

## 5 Changing Trends in Mortality Decline during the Last Decades

EDUARDO E. ARRIAGA

*US Bureau of the Census*

---

There has been a general concern about recent trends of mortality in developing countries. This concern emerged because in most of the developing countries for which there is information, mortality decline slowed down during the 1960s (as it also did in some developed countries). Data from most of these countries had shown significant gains in life expectation at birth during the 1950s; hence, optimistic predictions of future trends of mortality were made. However, life-tables for some developing countries in the early 1970s showed that the expected fast pace of mortality decline had not continued during the 1960s. Those populations for which information was available had mortality rates during the 1950s which declined rapidly at practically all ages, but during the 1960s most of the gain in life expectation was due to the reduction of infant mortality. At adult ages male mortality rates were only slightly reduced, or, in some countries, even tended to increase (Arriaga, 1981; Sivamurthy, 1981).

As a result of massive programmes for reducing 'excess' mortality during the 1950s, the age pattern of mortality decline in most developing countries was rather similar. Public health programmes were focused on infectious and contagious diseases. Consequently, the number of deaths from those were reduced in most of the countries, and hence the pattern of mortality change by age was also similar. Such similarities in the pattern of mortality decline did not continue during the 1960s. This situation generated several questions. For instance, was the slowing down of mortality decline a real phenomenon, or was it the consequence of the indices used for measuring the change of mortality? Do those developing countries with available information (the only ones that can be analysed) represent the 'developing countries' of the world? If there was indeed a slowing down of mortality decline in developing countries, was this an inevitable mortality trend? Since more information is now available for some countries, this chapter reviews mortality trends in a few developing countries. First, an attempt is made to

The author wishes to thank staff members of the Center for International Research who made valuable comments; Janet Sales, who typed several drafts; and Vivian Cash, who prepared the input data for the computer runs and prepared some of the tables in this chapter.

answer the previous three questions. Second, such data as are available for the middle or late 1970s are analysed so as to clarify as far as possible recent trends of mortality, including an analysis of the causes of death. Third, developing countries for which recent information is available will be compared with the United States in 1980, to determine the age patterns and causes of death that contribute to the differentials in life expectation between them.

### Mortality Change during the 1950s and 1960s

Since crude death rates (actual or standardized) and life expectation at birth are not good indices for measuring the change of mortality, the index used here is the relative change of *temporary life expectation* (Arriaga, 1981, 1984). This index measures the annual change in temporary life expectation between any specific ages, in relation to the possible maximum change in temporary life expectation. The greater the value of the index, the faster the mortality decline. (A brief explanation is given in Appendix 5.I.)

This index of annual relative change of temporary life expectation shows that although, in most countries, the pace of mortality decline was reduced in the 1960s in relation to the 1950s, mortality decline accelerated during the 1960s in 5 out of 19 countries for males and in 6 out of 19 countries for females (Arriaga, 1981). The countries in which the mortality decline accelerated were Chile, Colombia, Costa Rica, Malaysia, Paraguay, and Taiwan.<sup>1</sup> The analysis was also conducted by causes of death for a few countries with such information. It was found that in almost all countries (a) the mortality decline during the 1960s was due mainly to a reduction of mortality from infectious, contagious, and parasitic diseases; and (b) the decline of these diseases was not as fast as in the previous decade.

The question is whether or not those countries for which there is information can be accepted as representing all developing countries. No statistical answer can be given, since most developing countries do not have comparable information. Nevertheless, those countries with reliable information not only seem to be better-off economically, but also have a higher proportion of literate persons (Bureau of the Census, 1983). Although there are some exceptions, most of those countries for which the analysis can be made are probably those 'more developed' within the group known as developing countries. Hence, whatever conclusions are drawn from the available information may not hold true for 'most of the developing countries of the world'.

Finally, it was pointed out earlier that the 1950s was a special decade in which several developing countries implemented massive public health pro-

<sup>1</sup> The countries analysed were: Argentina, Belize, Brazil, Chile, Colombia, Costa Rica, Guatemala, Honduras, Malaysia, Mauritius, Mexico, Panama, Paraguay, Peru, Puerto Rico, Singapore, Sri Lanka, Taiwan, and Venezuela.

grammes (Arriaga and Davis, 1969). Such programmes brought fast declines in infectious, contagious, and parasitic diseases, resulting in a mortality reduction that can be labelled as the fastest in the history of those countries. Unfortunately, mortality decline is not only dependent upon public health programmes but also upon a number of other societal characteristics that are related to development, such as nutrition, education, water supply, housing, communications, and so forth. Public health programmes without development can reduce mortality, but only down to certain levels. The opposite is also true—development without a proper public health system and social programmes cannot reduce mortality efficiently. During the 1950s, some developing countries improved public health programmes without a similar improvement in economic conditions, producing a rapid increase in life expectation.

Although from 1960 to 1970 some countries in which the pace of mortality decline slowed had a substantial increase in per capita income, the increase was a result of sudden large investments (mostly foreign) that require time for the benefits to spread to most of society. The increase in per capita income observed during the early 1960s would have had its effect, in large sectors of the population, only during the late 1960s or 1970s.

It seems that the slowing down of mortality decline observed in most countries during the 1960s was due mainly to the extremely rapid mortality decline during the 1950s. This is supported by the fact that the annual pace of mortality decline during the two decades (from about 1950 to 1970) was higher for those countries which experienced a slowing down of the mortality decline during the 1960s than for those countries in which the mortality decline accelerated during the 1960s (Arriaga, 1981). In simple words, the slowing down of the pace of mortality decline in most of the countries was a logical consequence after a decade of astonishingly fast reduction of mortality. This statement refers only to those countries with available information, which, as has already been pointed out, may not represent the majority of the developing countries of the world.

### Mortality Change during the 1970s

There are recent reliable life-tables for dates between 1970 and 1980 for nine developing countries: Argentina, Costa Rica, Cuba, Hong Kong, India, Korea, Singapore, Taiwan, and Venezuela (Table 5.1). When the pace of mortality decline in these countries between birth and age 75 years is analysed, four show an acceleration of the mortality decline during the 1970s relative to the 1960s (Table 5.2). There are three interesting cases: (a) India, where after a long experience of rather slow mortality decline, there was a considerable increase in mortality reduction during the late 1970s; (b) Argentina, which had increased male mortality during the 1960s, has reduced mortality during the 1970s at a faster rate even than during the

Table 5.1. Life expectancy at birth and temporary life expectancy from birth to age 75 years, selected countries and years

Country	Year	Life expectancy, at birth		Temporary life expectancy from birth to age 75 years	
		Male	Female	Male	Female
Argentina	1947	58.68	62.95	56.71	59.49
	1960	63.16	68.88	60.41	63.77
	1970	61.82	69.19	59.58	64.40
	1978	65.43	72.12	62.35	66.51
Chile	1952	50.80	53.53	49.12	51.30
	1960	54.18	58.71	52.42	56.58
	1970	58.50	64.68	56.11	60.73
Costa Rica	1950	53.96	56.97	51.96	54.33
	1963	62.15	65.03	59.82	61.15
	1973	65.18	70.15	61.78	65.40
	1980	70.30	75.04	66.27	69.19
Cuba	1953	56.69	61.01	55.05	58.65
	1970	68.55	71.81	64.56	66.47
	1980	71.15	74.57	66.26	68.19
Hong Kong	1961	63.64	70.51	61.51	65.60
	1971	67.36	75.01	64.36	68.65
	1976	69.57	76.42	65.87	69.58
India	1956	41.89	40.55	39.50*	38.03*
	1966	46.37	44.65	41.57*	41.04*
	1977	50.84	49.99	46.21*	44.25*
	1980	54.08	54.73	48.32*	47.50*
Mexico	1950	46.16	49.00	44.44	46.80
	1960	56.38	59.58	53.52	56.08
	1970	58.39	62.38	55.68	58.78
Panama	1950	48.83	51.05	47.34	49.12
	1960	59.75	63.18	57.14	59.70
	1970	63.54	66.28	60.34	62.01
Singapore	1947	47.36	51.20	46.46	49.78
	1957	60.25	65.22	59.25	63.21
	1970	65.11	69.98	63.70	67.48
	1980	68.84	74.10	65.95	68.97
Taiwan	1951	53.10	57.34	51.96	54.91
	1961	61.32	65.59	59.36	62.03
	1971	66.43	71.45	63.69	66.83
	1981	67.43	72.55	64.49	68.38
United States	1940	61.60	65.89	59.30	62.49
	1950	65.47	70.96	62.59	66.30
	1960	66.80	73.24	63.69	67.80
	1970	67.04	74.64	63.89	68.38
	1980	69.96	77.48	65.91	69.80

\* From birth to age 65 years.

Source: Appendices.

Table 5.2. Annual percentage relative change<sup>a</sup> of temporary life expectancies from birth to age 75 years for selected countries, period, and ages, by sex

Country	Period	Male	Female	Country	Period	Male	Female
Argentina	1947-60	1.72	2.45	Korea	1966-70	3.00	2.84
	1960-70	-0.55	0.61		1970-9	1.42	1.31
	1970-8	2.60	2.73				
Costa Rica	1950-63	2.81	3.03	Singapore	1947-57	5.77	7.32
	1963-73	2.60	3.60		1957-70	2.52	3.40
	1973-80	4.69	6.93		1970-80	2.09	2.08
Cuba	1953-70	3.74	3.76	Taiwan	1951-61	3.80	4.28
	1970-8	2.34	2.95		1961-71	3.19	4.52
					1971-81	0.73	2.08
Hong Kong	1961-1	2.37	3.84	United States	1940-50	1.72	2.43
	1971-6	3.39	3.12		1950-60	0.65	1.15
India	1956-66 <sup>b</sup>	0.88	1.17		1960-70	0.13	0.49
	1966-77 <sup>b</sup>	1.67	1.36		1970-80	1.33	1.30
	1977-80 <sup>b</sup>	3.35	4.75				
				Venezuela	1950-61	3.87	4.50
					1961-71	0.85	1.56
					1971-5	2.06	3.66

<sup>a</sup> The annual relative change of temporary life expectancy refers to the observed change of the temporary life expectancy during the period of time in relation to the total possible change, estimated annually (Arriaga, 1981).<sup>b</sup> From birth to age 65 years.

1950s; and (c) Costa Rica, the most unusual case, has during the three decades continuously accelerated its mortality decline, achieving, together with Cuba, the lowest level of mortality in 1980 in the Latin American region. Hong Kong, on the other hand, has an accelerated mortality decline for males, but the opposite occurred for females during the 1970s. The remaining three countries show a slowing down of the mortality decline during the 1970s. For Singapore and Taiwan, the pace of the mortality decline during the 1970s was the slowest of the last three decades.

Changes in mortality by age groups in most of the countries during the 1950s produced a rather similar pattern of contributed life years to the life expectations from birth to age 75. The reduction of infant mortality, from the 1950s up to the most recent years for which there is information, has invariably been the largest single-age contributor to the change of temporary life expectation. Although most of the age groupings span ten years, the reduction of infant mortality contributed a larger number of life years than any other age group, in most cases (Tables 5.3 and 5.4). The exception is India, where females, according to the intercensal life-tables 1951-61 and 1961-71, had an increase of infant and child mortality.

The magnitude of the contribution of infant and child mortality to the

Table 5.3. Years contributed by the mortality change at each age group to the total change of temporary life expectancy from birth to age 75 years, selected countries and periods, males

Country	Period	Total change Age groups									
		0-75 years	Under 1 year	1-4 years	5-14 years	15-24 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years
Argentina	1947-60	3.70	.90	.45	.23	.36	.31	.38	.49	.42	.16
	1960-70	-0.83	-.03	.09	.02	-.02	-.08	-.16	-.23	-.24	-.16
	1970-8	2.77	1.14	.33	.10	.12	.17	.17	.21	.32	.20
Chile	1952-60	3.30	.73	.69	1.13	.67	.32	-.01	-.10	-.09	-.04
	1960-70	3.69	1.55	1.23	.28	.18	.07	.13	.07	.08	.09
Costa Rica	1950-63	7.14	2.14	.61	.90	.85	.75	.57	.61	.53	.16
	1963-73	3.68	1.67	.26	.26	.06	.07	.14	.14	.06	.05
	1973-80	3.49	2.11	.49	.15	.05	.12	.08	.11	.21	.15
Cuba	1953-70	9.51	2.79	1.82	.52	.69	.82	.90	.97	.68	.25
	1970-8	1.70	1.50	.08	.02	.04	.01	.01	-.05	-.01	.09
Hong Kong	1961-71	2.88	1.14	.71	.17	.04	-.03	.10	.29	.38	.08
	1971-6	1.68	.50	.13	.04	.01	.13	.13	.22	.34	.18
India*	1956-66	3.36	1.13	.67	-.39	-.00	.21	.72	.53	.50	
	1966-77	3.66	.19	-.29	1.18	.80	.77	.59	.37	.07	
Mexico	1977-80	2.40	.73	.35	.22	.14	.12	.14	.26	.44	
	1950-60	9.08	2.15	3.15	.88	.62	.66	.60	.51	.36	.13
Panama	1960-70	2.17	.19	.82	.30	.19	.25	.18	.05	.05	-.00
	1950-60	10.59	3.38	1.68	1.36	1.10	1.04	.79	.60	.45	.19
Singapore	1960-70	2.30	1.51	-.33	.22	.25	.24	.10	.07	.14	.11
	1947-57	12.79	5.55	2.09	.56	1.13	1.49	1.23	.63	.12	-.02
	1957-70	4.45	1.45	.75	.35	.01	.18	.35	.51	.64	.21
	1970-80	2.25	.72	.15	.14	.08	.05	.25	.27	.36	.23
Taiwan	1951-61	7.40	2.50	.96	.84	.40	.71	.73	.72	.41	.13
	1961-71	4.33	1.57	1.05	.20	.16	.12	.24	.38	.45	.16
	1971-81	0.80	.28	.08	.03	-.09	.05	-.05	.03	.26	.21
United States	1940-50	3.29	1.23	.36	.24	.27	.39	.36	.25	.13	.07
	1950-60	1.09	.28	.09	.10	.05	.11	.16	.15	.12	.02
	1960-70	0.20	.43	.05	.03	-.17	-.11	-.07	.04	.01	-.01
	1970-80	2.02	.56	.05	.08	.10	.07	.24	.34	.40	.17
Venezuela	1950-61	9.00	4.15	1.26	1.11	.83	.69	.41	.27	.19	.09
	1961-71	1.34	.24	.46	.16	.04	.12	.25	.16	-.06	-.03
	1971-5	1.06	.26	.23	.16	.01	-.02	.02	.17	.16	.07

\* For ages 0-65 years.

Table 5.4. Years contributed by the mortality change at each age group to the total change of temporary life expectancy from birth to age 75 years, selected countries and periods, females

Country	Period	Total change Age groups									
		0-75 years	Under 1 year	1-4 years	5-14 years	15-24 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years
Argentina	1947-60	4.28	.91	.47	.27	.57	.47	.43	.48	.46	.22
	1960-70	0.64		.16	.05	.09	.08	.00	.04	.08	.03
	1970-8	2.10	1.06	.32	.07	.08	.08	.07	.10	.20	.13
Chile	1952-60	4.54	.50	.24	1.36	.96	.71	.37	.22	.14	.06
	1960-70	4.89	1.68	1.80	.29	.27	.34	.18	.15	.08	.09
	1970-8										
Costa Rica	1950-63	6.82	2.00	.49	1.03	.97	.91	.54	.42	.33	.13
	1963-73	4.25	1.55	1.24	.27	.11	.16	.26	.26	.28	.13
	1973-80	3.79	1.84	.58	.15	.14	.18	.18	.24	.25	.23
Cuba	1953-70	7.83	2.15	1.76	.62	.67	.75	.70	.57	.37	.23
	1970-8	1.72	1.20	.07	.05	.02	.05	.10	.08	.06	.09
	1961-71	3.05	1.21	.85	.17	.06	.18	.17	.16	.21	.03
Hong Kong	1971-6	0.93	.35	.06	.02	.06	.01	.10	.17	.04	.11
	1956-66	3.24	.47	1.05	-.72	.33	.51	.76	.44	.42	.32
	1966-77	3.41	-.32	-1.50	1.68	.19	.83	1.37	.78	.39	.39
India*	1977-80	3.48	1.05	1.34	.32	.08	.22	.03	.12	.32	.32
	1950-60	9.80	2.00	3.56	.93	.59	.63	.59	.48	.36	.14
	1960-70	2.70	.35	.90	.32	.28	.28	.21	.19	.12	.04
Mexico	1950-60	9.80	3.60	1.53	1.09	.85	.85	.71	.59	.42	.16
	1960-70	3.20	1.56	-.23	.23	.25	.30	.26	.35	.38	.10
	1970-8										
Panama	1947-57	13.43	5.30	2.48	.62	.99	1.36	1.00	.73	.68	.26
	1957-70	4.27	1.23	.85	.32	.21	.28	.42	.45	.36	.16
	1970-80	1.50	.46	.15	.06	.04	.14	.21	.22	.13	.09
Singapore	1951-61	7.12	1.68	.81	.86	.51	.83	.92	.77	.54	.21
	1961-71	4.81	2.05	1.34	.23	.27	.30	.12	.17	.25	.07
	1971-81	1.55	.42	.13	.06	.04	.11	.33	.18	.16	.12
Taiwan	1940-50	3.81	1.06	.34	.22	.41	.47	.41	.37	.34	.19
	1950-60	1.50	.23	.08	.07	.13	.15	.19	.23	.28	.14
	1960-70	0.58	.35	.05	.02	.03	.01	.01	.02	.08	.08
United States	1970-80	1.42	.44	.06	.05	.06	.11	.20	.21	.18	.12
	1950-61	9.26	3.72	1.20	1.34	1.05	.88	.49	.29	.18	.11
	1961-71	2.04	.35	.38	.21	.22	.26	.22	.22	.04	.06
Venezuela	1971-5	1.47	.26	.39	.05	.06	.13	.14	.18	.20	.06

\* For ages 0-65 years.

increase of life years varies considerably among countries and between periods of time—from a contribution of 93 per cent made by ages 0–4 years to the total change of temporary life expectancy for Cuban males, to negative contributions in Argentina and India during the 1960s. The contribution was more uniform, or similar by age, during periods of fast mortality decline than during periods of slow decline, although during the latter the contribution made by infant mortality became more dominant.

Countries with the same mortality level in the late 1960s had different trends of mortality during the 1970s. Information for these countries supports the hypothesis that generalizations about recent trends of mortality in developing countries are almost impossible to make. Each country seems to be a separate case due to the unique combination of the mortality level already achieved and the socio-economic characteristics of the population. Thus, the similarity of the pace and pattern of mortality decline observed in many developing countries during the 1950s was apparently a unique phenomenon. Whether or not that phenomenon will be repeated in other developing countries is uncertain.

### The Change of Causes of Death

A study of causes of death permits analysis of the change of mortality from two different points of view. The first is a calculation of the contribution of each cause of death to the change of mortality within each age group. The second is a calculation of the contribution made by any change of each cause of death to life expectation, or years of life.

Relatively few developing countries have reliable information on causes of death. Among countries for which the change of mortality has been analysed, only 8 present information on causes of death by age and sex that allows determination of the main causes responsible for the reduction of mortality during different periods of time. Only 5 countries have information on causes of death which reaches the late 1970s.

The analysis of mortality change by age and causes of death does, however, permit some generalization. The reduction of mortality from infectious, contagious, and parasitic diseases, and diseases of the respiratory system, made the largest contribution to the reduction of mortality in most of the developing countries during the 1960s. Mortality from accidents, degenerative diseases, and diseases of the circulatory system did not change significantly during the same period (Arriaga, 1981).

Although the countries for which analysis by causes of death is possible have different levels of mortality, and the observations pertain to different periods, there are some similarities with respect to the causes of death which contributed the most to mortality decline. This similarity is more pronounced at the younger ages. In the 12 periods studied for 8 countries (Tables 5.5 and 5.6), for males in every period and for females in all but one,

the reduction of deaths from infectious, contagious, and parasitic diseases was one of the three main groups of causes contributing most to the decline of infant mortality. A very similar situation was observed at ages 1–4 years. (It should be mentioned here that the group of 'other' diseases includes deaths of early infancy, those connected with complications of delivery, and puerperal infections.) At older ages (over 45 years), the reduction in deaths due to circulatory diseases and degenerative diseases had a significant effect on mortality decline in all countries. Nevertheless, it seems that there was a different pattern of causes of death between some Latin American and Asian populations. In Hong Kong, Singapore, and Taiwan the reduction of mortality from diseases of the respiratory system in old age seems to be more important than it was in Latin American countries. Although Chile has some resemblance to the Asian countries, in Costa Rica and Argentina the reduction of mortality from diseases of the circulatory system and degenerative diseases were significant contributors to the decline of mortality. It seems that mortality related to diseases of the respiratory system in some Asian countries was 'excessively' high in the past. Their rather recently observed economic development may have had an important impact on reducing deaths from diseases related to the respiratory system.

The contribution of the change in each cause of death within each age group to the change of life expectancies can be estimated by using a new technique which does not require the construction of multi-decrement life-tables (see Appendix 5.I). Although nine groups of causes of death were analysed, they were reduced to five specific groups, with a sixth for 'other' causes.

For all ages, the specific contribution, in number of life years added to life expectation, made by the mortality reduction in each group of causes of death can be seen in Table 5.7. In the Latin American countries, except Chile and Argentina, the largest contributors were infectious, contagious, and parasitic diseases, while in Asian countries diseases of the respiratory system were the largest contributors. Since it is practically impossible to make further generalizations for all countries, the most important features of the experience of each country during the latest period for which there is information are indicated below.

*Argentina—1970–8:* The reductions in diseases of the respiratory system and of infectious, contagious, and parasitic diseases were the first and second most important contributors to the increase of years of life between birth and age 75. The contribution of the reduction of accidents, diseases of the circulatory system, and degenerative diseases was greater for males than females, although males still had higher mortality from such diseases than females. The reduction of diseases of the respiratory system among infants made the largest contribution of life years of all groups of causes to any age group.

Country, period, and life expectancy		Age groups			
at birth (E <sub>0</sub> )		Under 1 year	1-4 years	5-14 years	15-24 years
<b>Argentina</b>					
<i>Period</i>	E <sub>0</sub>	Respiratory system	Infectious and parasitic	Accidents	Accidents
1970 to	61.82	Infectious and parasitic	Respiratory system	Infectious and parasitic	Respiratory system
1978	65.43	Others	Others	Others	Degenerative Diseases
<b>Chile</b>					
<i>Period</i>	E <sub>0</sub>	Infectious and parasitic	Infectious and parasitic	Infectious and parasitic	Respiratory system
1960 to	54.20	Others	Respiratory system	Respiratory system	Other
1970	58.50	Respiratory system	Others	Others	Infectious and parasitic
<b>Costa Rica</b>					
<i>Period</i>	E <sub>0</sub>	Infectious and parasitic	Infectious and parasitic	Infectious and parasitic	Others
1963 to	62.15	Others	Others	Others	Infectious and parasitic
1973	66.18	Respiratory system	Respiratory system	Accidents	Degenerative diseases
1973 to	66.18	Infectious and parasitic	Infectious and parasitic	Infectious and parasitic	Circulatory system
1980	70.30	Respiratory system	Respiratory system	Respiratory system	Infectious and parasitic
		Others	Anaemia and avitaminosis	Circulatory system	Others
<b>Hong Kong</b>					
<i>Period</i>	E <sub>0</sub>	Infectious and parasitic	Infectious and parasitic	Infectious and parasitic	Respiratory system
1961 to	63.64	Respiratory system	Respiratory system	Accidents	Infectious and parasitic
1971	67.36	Degenerative diseases	Accidents	Others	
1971 to	67.36	Others	Infectious and parasitic	Infectious and parasitic	Others
1976	69.57	Infectious and parasitic	Respiratory system	Respiratory system	Respiratory system
		Respiratory system	Others	Degenerative diseases	Infectious and parasitic
<b>Mexico</b>					
<i>Period</i>	E <sub>0</sub>	Infectious and parasitic	Infectious and parasitic	Infectious and parasitic	Others
1960 to	56.38	Others	Others	Others	Infectious and parasitic
1970	58.39		Respiratory system	Respiratory system	Respiratory system
<b>Panama</b>					
<i>Period</i>	E <sub>0</sub>	Infectious and parasitic	Others	Accidents	Others
1960 to	59.75	Others		Others	Accidents
1970	63.55	Respiratory system		Infectious and parasitic	Respiratory system
<b>Singapore</b>					
<i>Period</i>	E <sub>0</sub>	Infectious and parasitic	Infectious and parasitic	Infectious and parasitic	Others
1957 to	60.25	Others	Respiratory system	Others	Infectious and parasitic
1970	65.11	Respiratory system	Others	Respiratory system	Respiratory system
1970	65.11	Infectious and parasitic	Infectious and parasitic	Others	Others
1980	68.84	Others	Respiratory system	Infectious and parasitic	Infectious and parasitic
		Respiratory system	Others	Accidents	Respiratory system
<b>Taiwan</b>					
<i>Period</i>	E <sub>0</sub>	Infectious and parasitic	Infectious and parasitic	Others	Others
1956 to	59.68	Circulatory system	Accidents	Respiratory system	Respiratory system
1961	61.32	Degenerative diseases	Others	Infectious and parasitic	Infectious and parasitic
1961	61.32	Infectious and parasitic	Infectious and parasitic	Infectious and parasitic	Others
1971	66.43	Others	Respiratory system	Others	Accidents
		Respiratory system	Others	Respiratory system	Infectious and parasitic

Note: See Appendix Table 5.A for groups of causes of death

25-34 years	35-44 years	45-54 years	55-64 years	65-74 years
Accidents Others Respiratory system	Accidents Respiratory system Circulatory system	Degenerative diseases Accidents Respiratory system	Circulatory system Degenerative diseases Respiratory system	Circulatory system Degenerative diseases Respiratory system
Respiratory system Other Circulatory system	Respiratory system Circulatory system Infectious and parasitic	Respiratory system Degenerative diseases Circulatory system	Others Respiratory system Circulatory system	na
Infectious and parasitic Degenerative diseases Others	Degenerative diseases Others Infectious and parasitic	Others Degenerative diseases Infectious and parasitic	Degenerative diseases Others Infectious and parasitic	Others Degenerative diseases Infectious and parasitic
Others Infectious and parasitic Respiratory system	Degenerative diseases Infectious and parasitic Anaemia and avitaminosis	Infectious and parasitic Circulatory system Respiratory system	Circulatory system Other Degenerative diseases	Circulatory system Infectious and parasitic Respiratory system
Respiratory system Infectious and parasitic Circulatory system	Respiratory system Circulatory system Infectious and parasitic	Respiratory system Circulatory system Infectious and parasitic	Circulatory system Respiratory system Infectious and parasitic	Circulatory system Infectious and parasitic Accidents
Respiratory system Others Infectious and parasitic	Respiratory system Others Infectious and parasitic	Respiratory system Others Infectious and parasitic	Respiratory system Others Infectious and parasitic	Others Respiratory system Infectious and parasitic
Others Infectious and parasitic Accidents	Others Infectious and parasitic Accidents	Others Infectious and parasitic Accidents	Others Infectious and parasitic	Others Infectious and parasitic
Others Respiratory system Infectious and	Others Respiratory system Accidents	Respiratory system Others Accidents	Others Respiratory system Circulatory system	Others Degenerative diseases Circulatory system
Respiratory system Others Infectious and parasitic	Respiratory system Others Infectious and parasitic	Respiratory system Others Infectious and parasitic	Others Respiratory system Infectious and parasitic	Others Infectious and parasitic
Respiratory system Others Circulatory system	Respiratory system Others Degenerative diseases	Respiratory system Others Infectious and parasitic	Respiratory system Others Infectious and parasitic	Others Infectious and parasitic Respiratory system
Respiratory system Others Infectious and parasitic	Respiratory system Others Infectious and parasitic	Others Respiratory system Infectious and parasitic	Respiratory system Others Infectious and parasitic	Others Circulatory system Respiratory system
Others Respiratory system Infectious and	Others Respiratory system Circulatory system	Others Respiratory system Circulatory system	Others Circulatory system Respiratory system	Others Infectious and parasitic

Table 5.6. Causes of death contributing most to the mortality change in specified ages, selected countries, circa 1950 to 1960, females

Country, period, and life expectancy		Age groups			
at birth (E <sub>0</sub> )		Under 1 year	1-4 years	5-14 years	15-24 years
Argentina					
Period	E <sub>0</sub>	Respiratory system	Infectious and parasitic	Infectious and parasitic	Others
1970 to	69.19	Infectious and parasitic	Respiratory system	Others	Respiratory system
1978	72.12	Others	Others	Respiratory system	Infectious and parasitic
Chile					
Period	E <sub>0</sub>	Infectious and parasitic	Infectious and parasitic	Infectious and parasitic	Respiratory system
1960 to	58.71	Others	Respiratory system	Respiratory system	Others
1970	64.68	Respiratory system	Others	Others	Infectious and parasitic
Costa Rica					
Period	E <sub>0</sub>	Infectious and parasitic	Infectious and parasitic	Infectious and parasitic	Others
1963 to	65.03	Others	Others	Others	Circulatory system
1973	70.15	Respiratory system	Respiratory system	Respiratory system	Infectious and parasitic
1973 to	70.15	Infectious and parasitic	Infectious and parasitic	Infectious and parasitic	Others
1980	75.04	Respiratory system	Respiratory system	Respiratory system	Infectious and parasitic
		Anaemia and avitaminosis	Anaemia and avitaminosis	Circulatory system	Respiratory system
Hong Kong					
Period	E <sub>0</sub>	Infectious and parasitic	Respiratory system	Infectious and parasitic	Respiratory system
1961 to	70.51	Respiratory system	Infectious and parasitic	Accidents	Infectious and parasitic
1971	75.01	Others	Accidents	Respiratory system	Others
1971 to	75.01	Others	Infectious and parasitic	Infectious and parasitic	Circulatory system
1976	76.42	Respiratory system	Respiratory system	Respiratory system	Infectious and parasitic
		Infectious and parasitic	Anaemia and avitaminosis	Others	Others
Mexico					
Period	E <sub>0</sub>	Infectious and parasitic	Infectious and parasitic	Infectious and parasitic	Others
1960 to	59.58	Others	Others	Others	Infectious and parasitic
1970	62.32		Respiratory system	Respiratory system	Respiratory system
Panama					
Period	E <sub>0</sub>	Infectious and parasitic	Accidents	Others	Others
1960 to	63.18	Others		Respiratory system	Accidents
1970	66.28	Respiratory system		Accidents	Respiratory system
Singapore					
Period	E <sub>0</sub>	Infectious and parasitic	Infectious and parasitic	Respiratory system	Others
1957 to	65.22	Respiratory system	Respiratory system	Infectious and parasitic	Respiratory system
1970	69.98	Others	Others	Others	Infectious and parasitic
1970 to	69.98	Infectious and parasitic	Respiratory system	Others	Others
1980	74.10	Others	Infectious and parasitic	Infectious and parasitic	Infectious and parasitic
		Respiratory system	Others	Respiratory system	Respiratory system
Taiwan					
Period	E <sub>0</sub>	Circulatory system	(All diseases increased)	Infectious and parasitic	Others
1956 to	63.54	Degenerative diseases		Respiratory system	Respiratory system
1961	65.59			Others	Circulatory system
1961 to	65.59	Infectious and parasitic	Infectious and parasitic	Infectious and parasitic	Accidents
1971	71.54	Others	Respiratory system	Others	Others
		Respiratory system	Others	Respiratory system	Circulatory system

Note: See Appendix Table 5.A for groups of causes of death

25-34 years	35-44 years	45-54 years	55-64 years	65-74 years
Others	Others	Degenerative diseases	Circulatory system	Circulatory system
Respiratory system	Respiratory system	Respiratory system	Degenerative diseases	Degenerative diseases
Infectious and parasitic	Degenerative diseases	Others	Others	Others
Others	Respiratory system	Respiratory system	Others	na
Respiratory system	Others	Others	Respiratory system	
Infectious and parasitic	Circulatory system	Degenerative diseases		
Others	Others	Degenerative diseases	Degenerative diseases	Others
Respiratory system	Degenerative diseases	Others	Others	Degenerative diseases
Infectious and parasitic	Infectious and parasitic	Circulatory system	Infectious and parasitic	Infectious and parasitic
Others	Circulatory system	Circulatory system	Circulatory system	Circulatory system
Circulatory system	Others	Others	Degenerative diseases	Respiratory system
Respiratory system	Infectious and parasitic	Infectious and parasitic	Respiratory system	Infectious and parasitic
Respiratory system	Respiratory system	Respiratory system	Circulatory system	Circulatory system
Others	Circulatory system	Circulatory system	Respiratory system	Respiratory system
Circulatory system	Accidents	Degenerative diseases	Infectious and parasitic	Infectious and parasitic
Respiratory system	Others	Others	Others	Others
Others	Respiratory system	Respiratory system	Respiratory system	Respiratory system
Infectious and parasitic	Degenerative diseases	Degenerative diseases	Anaemia and avitaminosis	Anaemia and avitaminosis
Others	Others	Others	Others	Others
Infectious and parasitic	Infectious and parasitic	Infectious and parasitic	Infectious and parasitic	Infectious and parasitic
Respiratory system	Respiratory system	Degenerative diseases		
Others	Others	Others	Others	Others
Respiratory system	Respiratory system	Respiratory system	Respiratory system	Respiratory system
Infectious and parasitic	Degenerative diseases	Respiratory system	Circulatory system	Degenerative diseases
Others	Others	Degenerative diseases	Others	Degenerative diseases
Respiratory system	Respiratory system	Respiratory system	Respiratory system	Respiratory system
Circulatory system	Circulatory system	Circulatory system	Infectious and parasitic	Circulatory system
Others	Others	Others	Others	Others
Respiratory system	Respiratory system	Respiratory system	Respiratory system	Respiratory system
Infectious and parasitic	Infectious and parasitic	Infectious and parasitic	Infectious and parasitic	Infectious and parasitic
Others	Others	Others	Others	Others
Respiratory system	Respiratory system	Respiratory system	Respiratory system	Respiratory system
Circulatory system	Circulatory system	Circulatory system	Infectious and parasitic	Infectious and parasitic
Others	Others	Others	Others	Others
Respiratory system	Respiratory system	Respiratory system	Respiratory system	Respiratory system
Circulatory system	Infectious and parasitic	Infectious and parasitic	Infectious and parasitic	Infectious and parasitic
Others	Others	Others	Others	Others
Respiratory system	Respiratory system	Respiratory system	Respiratory system	Respiratory system
Circulatory system	Circulatory system	Circulatory system	Circulatory system	Circulatory system

Table 5.7. Contribution of specific causes of death to the change of temporary life expectancy from birth to age 75 years, all ages and under 1 year, selected countries and periods, males and females

	Argentina 1970-8		Chile 1960-70		Costa Rica 1963-73		1973-80	
	Male	Female	Male	Female	Male	Female	Male	Female
Total change (in years) of the temporary life expectancy from birth to age 75 years	2.77	2.10	3.60	4.80	3.68	4.25	3.49	3.79
Total contribution of selected causes (all ages)	1.92	1.34	2.27	2.92	2.10	2.32	2.79	3.06
Respiratory system	.65	.56	1.28	1.51	.22	.33	.58	.68
Degenerative diseases	.25	.13	.02	.00	.31	.39	.11	.11
Accidents	.24	.12	-.31	-.09	-.06	-.06	-.15	.08
Circulatory system	.20	.08	.10	.06	-.16	-.06	.31	.50
Infective and parasitic	.51	.50	1.41	1.63	1.79	1.72	1.74	1.64
Anaemias and avitaminosis	.07	.05	n.a.	n.a.	n.a.	n.a.	.20	.21
Per cent of total contribution due to selected causes	70	64	63	61	57	55	80	81
Contribution of infant mortality rate change	1.14	1.06	1.55	1.68	1.67	1.55	2.24	2.00
Contribution of selected causes	.99	.89	1.65	1.74	1.40	1.29	1.86	1.64
Respiratory system	.41	.37	.29	.35	.13	.18	.40	.41
Infective and parasitic	.34	.33	.75	.75	.91	.87	1.22	1.10
Other	.17	.14	.61	.64	.36	.24	.13	.03
Anaemias and avitaminosis	.07	.05	n.a.	n.a.	n.a.	n.a.	.11	.10
Per cent of the total infant mortality contribution due to selected causes	87	84	106	104	84	83	83	82

Note: See Appendix Table 5.A. for groups of causes of death.

**Chile—1960-70:** The reduction of infectious, contagious, and parasitic diseases produced a gain of one and a half years of life expectation between ages 0 and 65. The decline of diseases of the respiratory system also made a significant contribution. Most of the contribution of reductions in infant mortality to the increase of life years was due to the reduction of infectious, contagious, and parasitic diseases and diseases of early infancy (which are included in the group of 'others').

**Costa Rica—1963-73, 1973-80:** The contribution of the groups of causes of deaths to the increase of years of life was astonishingly similar during the two periods of time. Infectious, contagious, and parasitic diseases contributed around 1.7 years of life in both periods (the largest contribution). However, while a change (an increase) in mortality from diseases of the circulatory system tended to reduce life expectation during the first period, a change in the opposite direction added 0.3 and 0.5 years among males and females, respectively, during the second period. Among infants, the reductions of infectious, contagious, and parasitic diseases added about one year of life in each period.

**Hong Kong—1961-71, 1971-6:** Each period presents a completely different pattern. While the reduction of infectious, contagious, and parasitic diseases contributed more than one year of life during the first period, the contribution during the second period was almost insignificant; during that second period the reduction of mortality from diseases of the respiratory

	Hong Kong 1961-71		1971-76		Mexico 1960-79		Panama 1960-70		Singapore 1957-70		1970-80		Taiwan 1961-72	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
	2.85	3.04	1.71	.93	2.17	2.70	3.20	2.30	4.45	4.27	2.25	1.50	4.33	4.81
	2.61	2.71	.60	.28	1.30	1.28	.96	.68	1.88	1.63	1.32	.85	2.94	3.15
	1.05	1.11	.79	.35	-.16	-.15	.40	.20	1.12	.91	.61	.36	.86	.96
	-.26	-.01	-.11	.02	-.02	.00	.12	.06	-.17	.11	.09	-.05	-.13	.17
	.09	.14	.12	.07	.11	.03	.19	.01	-.12	.00	.28	.09	-.10	.13
	.49	.29	-.17	.21	-.14	-.12	.08	-.07	-.16	.13	.13	.19	.32	.10
	1.24	1.17	.19	.17	1.51	1.60	.93	.47	1.20	.96	.16	.19	1.98	2.13
	n.a.	n.a.	.02	.01	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	.06	.08	n.a.	n.a.
	91	89	35	30	60	57	30	30	42	38	59	57	.68	66
	1.14	1.21	.50	.35	.19	.35	1.56	1.51	1.45	1.23	.72	.46	1.57	2.05
	1.05	1.13	.51	.34	.66	.78	1.32	1.24	1.00	.85	.65	.39	1.60	2.04
	.38	.40	.11	.11	-.37	-.27	.16	.23	.20	.19	.14	.12	.13	.31
	.75	.67	.02	.02	.60	.57	.91	.67	.59	.49	.08	.08	1.08	1.14
	-.08	.06	.38	.21	.43	.48	.25	.34	.21	.17	.43	.18	.39	.59
	n.a.	n.a.	.00	.00	n.a.	n.a.	n.a.	n.a.	n.a.	.00	.00	.01	n.a.	n.a.
	92	93	100	97	347	223	85	82	69	69	90	85	102	100

system was the largest contributor of years of life. In addition, the increase of accidents, diseases of the circulatory system, and degenerative diseases during the second period acted to reduce life by 0.4 of a year.

**Mexico—1960-70:** Although mortality was still high in 1960, it did not decline very much during the next decade. The only diseases whose reduction contributed significantly to the increase of life were infectious, contagious, and parasitic diseases, and their contribution was only 1.5 years. The contribution of life years made by the change in infant mortality was the lowest among the countries analysed.

**Panama—1960-70:** Declines in the five groups of causes of death listed in Table 5.7 made a relatively small contribution to increase in life expectation in this country (only 30 per cent). But nevertheless the reduction of deaths from infectious, contagious, and parasitic diseases added almost 1 year to the life expectation of males and 0.5 years to that of females.

**Singapore—1957-70, 1970-80:** The reduction of deaths from respiratory and infectious, contagious, and parasitic diseases in this country from 1957-70 made a contribution of life years which exceeded 2.3 years and 1.9 years for males and females, respectively. However, during the same period the increase of mortality from degenerative diseases, accidents, and diseases of the circulatory system reduced the number of life years (0.45 and 0.24 for males and females, respectively). The total decline in infant mortality added more than a year of life, of which half a year was due to the decline of



infectious, contagious, and parasitic diseases among infants. During the later period, 1970–80 (when Singapore had already achieved low mortality), the main contributor to the increase of life years was the reduction of mortality from respiratory diseases; for infants, the group of causes with the largest contribution was 'other' (mainly because of the reduction of deaths from diseases of early infancy such as puerperal infections and complications during delivery).

*Taiwan—1961–72:* Taiwan's experience resembled that of Singapore during a similar period. The reduction of mortality from infectious, contagious, and parasitic diseases and diseases of the respiratory system added 2.8 and 3.1 years of life among males and females, respectively. Mortality from degenerative diseases and accidents increased, and tended to reduce the life of the population. Among infants, the reduction of mortality from infectious, contagious, and parasitic diseases contributed an additional year of life to each sex.

### The Gap between Developing Countries and the United States

The United States has achieved low mortality levels (particularly for females) when compared with the rest of the world. The comparison of the United States with the countries considered in this article has the purpose of identifying (a) the causes of death that may be reduced in developing countries; (b) possible gains in life expectation if mortality differentials for each cause of death are reduced; and (c) the differences among developing countries (since all are compared with the United States as standard). (See Tables 5.8 and 5.9.)

For males, Costa Rica and Hong Kong have the lowest mortality between birth and age 75, even lower than the United States. The difference in mortality from diseases of the circulatory system between the United States and Costa Rica gives to the latter 1.1 more years of life than the former (Table 5.9). Similarly, a half year in favour of Costa Rica is due to mortality differentials for accidents and degenerative diseases. On the other hand, if Costa Ricans wish to reduce male mortality further, efforts should be concentrated on diseases of the respiratory system and infectious, contagious, and parasitic diseases. If the mortality level from these two groups were reduced to the level of the United States, males in Costa Rica would, on the average, add another half year of life from birth to age 75. Life among Costa Ricans could also be increased by further reduction of infant mortality.

Hong Kong and Singapore are not so different from Costa Rica. These three countries have achieved low mortality levels and are no longer representative of the mortality conditions in developing countries. However, some attention should be given to such situations as the case of Chile, Mexico, and Panama in 1970. Although these three countries continued to

Table 5.8. Comparison of the United States temporary life expectancy from birth to age 75 years with selected countries, contribution of the mortality differential at each particular age group to total difference of temporary life expectancy, by sex

Country and year	Sex	Contribution of age groups										
		Total	Under 1 year	1-4 years	5-14 years	15-24 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years	
Argentina 1978	Male	3.56	2.01	.30	.14	—	.12	.06	.34	.43	.29	.11
	Female	3.29	1.79	.34	.13	.16	.25	.27	.16	.06	.13	
Chile 1970	Male	9.80	5.01	.73	.29	.17	.86	1.00	.93	.62	.20	
	Female	9.07	4.51	.73	.25	.32	.58	.76	.71	.77	.43	
Costa Rica 1980	Male	—0.36	.67	.08	.12	—	.23	—	.01	—	.45	—
	Female	0.60	.42	.09	.07	.01	.04	.03	.09	.05	.09	
Hong Kong 1976	Male	—0.16	.11	.03	.03	—	.38	—	.00	.01	.09	.11
	Female	0.22	.06	.08	.04	—	.04	.06	.02	.05	.03	.02
Mexico 1970	Male	10.23	4.37	2.18	.66	.38	.81	.81	.94	.60	.26	.04
	Female	11.02	3.92	2.48	.69	.51	.85	.85	.87	.67	.65	.38
Panama 1970	Male	5.58	2.84	1.86	.64	.08	.18	.18	.17	.05	.17	.02
	Female	7.79	2.37	1.96	.66	.45	.58	.58	.54	.47	.44	.32
Singapore 1980	Male	—0.04	.15	.01	.06	—	.30	—	.23	.15	.37	.29
	Female	0.82	.02	.03	.04	.03	.02	.02	.03	.04	.42	.34
Taiwan 1972	Male	2.22	1.20	.23	.15	—	.15	.09	.16	.06	.22	.25
	Female	2.97	.94	.21	.12	.08	.18	.40	.26	.38	.40	

Table 5.9. Difference in temporary life expectancy from birth to age 75 years between the United States (1980) and selected countries and the contribution to such differential by selected causes of death, all ages and age under 1 year, male and female

	Argentina 1978		Chile 1970		Costa Rica 1980		Hong Kong 1976		Mexico 1970		Panama 1970		Singapore 1980		Taiwan 1972	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Total difference (in years) of the temporary life expectancy from birth to age 75 years (US-country)	3.56	3.29	9.80	9.07	-.36	.60	-.16	.22	10.23	11.02	5.58	7.79	.09	.82	2.22	2.97
Total difference due to selected causes:																
Respiratory system	3.22	2.96	9.43	8.64	-.67	.45	-.20	.22	8.64	9.40	3.64	5.72	.16	.89	2.02	2.82
Degenerative diseases	.54	.47	3.10	2.67	.34	.31	.76	.37	3.11	2.87	1.40	1.59	.68	.43	1.52	1.24
Accidents	.14	-.01	.17	.49	-.31	-.14	.45	.03	-.69	-.11	-.40	.01	.31	.10	.06	-.02
Circulatory system	-.14	-.03	1.44	.32	-.21	-.13	-.91	-.17	.80	.08	.01	-.07	-.88	-.32	-.12	.11
Infectious and parasitic	.59	.54	-.14	.69	-1.12	-.16	-.65	-.09	.73	.54	-.62	.36	.05	.37	-.49	.56
Other <sup>a</sup>	.82	.78	1.86	1.82	.20	.18	.08	.04	3.84	3.91	2.12	2.32	.09	.08	.45	.39
Other <sup>b</sup>	1.27	1.21	3.00	2.65	.43	.39	.07	.04	2.31	2.11	1.13	1.51	-.09	.23	.60	.54
Per cent of total difference due to selected causes	90	90	96	95	186	75	125	100	84	85	65	73	177	109	91	95
Total difference due to different infant mortality rates:																
Difference due to selected causes:																
Respiratory system	2.01	1.79	5.01	4.51	.67	.42	.11	.06	4.37	3.92	2.84	-2.37	-.15	.02	1.20	.94
Infectious and parasitic	1.80	1.58	4.81	4.32	.67	.45	.25	.17	3.96	3.53	2.17	1.77	-.01	.11	1.21	.94
Other <sup>b</sup>	.32	.30	1.82	1.70	.18	.11	.11	.08	1.56	1.41	.55	.49	.06	.05	.70	.61
Per cent of total difference due to infant mortality made by selected causes	.59	.54	1.44	1.34	.15	.12	.03	.02	1.71	1.61	.92	.86	.02	.03	.31	.25
Other <sup>b</sup>	.89	.74	1.55	1.28	.34	.22	.11	.07	.69	.51	.70	.42	-.09	.03	.20	.08
Per cent of total difference due to infant mortality made by selected causes	90	88	96	96	100	107	225	283	91	90	76	75	7	550	101	100

<sup>a</sup> Includes anaemia and avitaminosis.

<sup>b</sup> Most of deaths pertain to early infancy causes.

Notes: See Appendix Table 5.A for groups of causes of death.

reduce mortality (mainly infant mortality) after 1970 their comparison with the United States gives a picture of mortality improvements that 'developing countries' could make. More than 3 years of life between birth and age 75 could be added to populations like those of Chile and Mexico in 1970, if only infant mortality from respiratory diseases and infectious, contagious, and parasitic diseases were reduced to levels similar to the United States (Table 5.9). Among males, almost another one and a half years of life could be added if mortality rates from accidents were reduced from levels found in Chile in 1970 to the levels of the United States. (For Mexico, it would be 0.8 of a year.) Countries with situations similar to that of Mexico in 1970 could increase the average life of their populations by almost 7 years if they reduced mortality from diseases of the respiratory system and infectious, contagious, and parasitic diseases at all ages.

### Conclusions

The similarity of massive public health programmes applied in some developing countries in the 1950s or earlier produced not only a fast mortality decline but also a similar decline by age and causes of death. Diseases of the respiratory system and infectious, contagious, and parasitic diseases were significantly reduced from very high levels. The reductions in these causes of death were the main contributors to the increase of life expectancy.

During the 1960s, the patterns of mortality reduction in these countries presented fewer similarities than previously. Some countries, because of particular characteristics (education, nutrition, and area of the territory) and the concern of their planners in improving health conditions, were able to continue a fast reduction of mortality. Hong Kong, Costa Rica, Cuba, Singapore, Paraguay, and Malaysia, among others, are examples. Other developing countries suffered a stagnation of the mortality decline. Argentina, Mexico, and Sri Lanka are typical documented cases (Arriaga, 1981, Meegama, 1981). During the 1960s, infant and child mortality was reduced much more than adult mortality, and in some populations adult males suffered an increase in mortality. In general, during the decade of the 1960s there was a slowing down of the mortality decline, but it was in relation to the pace during the previous decade, which was one without precedent. In addition, the reduction of mortality during the 1960s depended, more than before, upon the social and economic characteristics of each population, and since those differ from country to country, generalizations become more difficult to make.

The mortality trends in developing countries during the 1970s have become even more distinct in each country. The available information pertains to countries which have already achieved rather low mortality levels, and further reduction will be more dependent than before upon the

characteristics of each country. Generalizations are almost impossible to make concerning the pace and pattern of the mortality trend in the 1970s. For those developing countries which have achieved low mortality, further reduction could be achieved by concentrating efforts on reducing deaths from diseases of the respiratory system and those related to infectious, contagious, and parasitic diseases. However, mortality reduction from these causes of death would only increase life expectation by a fraction of a year. If these countries with low mortality can afford to have expensive equipment for further reducing early infant mortality, another fraction of a year could be added to life.

In those countries where life expectations at birth still range between 60 and 65 years, a significant increase of life years could be achieved by concentrating efforts on reducing mortality from respiratory and infectious, contagious, and parasitic diseases.

The question remains of the situation in countries where no information is available. The registration sample system of India has provided some mortality data for that country. Mortality in India appears to have declined slowly during the 1950s and 1960s. However, information for the latter part of the 1970s shows a more rapid mortality decline. Other countries may soon follow the trend of India, with a faster mortality decline during a rather short period of time. Although no reliable information exists on causes of death, it is likely that the reduction will be made possible by combating infectious, contagious, and parasitic diseases, and diseases of the respiratory system. In other words, the experience of countries such as Sri Lanka, Costa Rica, Cuba, and even China, where mortality was rapidly reduced during the 1950s and 1960s without substantial economic development, can be repeated in other developing countries. Programmes for reducing mortality which have been conducted in those countries may serve as examples of what can be done in other developing countries to extend life expectation.

## APPENDIX 5.1

### *Measuring the Change of Mortality*

In this chapter, the change of mortality has been measured by using the index of relative annual change of temporary life expectations. The index is:

$$ARC = 1 - (1 - RC)^{1/n}$$

where

$$RC = \frac{e_x^{t+w} - e_x^t}{i - e_x^t}$$

and

$$e^t = \frac{T_x^t - T_{x+i}^t}{1_x}$$

The RC index measures the change in the average number of years lived between ages  $x$  and  $x+i$  by those alive at age  $x$  from year  $t$  to  $t+n$ , in relation to the maximum possible change. The latter is the difference between the length of the age group ( $i$ ) under study and the average number of years lived between age  $x$  and  $x+i$  by those alive at age  $x$  in year  $t$ .

### *Estimation of the Contribution of the Mortality Change by Age and Causes of Death to the Life Expectation*

A recent article (Arriaga, 1984) gives a simple procedure for measuring the contribution to life expectation made by the change of mortality at each particular age group. The procedure estimates the number of years added to or removed from life expectation because of the decrease or increase (respectively) of the central mortality rates of life-tables. The contribution of mortality change by causes of death to the life expectations was estimated under the assumption that the contribution to the life expectation by the mortality change by causes of death in each age group was proportional to the contribution to the change of the total central mortality rate made by the mortality change in each cause of death in the same age group. In symbols, for each age group, the contribution to the life expectation made by the change of mortality in a specific age group ( $SAC_j(e_x)$ ) is a function of the mortality change in each age group ( $m_j^t - m_j^0$ ) from year 0 to 1.

$$SAC_j(e_x) = F(m_j^t - m_j^0)$$

If we write  $C_j = m_j^t - m_j^0$  for the total change of mortality in the age group  $j$ , the change of mortality for each cause of death would be

$${}_cC_j = {}_cm_j^t - {}_cm_j^0$$

and consequently

$$C_j = \sum_{c=1}^s {}_cC_j$$

for the  $s$  groups of causes of death. In other words, the change of mortality in a given age group equals the sum of the changes of mortality in each cause of death within the same age group. Therefore, it is assumed that the contribution to the life expectation made by the change of each cause of death will be (proportional):

$${}_cSAC_j(e_x) = SAC_j(e_x) \frac{{}_cC_j}{C_j}$$

This procedure gives results which are similar to those produced by using multiple-decrement life-tables. The advantage is that this procedure does not require the construction of as many multiple-decrement life-tables as the product of the number of age groups by the number of causes of death being analysed for each sex.

## APPENDIX 5.2. SOURCES OF DATA

### *Causes of Death*

For all countries except the United States and Taiwan 1971-3, these were obtained from various years of World Health Organization, *World Health Statistics Annual*,

Geneva. For the United States 1979 and 1980, they were obtained from the US Department of Health and Human Services, *Vital Statistics of the United States (1979 and 1980)*, vol. 2, *Mortality*, Washington, DC, 1983 and 1984. For Taiwan 1971, 1972, and 1973, the figures came from National Health Administration, *Health Statistics, Vital Statistics*, 1971, 1972, 1973, Taipei, Taiwan.

### Sources of Life-tables

Argentina	1946-8	Camisa, Zulma, <i>Tabla Abreviada de Mortalidad. Republica Argentina, 1946-48</i> , CELADE, Santiago, Chile, 1964.
	1959-61	Ortega, Antonio, <i>Tablas Completas de Mortalidad Para la Republica Argentina, 1959-61</i> , CELADE, Santiago, Chile, 1967.
	1969-70	US Bureau of the Census, unpublished life-table, Washington, DC, 1979.
	1975-80	Instituto Nacional de Estadística y Censos, and UN CELADE, <i>Estimaciones y Proyecciones de Poblacion 1950-2025</i> , Buenos Aires, 1982.
Chile	1952	Arriaga, Eduardo, <i>New Life Tables for Latin America Populations in the Nineteenth and Twentieth Centuries</i> , Institute of International Studies, University of California, Berkeley, 1968.
	1960	
	1969-70	US Bureau of the Census, <i>Country Demographic Profiles: Chile</i> , Washington, DC, 1978.
Costa Rica	1950	Arriaga, Eduardo, op. cit.
	1963	Ibid.
	1972-4	US Bureau of the Census, <i>Country Demographic Profiles: Costa Rica</i> , Washington, DC, 1977
	1980	Rosero, Luis and Caamano, Hernan, 'Tablas de vida de Costa Rica 1900-1980' in <i>Mortalidad y Fecundidad en Costa Rica</i> , Asociacion Demografica Costarricense, San Jose, March 1984.
Cuba	1952-4	Gonzalez, Fernando and Debasa, Jorge, 'Cuba: Evolucion y ajuste del censo de 1953 y las estadísticas de nacimientos y defunciones entre 1943 y 1958. Tabla de Mortalidad por Sexo 1952-54', CELADE, Santiago, Chile, 1970.
	1969-71	Bureau of the Census, Rowe, Patricia, and O'Connor, Susan, 'Detailed Statistics on the Urban and Rural Population of Cuba: 1950 to 2010', Center for International Research, Washington, DC, March 1984.
	1977-8	Ibid.
Hong Kong	1961	Commissioner of Census and Statistical Planning, 'Hong Kong Life Tables 1961-68', Hong Kong, 1963.

	1971	Census and Statistical Department, 'Hong Kong Life Tables 1971-1991', Hong Kong, 1973.
	1976	Census and Statistical Department, 'Hong Kong Life Tables', Hong Kong, March 1978.
India	1951-61	Jain, S. P., Office of the Registrar General, 'Actuarial Report and Life Tables 1951-1961', New Delhi.
	1961-70	Chari, R. B., Registrar General and Census Commissioner, <i>Life Tables: Census of India 1971. Series I, India</i> . Paper 1 of 1977, New Delhi, 1977.
	1976-7	Registrar General, <i>Sample Registration Bulletin</i> , vol. 14, no. 2, December 1980.
	1980	Registrar General, <i>Census of India 1981: Series I, India</i> . Paper 1 of 1984. Population Projections for India 1981-2001, New Delhi, 1984.
Mexico	1950	Arriaga, Eduardo, op. cit.
	1960	Ibid.
	1969-70	Rowe, Patricia, <i>Country Demographic Profiles: Mexico</i> . US Bureau of the Census, Washington, DC, 1979.
Panama	1950	Arriaga, Eduardo, op. cit.
	1960	Ibid.
	1969-70	US Bureau of the Census, <i>Country Demographic Profiles: Panama</i> . Washington, DC, 1977
Singapore	1947	US Bureau of the Census, unpublished life-tables.
	1957	Chua, S. C., State of Singapore, <i>Report on the Census of Population 1957</i> , Singapore, no date.
	1980	US Bureau of the Census, unpublished life-tables.
Taiwan	1951	Lu Liang Chinn, Chu Yihui, and Wei Shou Pen, 'Abridged Life Tables for Residents of Taiwan 1950-1969' (no date or name of institution).
	1961	Ministry of Interior, 'Abridged Life Tables for Taiwan 1961-70', Taipei, March 1972.
	1971	Ministry of Interior, <i>1971 Taiwan Demographic Fact Book</i> , Taiwan, 1972.
	1981	Ministry of Interior, <i>1981 Taiwan-Fukien Demographic Fact Book</i> , Taipei, December 1982.
United States	1980	US Department of Health and Human Services, National Center for Health Statistics, <i>Monthly Vital Statistical Report</i> , vol. 33, no. 3, supplement, 22 June 1984.
Venezuela	1950	Arriaga, Eduardo, op. cit.
	1961	Ibid.
	1971	US Bureau of the Census, unpublished life-table.

Table 5.A. Groups of causes of death

Cause group	Diseases		
	1960 <sup>a</sup>	1970 <sup>b</sup>	1980 <sup>c</sup>
Certain respiratory diseases	B1	A6	020-1
	B31-2	A89, A91-6	310-15
			319-21
			323-7
			329
Certain degenerative disease	B18-19	A45-61	080-170
	B33	A98	341, 360
	B39	A109	
Accidents and violence	BE45-50	AE138-50	E470-560
Certain circulatory diseases	B22	A80-8	250-300
	B25-9		
Other parasitic and infectious diseases	B2-17	A1-5	010-019
	B30	A7-44	022-070
	B36	A90	
	B43	A99	
Anaemias	B21	A67	200
Avitaminosis	Included in next section	A65	190-3
Other causes	All diseases not mentioned elsewhere.		
Senility and unknown causes	B45	A136-7	465-9

<sup>a</sup> Diseases were grouped according to the Abbreviated List of 50 Causes for Tabulation of Mortality (see World Health Organization, *International Classification of Diseases*, 1955 revision, volume 1, Geneva, 1957).

<sup>b</sup> Diseases were grouped according to the List of 150 Groups of Causes for Tabulations of Morbidity and Mortality (see World Health organization, *International Classification of Diseases*, 1965 revision, volume 1, Geneva, 1968).

<sup>c</sup> Diseases were grouped according to the list of ICD-9 of 1979, which includes the causes of death (see World Health Organization, *International Classification of Diseases*, 1979 revision, Geneva, 1979).

## References

- Arriaga, E. E. (1981), 'The Deceleration of the Decline of Mortality in LDCs: The Case of Latin America', *IUSSP International Population Conference, Manila 1981*, vol. 2, International Union for the Scientific Study of Population, Liège, 21-50.
- (1984), 'Measuring and Explaining the Change of Life Expectancies', *Demography* 21(1), 83-96.
- and Kingsley Davis (1969), 'The Pattern of Mortality Change in Latin America', *Demography* 6(3), 223-42.
- Bureau of the Census (1983), *World Population 1983: Recent Demographic Estimates for the Countries and Regions of the World*, Washington, D.C.
- Meegama, S. (1981), 'The Decline of Mortality in Sri Lanka in Historical Perspective', *IUSSP International Population Conference, Manila 1981*, vol. 2,

International Union for the Scientific Study of Population, Liège, 143-64.

Sivamurthy, M. (1981), 'The Deceleration of Mortality Decline in Asian Countries', *IUSSP International Population Conference, Manila 1981*, vol. 2, International Union for the Scientific Study of Population, Liège, 51-78.