certainly afford to support this burden, but it has not been painless. The extremely rapid increase in the number of children in the past decade has required the construction of many new schools and the training of many teachers. In some communities where foresight, willingness to pay increased taxes, or resources were inadequate, schools have been overcrowded and the quality of instruction has suffered.

The countries that have not undergone intensive industrialization have experienced no major changes in fertility, no trends of sustained decline and recovery such as occurred in France and the United States. Rather they have experienced a largely unbroken sequence of high birth rates. There has been in consequence little change in the age composition of underdeveloped areas. All have 40 percent or more under age 15, only 2 to 4 percent over 65, and a median age of 20 years or less.

The age distributions of the industrialized countries on the one hand and of the preindustrial countries on the other are ironically mismatched with what each sort of country seems best equipped to accommodate. As we have noted before, the contrast in age of population is striking. In Pakistan or Mexico nearly one person of every two a visitor might encounter would be a child, and only two or three of every hundred would be old (over 65); while in England only one in four would be a child and about one in eight would be old. In the industrialized countries where the proportion of the aged is so large, the importance of the family in the predominantly urban environment has diminished, and consequently the role of respected old patriarch or matriarch has nearly vanished. The wealthy industrial countries can readily afford to support a sizable component of old people but have not in fact always done so adequately. The aging of their populations has been accompanied by a weakening or a disappearance of the traditional claims of the aged on their descendants for material support and, perhaps more tragically, by a weakening or disappearance of recognized and accepted position for old people in the family.

In the underdeveloped countries, on the

other hand, the relatively few old people are accorded traditional respect and whatever economic support their families have to offer, and hence the aged are less subject to special economic and social deprivation.

Because of extremely young age distributions, adults in the impoverished underdeveloped countries must support a disproportionately large dependent-child population—twice as great a burden of dependency per adult in the working ages of 15 to 65 as in typical industrialized countries—a burden these poor countries can scarcely afford. The enormous proportion of children makes it extraordinarily difficult, where incomes are extremely low, to provide adequate shelter, nourishment, and education for the young.

Moreover, the preindustrial countries can expect no relief from dependency as a result of the spectacular drop in death rates now occurring. Unless fertility declines, this drop in mortality will only make the populations younger, adding to the already extreme burden of dependent children.

In sum, it is the industrialized countries that, better able to afford a high burden of child dependency, have only half the proportion of children found in underdeveloped areas, and that, having abandoned the institutions giving a meaningful role to the aged, have four times the proportion of the elderly found in preindustrial countries.

The last question considered in this brief survey of the age of populations is the past trend in age distribution from man's origin to the present, and what alternative trends may possibly develop in the future.

The human population as a whole has always been and is now a young population, consisting of at least 40 percent children, and have a median age of no more than about 20 years, because the overall human birth rate has always been about 40 per 1,000 or higher. It is almost certain that until perhaps two hundred years ago all sizable national or regional populations likewise were young, with about the same age characteristics as the population of the world.

These statements can be made with confidence, even though no reliable records of the age distribution of the world, or of world birth rates, or even records of many national populations exist for most of man's history. We can be confident that the world's populatin has always been young because until the last two centuries it was not possible for any population to achieve low mortality for any sustained period, and any population with a low birth rate would therefore have become extinct.

It is simply not possible for a possible for a population to have a birth rate much below its death rate for a prolonged period, as can be shown by the following example. The population of the world has grown from about one-quarter billion to about three billion since the time of Julius Caesar—it has been multiplied by about twelve. But the average annual rate of increase has been very little—about 1 per 1,000 per year. If the world birth rate has averaged 40 per 1,000 (a reasonable guess), the world death rate by logical necessity has averaged 39 per 1,000. A world birth rate only 2 points lower (38 instead of 40 per 1,000) would have led to an annual *decrease* of 1 per 1,000, and the current population would be only one-twelfth instead of twelve times the population of Caesar's day. A birth rate of 35—that of England or the United States in 1880—would have reduced the 250 million of two thousand years ago to less than one hundred thousand today.

The industrialized countries have been able to reduce their birth rates without having their populations shrink drastically because they first reduced their death rates. Beginning in the late eighteenth century some countries made preliminary steps in the improvement in living conditions and sanitation that has continued until today, and in the latter half of the nineteenth century there began the remarkable development of modern medicine and public health that so greatly extended the average duration of life in the industrially more advanced countries.

In the past few decades modern medical techniques and public health methods have been introduced into the underdeveloped countries, causing an extraordinary drop in death rates, and since birth rates have not changed, the growth of world population has sharply accelerated so that it is now 2 percent per year.

Just as it is not possible for a population to maintain for long a birth rate much below its death rate, because such a population would shrink to extinction, it is not possible to maintain for long a birth rate much *above* a death rate, because then the population would grow to a physically impossible size. For example, had the current 2 percent rate of growth existed since the time of Caesar, the population of the world would have been multiplied by about 135 quadrillion instead of twelve, and there would be more than 30,000 times the entire

world's current population on each square mile of land area on the earth. Starting with today's three billion persons, it would take only about 650 years for a 2 percent rate of increase to produce one person per square foot, and about twice that long to produce a total that would outweigh the earth.

In short, the present combination of a high world birth rate and a moderate and rapidly falling death rate can only be temporary. The only combinations that can long continue are birth and death rates with the same average levels.

If man chooses to continue the high birth rate that he has always had, the human population will remain a young one—but in the long run it can remain young only by returning to the high death rate and short average life it has always had. Sustained geometric increase is impossible.

If, on the other hand, mankind can avoid nuclear war, and bring the fruits of modern technology, including prolonged life, to all parts of the world, the human population must become an old one, because only a low birth rate is compatible in the long run with a low death rate, and a low birth rate produces an old population. In fact, if the expectation of life at birth of 70 years—now achieved or exceeded in many industrialized countries—becomes universal, the average number of children born per woman must decline to about two from five or more in the underdeveloped areas, slightly more than three in the United States, and some two and a half in Europe. Such a decline in fertility would give the whole world as old a population as any country has had to date—only about 21 percent under 15, at least 15 percent over 65, and as many persons over 36 as under.

A world population with the age composition of a health resort is a mildly depressing prospect. Such a population would presumably be cautious, conservative, and full of regard for the past. A young, vigorous, forward-looking population perhaps appears more attractive, but in the long run the world can keep its youth only by tolerating premature death.

We find at the end, then, that although the birth rate determines how old a population is, the death rate determines what the average birth rate in the long run must be. If prolonged life produces by its direct effects a younger population, it is nevertheless compatible only with an older population.