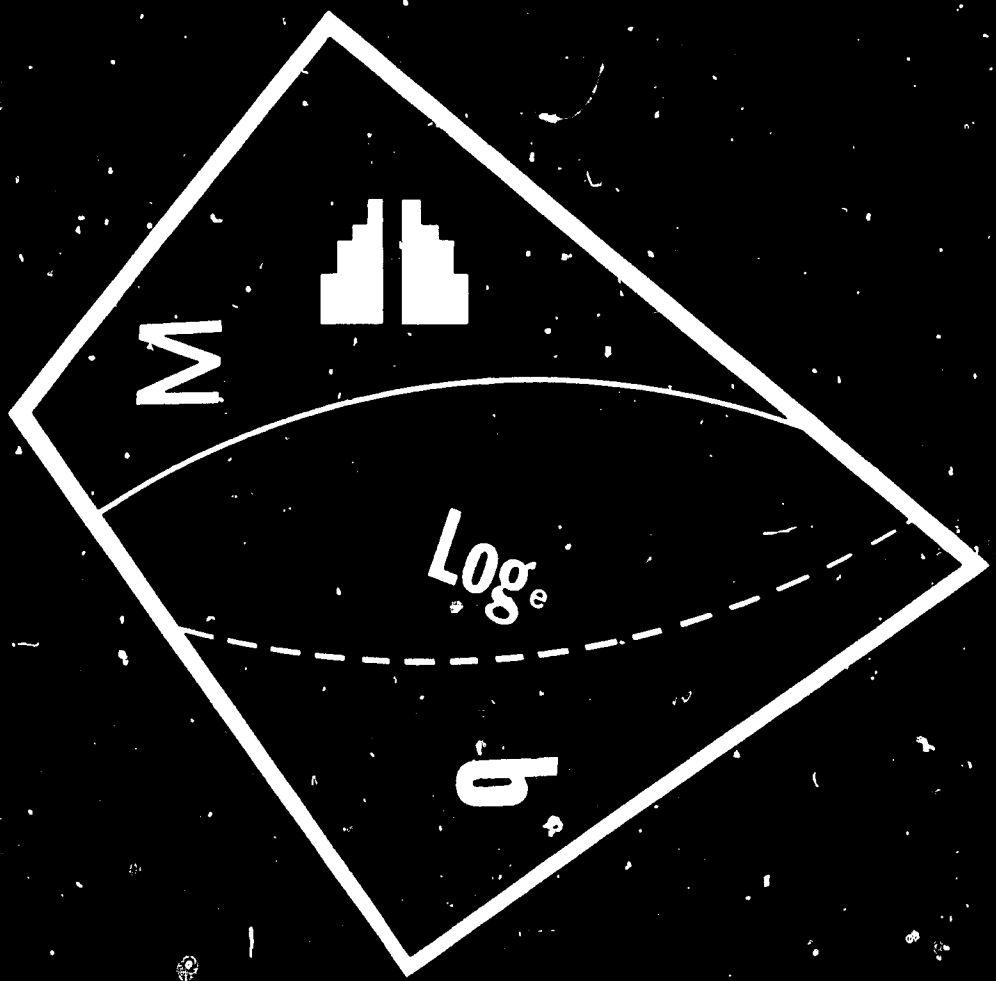
ISP-RD-2

Levels and Trends of Mortality in Indonesia 1961 to 1971

International Research Document No. 2



U.S. DEPARTMENT OF COMMERCE
Bureau of the Census

Prepared under a resources support services agreement with the
U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT
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Levels and Trends of Mortality in Indonesia: 1961 to 1971

by Larry Heligman

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ACKNOWLEDGEMENTS

International Research Document No. 2 was prepared in the International Statistical Programs Center under the general direction of Samuel Baum, Assistant Chief for Demographic Research, and Eduardo Arriaga, Chief, Data Evaluation Branch, by Larry Heligman. Basic editing and design of the publication were conducted under the direction of Lloyd Freese, Chief, Documentation Branch, by Carol Van Horn.

The paper was prepared under a resources support services agreement with the Office of Population, Agency for International Development.

Mr. Heligman first presented the paper at the Annual Meeting of the Population Association of America held in Seattle, Washington, April 17 to 19, 1975.

SUGGESTED CITATION

U.S. Bureau of the Census, Levels and Trends of Mortality in Indonesia, 1961 to 1971, by Larry Heligman, International Research Document No. 2 (ISP-RD-2)
Library of Congress
Card No. 75 - 600074
U.S. Government Printing Office
Washington, D.C. 1975

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Stock Number 003-024-01152-2

Levels and Trends of Mortality in Indonesia, 1961 to 1971

INTRODUCTION

Since the Second World War rapid mortality declines have taken place in many countries of the developing world. Because the major causes of these declines, innovations in public health and sanitation, are thought to be easily importable and applied to countries at any level of economic and technological development, it has been expected that similarly rapid declines would be repeated in other high mortality countries[1].

Indonesia has only partially participated in these declines. During the last half of the 1930's the crude death rate of Indonesia (about 28 per 1,000 inhabitants) was similar to that of its neighbors, Malaysia (21 per 1,000), Hong Kong (29 per 1,000), and Singapore (22 per 1,000) [2]. In 1971, the death rate of Indonesia was still around 20 per 1,000, but the death rates of the three other countries were all below 10 per 1,000.[1] Why did the Indonesian death rate not fall as quickly? Probable factors include:

- A late start in public health and sanitation programs caused by the War of Independence, which immediately followed the Japanese occupation and lasted until 1949; the effects must have lasted beyond the end of the war;
- A precarious and fluctuating food supply, especially of rice, which negated much of the disease eradication program;
- The high cost of modern medicine relative to incomes[3];
- The rapid rise of food prices relative to incomes [4].

This report takes a close look at mortality trends in Indonesia during the 1960's, presents life tables for the country for 1961 and 1971, and discusses the effect of mortality change on other demographic variables.

[1] See table K; and United Nations, *Demographic Yearbook 1972*, New York, pp. 529-530.

SOURCES OF DATA

Levels of mortality in Indonesia are as uncertain as other demographic variables and equally difficult to measure. Vital registration has been mandatory off and on since 1911, but it has never been enforced and has been deficient in both coverage and content. Only changing and selected areas of Java and Madura have been included and about half of the deaths in the covered areas are missed[5]. Annual totals of registered deaths have not been published regularly.

The first population count in Indonesia took place in 1775. Although there have been many since then, the coverage generally has been of low quality and limited to Java. The first attempt to count people individually, instead of relying on village heads for local totals, was in 1920. This was also the first time islands in addition to Java and Madura were included. Other censuses followed in 1930, 1961, and 1971.[2]

In the 1920 census the native population was divided into two broad age groups: less than 15 years and 15 years and older. In the 1930 census the native population was separated into three groups: infants unable to walk, other children, and adults. The actual breakoff point for "children" in 1930 and "less than 15" in 1920 appears to be the same, but probably was not age 15.

The reported age distributions in the 1961 and 1971 censuses show extensive age misstatements and are inconsistent with each other. The International Statistical Programs Center (ISPC) has undertaken a simultaneous evaluation and adjustment of these censuses[6]. These adjusted censuses form the basis for the life tables presented here.

[2] For details about these population counts, see Widjojo Nitisastro, Population Trends in Indonesia, Cornell University Press, New York, 1970, p. 158, and Sam Suharto, Geoffrey McNicoll and Lee Jay Cho, *The 1971 Indonesian Census: An Introduction*, mimeographed, undated.

There have also been numerous demographic and labor force surveys since the mid-1950's, but their low quality renders them of little use for estimating vital events.

THE HISTORICAL TREND OF MORTALITY IN INDONESIA

It is extremely difficult to estimate accurately the historical trend of mortality in Indonesia.[3] The mortality level was extremely high during the period preceding the Second World War. Estimates of crude death rates for this period generally vary from 28 to 35 per 1,000, implying a life expectancy at birth of 30 to 35 years. The annual death rates during this period were highly erratic, varying with the incidence of the traditional epidemic and endemic diseases—malaria, tuberculosis, cholera, smallpox, plague, and typhus. Although some disease control measures were introduced during this period, the incidence of these diseases, except possible plague and smallpox, remained high, facilitated by unsanitary housing and malnutrition[7]. Any decrease in death rates that might have occurred during the late 1930's was probably erased during the Japanese occupation of 1942-45 and the following War of Independence which lasted until 1949.

In spite of the return of smallpox and plague in the early 1950's and a smallpox epidemic in 1956[8], most estimates of death rates have shown a decline during the decade to about the prewar level. The fairly quiet and stable period of economic growth during the 1950's made some kind of decline possible, but expectation of life at birth was probably no higher than 35 to 38 years during the decade.

Although the decline in mortality during the 1950's was probably small, it appears to have signaled a turning point in the mortality history of Indonesia. Instead of continuing on a high, trendless path, mortality had begun a downward trend, albeit slow and erratic.

How fast death rates fell during the 1960's is a matter of speculation. Even though there is a wealth of data for this decade, including the censuses of 1961 and 1971, demographic surveys in 1961 and 1962, and several national socioeconomic surveys, the data in general are defective and inconsistent. As a result, estimates of life expectancies and death rates have been as much a function of the data base chosen and the data-adjustment technique used as of the actual level of mortality.

Estimates of expectation of life at birth during the 1960's have been as low as 37.5 years for 1960 and as high as 45 for 1961 and 47.5 for 1961.[4] Assuming an expectation of life at birth between 35 and 38 years for the 1950's, and considering the economic, environmental, and political conditions of Indonesia during the following years, it is doubtful that expectation of life at birth during the 1960's could have been any higher than 40 to 41.

LIFE TABLES FOR THE 1960's

Previous researchers have prepared three life tables for the 1960's which, because of their accessibility, have been referred to most often[9]. Two are based on the 1961 census and the third on the 1964 national social and economic survey.

In the previous section, life expectancy at birth for the 1950's was judged to be between 35 and 38. Assuming that the life expectancy in 1959 was no greater than 40, all three life tables imply rapid declines in the risk of death. Such rapid declines are inconsistent with the health and economic conditions in Indonesia during the first half of the sixties.[5] Table A gives expectation of life at birth for each of these life tables and the implied pace of improvement from a hypothetical life expectancy of 40 in 1959.

All three of these life tables were constructed with the help of model life tables. As more data are obtained from the developing world, it becomes clear that patterns of mortality much different from those implied by the existing model life table systems have been in force. The most notable differences are in the unexpectedly high levels of child, old age, and female mortality.[6]

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[3] For a more detailed description of the historical trend of mortality, see *Demographic Factbook of Indonesia*, Lembaga Demografi, Fakultas Ekonomi, Universitas Indonesia, Jakarta 1973, pp. 84-129. Except where otherwise noted, this section is based on that source.

[4] An extensive list of mortality estimates for the 1960's is given in Peter F. McDonald, "Fewer Indonesians? *Bulletin of Indonesian Economic Studies*, Vol. 8, No. 1, March 1972, pp. 77-78, and *Demographic Factbook of Indonesia, op. cit.*, pp. 101-111.

[5] A description of the health and economic conditions during the 1960's is given in a later section.

[6] For a comprehensive statement on the deviations of empirical life tables from model life tables and on the weaknesses of existing model life table systems, see the United Nations conference report, *Report of the Ad Hoc Committee of Experts on Methods of Revising United Nations Model* Life Tables (ESO3-WHO EMR/MORT/BP.1), Beirut 1972.

With the results of the 1971 census now available it has become possible to construct new life tables for the 1960's without depending on a model age distribution and life table scheme. The methodology used to construct the life table is based essentially on the census survival technique.[7] The base data were the preliminarily adjusted results of the 1961 and 1971 censuses of Indonesia. Based on the evidence available, it can be assumed that international migration was negligible, thus implying that the intercensal growth rate is a good estimate of the rate of natural increase.[8] That is, the population aged 10 and over in 1971 is simply the entire population in 1961 less the deaths that occurred during the 10-year period. Tables B and C are the resultant intercensal life tables for males and females respectively.

[7] A detailed statement of the methodology is given in the Appendix.

[8] Relative to the total population, international migration has been negligible. See *Demographic Factbook of Indonesia, op. cit.*, pp. 132-137.

Table A. Estimates of Expectation of Life at Birth and Implied Hypothetical Pace of Improvement Since 1959: Indonesia

Source of estimate	Reference period	Expectation of life at birth[1]	Annual improvement in life expectancy at birth (years)[2]
Keyfitz and Flieger[3]	1961	41.9	0.95
Keyfitz and Flieger[4]	1961	45.8	2.90
Demographic Factbook[5] ...	1964	47.4	1.49

[1] Computed from expectations of life at birth by sex by assuming sex ratio at birth = 1.05.

[2] Based on the hypothetical assumption that expectation of life at birth = 40.0 in 1959.

[3] N. Keyfitz and W. Flieger, World Population: An Analysis of Vital Data, University of Chicago Press, Chicago 1968, p. 660.

[4] N. Keyfitz and W. Flieger, Population: Facts and Methods of Demography, W. H. Freeman, San Francisco 1971, p. 392.

[5] Demographic Factbook of Indonesia, Universitas Indonesia Fakultas Ekonomi Lembaga Demografi, Jakarta 1973, pp. 123-124.

Table B. Intercensal Life Table for Males, Indonesia: 1961 to 1971

Age interval	Probability of dying between age x and age x + n	Number of deaths between age x and age x + n	Death rate of life table population between age x and age x + n	Number of persons living at exact age x	Number of persons living between age x and age x + n	Proportion of persons between age x and x + n alive 5 years later	Total years lived after exact age x	Expectation of life, average number of years of life remaining for those alive at exact age
x to x + n.....	$_nq_x$	$_nd_x$	$_nm_x$	l_x	$_nL_x$	$_nP_x$	T_x	e^o_x
0 to 1 year.....	0.15522	15,522	0.17234	100,000	90,066	[1]0.79770	3,739,554	37.40
1 to 4 years.....	0.12270	10,365	0.03357	84,478	308,745	[2]0.89851	3,649,489	43.20
5 to 9 years.....	0.03972	2,941	0.00821	74,113	358,373	0.97406	3,340,705	45.08
10 to 14 years..	0.03796	2,702	0.00774	71,169	349,076	0.96032	2,982,333	41.91
15 to 19 years..	0.04202	2,877	0.00858	68,467	335,226	0.95539	2,633,258	38.46
20 to 24 years..	0.04723	3,098	0.00967	65,590	320,273	0.95080	2,298,033	35.04
25 to 29 years..	0.05118	3,198	0.01050	62,492	304,516	0.94653	1,977,760	31.65
30 to 34 years..	0.05630	3,338	0.01158	59,294	288,232	0.93909	1,673,245	28.22
35 to 39 years..	0.06612	3,717	0.01373	55,956	270,676	0.92682	1,385,013	24.75
40 to 44 years..	0.08128	4,216	0.01693	52,239	250,869	0.90733	1,114,337	21.33
45 to 49 years..	0.10628	5,101	0.02241	47,993	227,637	0.87535	863,468	17.99
50 to 54 years..	0.14636	6,278	0.03150	42,892	199,263	0.82743	635,831	14.82
55 to 59 years..	0.20127	7,479	0.04536	36,615	161,876	0.75296	436,568	11.92
60 to 64 years..	0.29800	8,682	0.06994	29,135	121,146	0.65267	271,691	9.33
65 to 69 years..	0.40750	8,316	0.10264	20,453	81,026	0.53612	147,546	7.21
70 to 74 years..	0.53800	6,530	0.15032	12,137	43,440	0.38045	66,519	5.48
75 to 79 years..	0.69500	3,897	0.23580	5,607	16,527	[3]0.28394	23,080	4.12
80 years and over.....	1.00000	1,710	0.26097	1,710	6,553	0.0	6,553	3.83

[1] Proportion of persons born during the previous 5 years presently between age 0 and age 4.
[2] Proportion of persons between age 0 and age 4 alive 5 years later.
[3] Proportion of persons age 75 and over alive 5 years later.

Table C. Intercensal Life Table for Females, Indonesia: 1961 to 1971

Age interval	Probability of dying between age x and age x + n	Number of deaths between age x and age x + n	Death rate of life table population between age x and age x + n	Number of persons living at exact age x	Number of persons living between age x and age x + n	Proportion of persons between age x and x + n alive 5 years later	Total years lived after exact age x	Expectation of life, average number of years of life remaining for those alive at exact age x
x to x + n.....	$_nq_x$	$_nd_x$	$_nm_x$	l_x	$_nL_x$	$_np_x$	T_x	e^o_x
0 to 1 year.....	0.14173	14,173	0.15635	100,000	90,646	[1]0.81575	3,997,128	39.97
1 to 4 years....	0.10891	9,347	0.02947	85,827	317,230	[2]0.91727	3,906,782	45.52
5 to 9 years....	0.04043	3,092	0.00826	76,480	374,134	0.96201	3,589,552	46.93
10 to 14 years..	0.03858	2,802	0.00778	73,388	359,920	0.96085	3,215,418	43.81
15 to 19 years..	0.04130	2,915	0.00843	70,586	345,829	0.95628	2,855,498	40.45
20 to 24 years..	0.04535	3,069	0.00928	67,671	330,708	0.95326	2,509,669	37.09
25 to 29 years..	0.04802	3,102	0.00981	64,602	315,250	0.95046	2,178,961	33.73
30 to 34 years..	0.05162	3,174	0.01059	61,500	299,632	0.94534	1,863,711	30.30
35 to 39 years..	0.05950	3,470	0.01225	58,325	283,253	0.93449	1,561,079	26.82
40 to 44 years..	0.07196	3,947	0.01191	54,855	264,697	0.92002	1,280,826	23.35
45 to 49 years..	0.09029	4,596	0.01887	50,908	243,527	0.89580	1,016,130	19.96
50 to 54 years..	0.12445	5,761	0.02642	46,311	218,152	0.85037	772,603	16.68
55 to 59 years..	0.18051	7,319	0.03945	40,548	185,510	0.78495	554,451	13.67
60 to 64 years..	0.25005	8,309	0.05706	33,228	145,616	0.71216	368,941	11.10
65 to 69 years..	0.33009	8,226	0.07932	24,920	103,702	0.62455	223,325	8.96
70 to 74 years..	0.41767	6,973	0.10766	16,694	64,767	0.54170	119,623	7.17
75 to 79 years..	0.49351	4,817	0.13730	9,721	35,084	[3]0.36013	54,856	5.64
80 years and over.....	1.00000	4,904	0.21805	4,904	19,772	0.0	19,772	4.03

[1]Proportion of persons born during the previous 5 years presently between age 0 and age 4.
[2]Proportion of persons between age 0 and age 4 alive 5 years later.
[3]Proportion of persons age 75 and over alive 5 years later.

THE TREND OF MORTALITY DURING THE 1960's

Because death registration in Indonesia is not reliable and age distributions are known only at census dates, indirect measures must be used to estimate the trend of death rates within the intercensal period. The level and age pattern of mortality have their origin in the epidemiological conditions of an area. Epidemiological conditions vary with changes in nutrition and public health. In this section some factors of nutrition and public health--food production, food prices, food consumption, and health services--are considered under the assumption that changes in these factors bring about changes in mortality.

Food production during the 1960's failed to keep pace with the rate of population growth (table D and fig. 1). While food production increased about 1.8 percent per year, the population increased at a rate of 2.4 percent.

Although the production of rice, the main staple food, increased almost as fast as population, the increase was uneven over the period. Production increased less than 1 percent per year until 1968. The area under crops increased little during this period [10] as irrigation systems fell into disrepair [11]. From 1968 until the end of the decade, rice production increased by over 5 percent per year, due mainly to a massive rice intensification program [12]. This program concentrated on the introduction of new seeds and fertilizers and the improvement of the infrastructure and credit facilities [13]. But even with the increase in rice production, Indonesia was not self-sufficient and imported rice throughout the decade [14].

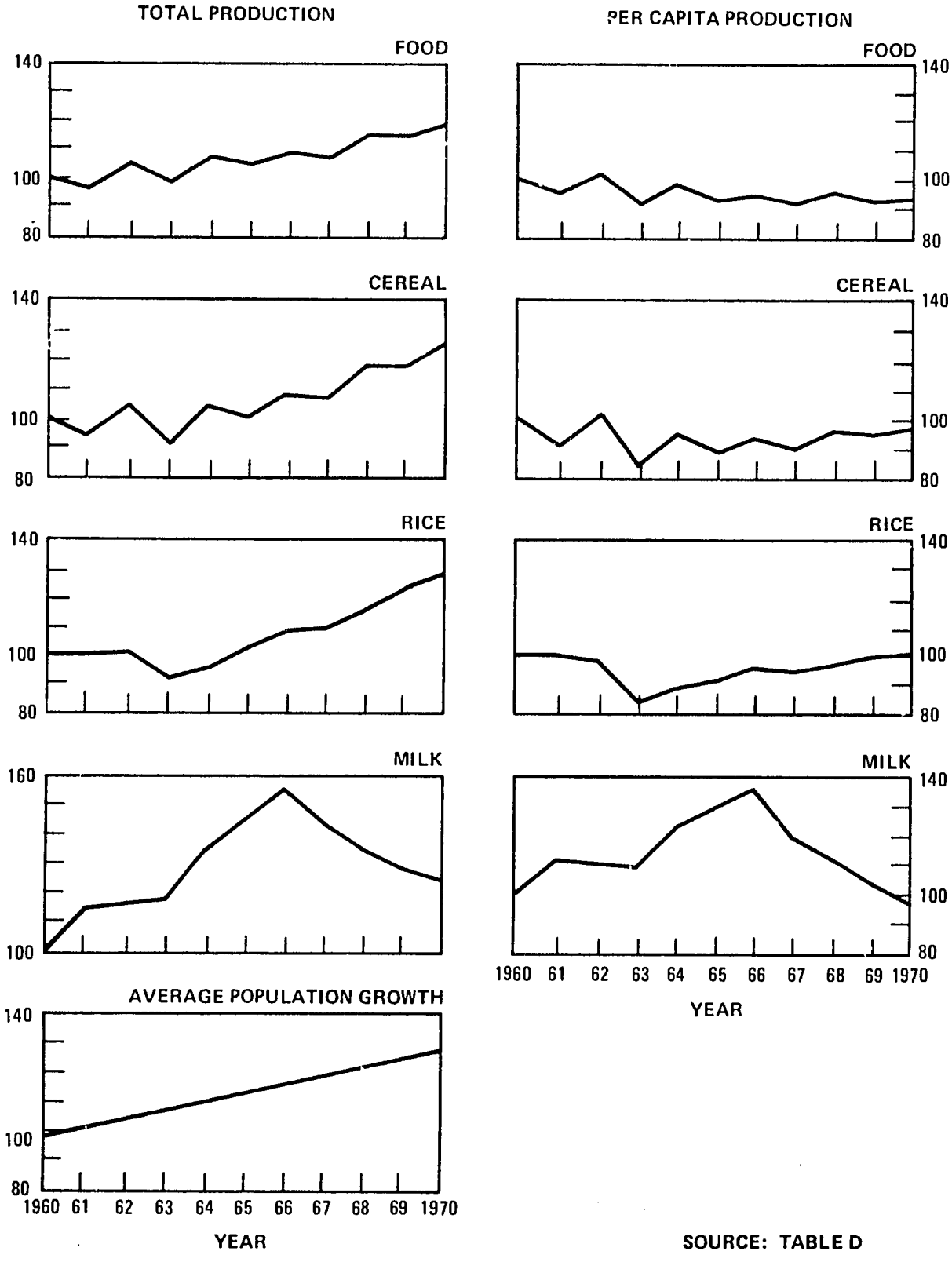
Because milk is an essential factor in the decline of morbidity and mortality among children[15], it is worthwhile to look at trends in milk production separately. Unlike the production of other foodstuffs, milk production increased rapidly during the first half of the decade. After 1966, milk production fell just as rapidly. Evidence of the effect of the fall in milk production, which coincided with the ending of the free milk program of the United Nations Children Fund (UNICEF), may be found in the rising importance of childhood diseases as a cause of death during the 1960's[16].

The inadequate food production was a factor in the extraordinary inflation of food prices and in the declining real family incomes throughout the decade (table E and fig. 2).

Singarimbum emphasizes that an increase in food production does not automatically mean that everyone will have more to eat. "At the family level the availability of rice and other foodstuffs is inevitably 'a function of the distribution of income, which in turn

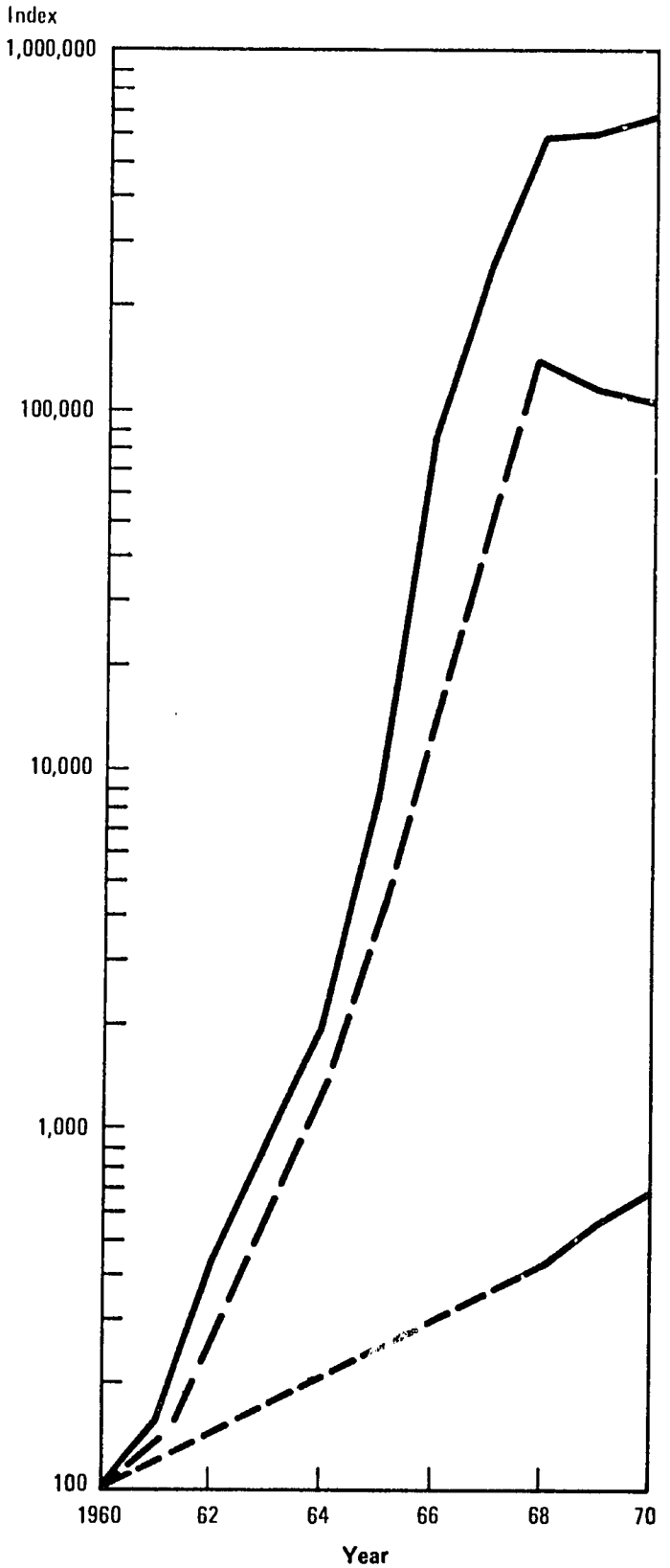
Figure 1. Trends in Production of Selected Food Commodities, Indonesia: 1960 to 1970

(INDEX NUMBERS: 1960 = 100)



SOURCE: TABLE D

Figure 2. Index Numbers of Retail Price of Food (Jakarta only) and of National Income (current prices): 1960 to 1970



Note: Index numbers of per capita national income at current prices were computed only for 1960, 1968, 1969, and 1970. A hypothetical trend was assumed from 1960 to 1968. Per capita national income was computed from data on gross domestic product, assuming a constant depreciation rate of 12.8 percent and an annual rate of population growth of 2.4 percent.

Food price – Income ratio (an index of the degree food price rises exceeded income rises) is the ratio of the index numbers of retail food prices to per capita national income. The total ratio was computed only for 1960, 1968, 1969, and 1970. A hypothetical trend was assumed from 1960 to 1968.

Sources: FAO Production Yearbook 1971, pp. 684; Statistical Yearbook for Asia and the Far East 1970, pp. 135; Indonesia Monthly Statistical Bulletin, October 1973, pp. 151.

Table D. Trends in Production of Selected Food Commodities. Indonesia: 1960 to 1970

(Index numbers: 1960 = 100)

Year	Total production				Per capita production			
	Food	Cereal	Rice	Milk	Food	Cereal	Rice	Milk
1960.....	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1961.....	97.4	94.1	(*)	114.3	95.0	91.8	(*)	111.5
1962.....	106.1	105.9	101.5	116.1	100.9	100.9	97.9	110.6
1963.....	99.1	91.6	90.5	117.9	92.0	85.1	85.1	109.5
1964.....	108.7	105.0	96.0	135.7	98.5	95.2	88.1	123.0
1965.....	105.2	101.7	102.1	146.4	93.0	89.9	91.4	129.4
1966.....	109.6	108.4	108.8	157.1	94.6	93.5	95.0	135.5
1967.....	108.7	107.6	109.1	142.9	91.5	90.6	93.0	120.3
1968.....	115.7	118.5	116.0	135.7	95.0	97.3	96.4	111.4
1969.....	115.7	118.5	123.2	128.6	92.7	95.0	99.9	103.0
1970.....	119.1	124.4	128.0	125.0	93.1	97.3	100.0	97.7

* Base refers to 1960 and 1961 combined.

Source: Food and Agriculture Organization, Production Yearbook 1963. Food and Agriculture Organization, Production Yearbook 1967. United Nations, Economic Bulletin for Asia and the Far East, Vol. XXI, No. 3, December 1970.

Table E. Distribution of Families and Median Household Income in Rice Equivalents, by Occupational Groups, Indonesia: 1959 and 1968

Occupational group	Distribution of families		Median household income in rice equivalents (Kg per year)	
	1959	1968	1959	1968
All groups.....	100.0	100.0	847	715
Large farmer.....	11.0	11.1	1,237	1,411
Medium farmer.....	12.7	11.4	689	766
Small farmer.....	12.1	17.1	352	266
Farmer-laborer.....	10.2	12.5	500	448
Farmer-other.....	13.5	11.1	706	621
Laborer.....	9.9	11.8	725	489
Transfer receiver.....	9.7	6.8	825	565
White collar.....	7.8	6.4	1,970	1,435
Other.....	13.1	11.8	974	957

Source: M. Singarimbum, Some Consequences of Population Growth in Java, p. 17.

depends on the distribution of land and other wealth, the occupational structure and the social stratification' "[17].

The decreasing food production and increasing food prices led to decreasing levels of food consumption and nutrition both in terms of quantity (calories per person per day) and quality (grams of protein per person per day). After 1967, as food production increased and prices stabilized, nutritional levels rose. But at no time during this decade was the Indonesian diet nutritionally adequate. Table F summarizes the trends in food consumption and nutrition.

Progress in public health in Indonesia has been as erratic as that in nutrition. The author of Indonesia's 'irst five-year development plan stated, "Activities in the field of public health according to a new concept were begun after 1950, and were progressing step by step, but in the long run this achievement took a downward turn because of growing inflation. Deterioration could be observed everywhere, especially in hospital conditions and in programs for the eradication of contagious diseases. Now [1968-69] the health sector has begun to move forward again after suffering a serious decline"[18].

Table F. Levels of Food Consumption and Nutrition, Indonesia: 1961 to 1970

Reference period	Calories per person per day	Minimum daily calorie requirement	Percent deficiency	Grams of protein per person per day	Minimum daily protein requirement	Percent deficiency
1961 to 1963	1,930	2,350	17.9	42.5	60	29.2
1964 to 1966	1,920	2,350	18.3	42.3	60	29.5
1967 to 1969	1,780	2,350	24.3	40.1	60	33.2
1970	1,920	2,350	18.3	42.8	60	28.7

Sources: FAO Production Yearbook 1971, p. 446, 453. U.S. Department of Agriculture. The World Food Budget, 1970, pp. 23-28.

The deterioration in public health occurred in both rural and urban areas. Hospitals and other public health facilities lacked medicine and equipment and therefore could utilize only a small part of their capacity. Since doctors preferred to remain in the cities, the rural health clinics lacked doctors as well as medicine. Although the number of child and maternal health clinics increased, the number of visiting patients fell when UNICEF stopped supplying medicine and milk powder[19].

As a result of the deterioration in health services, epidemic and endemic diseases which were thought to have been eradicated, began reappearing. After 1963 when the funds for DDT spraying disappeared, the number of malaria cases increased continuously, even in the previously eradicated areas. Vaccinations for smallpox declined during the decade and thousands of cases began appearing, also in areas previously eradicated. A plague epidemic occurred in 1968 and the population reportedly is still susceptible to tuberculosis and cholera[20].

It appears, then, that many of the earlier successes in controlling contagious diseases were erased during the 1960's. This coincided with the underutilization of health clinics because of problems in transportation, visiting hours, and quality of service. With the initiation of the first five-year development plan and the curtailment of inflation after 1968, improvements in public health probably did occur.

It is likely that because of declines in per capita food production, disease eradication programs, and health services, plus the effect of a rampant inflation, mortality rose during much of the decade (from about 1963 to 1968). As inflation came under control, the economic situation improved, nutrition rose, per capita food production (especially rice) increased, and public health services strengthened. Mortality has probably fallen since 1968.

Therefore, it is likely that expectation of life at birth was higher in both 1961 and 1971 than during the decade as a whole. Figure 3 presents the hypothetical trend in mortality for the decade.

NEW LIFE TABLES FOR 1961 AND 1971

To estimate mortality trends for the 1960's, it was necessary to analyze not only population data but also materials related to causal factors in mortality. Clearly, this type of analysis is better suited to the estimation of trends than to the estimation of levels. In the absence of reliable mortality data, expectation of life at birth for 1961 and 1971 was estimated by assuming that the trend presented in figure 3 and the average level of life expectancy for the decade presented in tables B and C are accurate representations of Indonesia's mortality situation during the 1960's. Life expectancy at birth was thus judged to be 39.5 in 1961 and 41.5 in 1971.[9] Males and females were assumed to follow the same pattern.

The life tables for the census years 1961 and 1971 were then computed by assuming that the "pattern of change" in the mortality probabilities between the intercensal life table and the 1961 and 1971 life tables was the same "pattern of change" as that implied by the Coale-Demeny West tables[21] at equivalent expectations of life at birth.[10]

The estimated life tables, age patterns of death, and crude death rates are shown in tables G, H, I, J, and K.

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[9] As a check, stable population theory was used to compute independent estimates of life expectancies at birth. This method produced approximate estimates of life expectancy equal to 40 in 1961 and 42 in 1971.

[10] That is $5q_x^j = \frac{5q_x^{cd1}}{5q_x^{cd2}} \cdot 5q_x^i$ where

$5q_x^j$ = estimated probability of death for age group (x,x+5) for Indonesia in year j (j = 1971 or 1961),

$5q_x^i$ = probability of death for age group (x,x+5) during the intercensal period for Indonesia,

$5q_x^{cd1}$ = probability of death for age group (x,x+5) in Coale Demeny West table with e_0^o equivalent to the estimated e_0^o for Indonesia, year j, and

$5q_x^{cd2}$ = probability of death for age group (x,x+5) in Coale-Demeny West table with e_0^o equivalent to the estimated e_0^o for the intercensal period in Indonesia.

Figure 3. Hypothetical Trend of Life Expectancy at Birth, Indonesia: 1961 to 1971

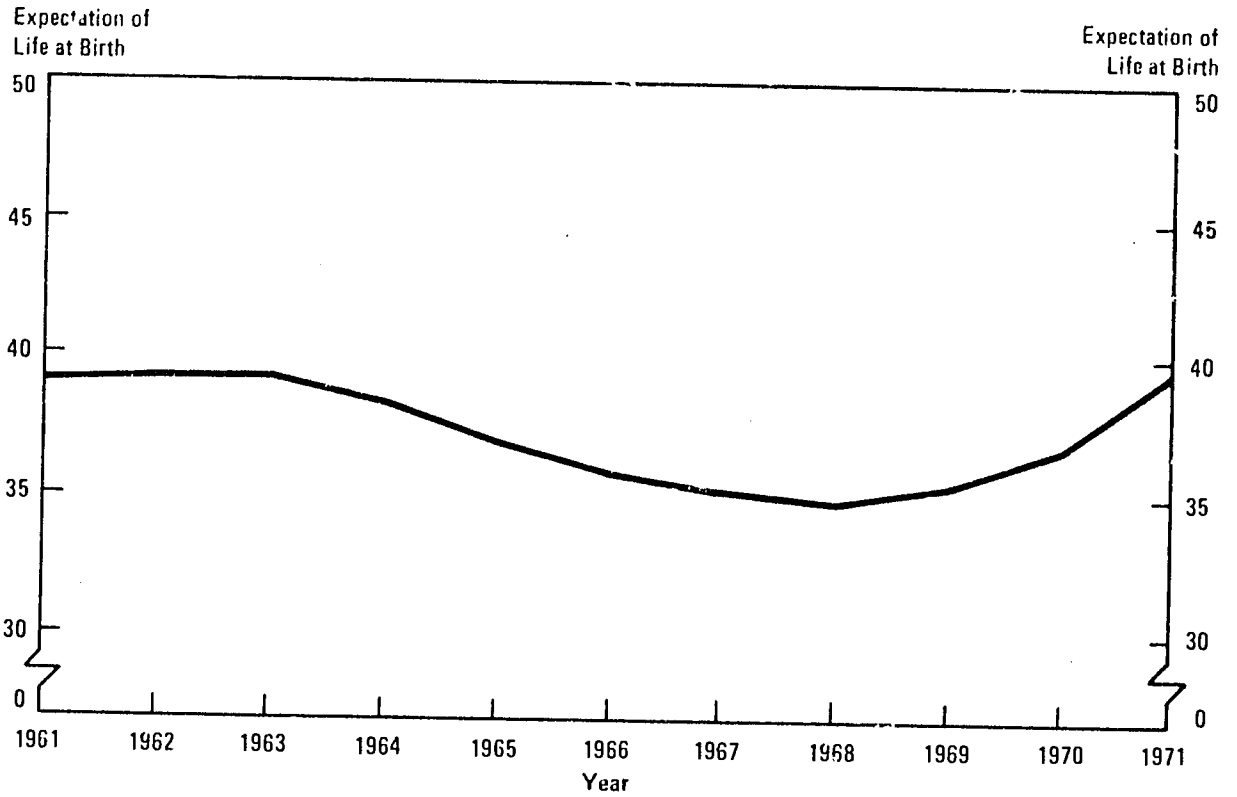

Table G. Life Table for Males, Indonesia: 1971

Age interval	Probability of dying between age x and age x + n	Number of deaths between age x and age x + n	Death rate of life table population between age x and age x + n	Number of persons living at exact age x	Number of persons living between age x and age x + n	Proportion of persons between age x and x + n alive 5 years later	Total years lived after exact age x	Expectation of life, average number of years of life remaining for those alive at exact age x
x to x + n.....	$_nq_x$	$_nd_x$	$_nm_x$	l_x	$_nL_x$	$_nP_x$	T_x	e^o_x
0 to 1 year.....	0.13239	13,239	0.14465	100,000	91,527	[1]0.82232	4,015,047	40.15
1 to 4 years.....	0.11213	9,755	0.03052	86,761	319,633	[2]0.91074	3,923,520	45.22
5 to 9 years.....	0.03700	2,849	0.00761	77,006	374,459	0.97653	3,603,887	46.80
10 to 14 years..	0.03043	2,256	0.00617	74,157	365,672	0.96442	3,229,428	43.55
15 to 19 years..	0.03838	2,760	0.00783	71,901	352,663	0.95985	2,863,756	39.83
20 to 24 years..	0.04223	2,920	0.00863	69,141	338,502	0.95579	2,511,093	36.32
25 to 29 years..	0.04593	3,041	0.00940	66,221	323,538	0.95205	2,172,591	32.81
30 to 34 years..	0.05085	3,213	0.01043	63,180	308,024	0.91534	1,849,053	29.27
35 to 39 years..	0.05958	3,573	0.01227	59,967	291,187	0.93411	1,541,029	25.70
40 to 44 years..	0.07384	4,164	0.01531	56,394	272,002	0.91595	1,249,842	22.16
45 to 49 years...	0.09749	5,092	0.02044	52,230	249,141	0.88580	977,841	18.72
50 to 54 years..	0.13468	6,349	0.02877	47,138	220,689	0.84011	728,700	15.46
55 to 59 years..	0.19256	7,855	0.04236	40,790	185,403	0.76868	508,011	12.45
60 to 64 years..	0.27672	9,114	0.06395	32,935	142,515	0.67196	322,608	9.80
65 to 69 years..	0.38163	9,091	0.09493	23,821	95,765	0.55764	180,093	7.56
70 to 74 years.	0.51595	7,600	0.11232	14,731	53,402	0.40345	84,328	5.72
75 to 79 years..	0.68556	4,710	0.21862	7,130	21,545	[3]0.30333	30,926	4.34
80 years and over.....	1.00000	2,420	0.25798	2,420	9,381	0.0	9,381	3.88

[1]Proportion of persons born during the previous 5 years presently between age 0 and age 4.
[2]Proportion of persons between age 0 and age 4 alive 5 years later.
[3]Proportion of persons age 75 and over alive 5 years later.

Table H. Life Table for Females, Indonesia: 1971

Age interval	Probability of dying between age x and age x + n	Number of deaths between age x and age x + n	Death rate of life table population between age x and age x + n	Number of persons living at exact age x	Number of persons living between age x and age x + n	Proportion of persons between age x and x + n alive 5 year later	Total years lived after exact age x	Expectation of life, average number of years of life remaining for those alive at exact age x
x to x + n.....	$_nq_x$	$_nd_x$	$_nm_x$	l_x	$_nL_x$	$_nP_x$	T_x	e^o_x
0 to 1 year.....	0.11832	11,832	0.12843	100,000	92,191	[1]0.81079	1,295,831	42.96
1 to 4 years....	0.09917	8,770	0.02672	88,168	328,202	[2]0.91987	1,203,640	47.68
5 to 9 years....	0.03659	2,900	0.00751	79,398	396,708	0.97199	3,875,437	48.81
10 to 14 years..	0.03692	2,912	0.00621	76,498	377,036	0.96524	3,188,729	45.61
15 to 19 years..	0.03699	2,713	0.00751	71,150	363,929	0.96164	3,111,693	41.96
20 to 24 years..	0.03996	2,851	0.00815	71,407	319,970	0.95855	2,741,764	38.48
25 to 29 years..	0.04261	2,923	0.00871	68,551	335,165	0.95594	2,397,791	31.98
30 to 31 years..	0.04618	3,031	0.00945	65,630	320,683	0.95383	2,062,329	31.42
35 to 39 years..	0.05219	3,330	0.01092	62,600	304,935	0.94163	1,741,646	27.82
40 to 44 years..	0.06152	3,821	0.01342	59,270	287,135	0.92760	1,436,711	24.24
45 to 49 years..	0.08955	5,583	0.01721	55,116	266,317	0.90581	1,149,776	20.73
50 to 54 years..	0.11499	5,819	0.02330	49,863	240,728	0.86203	883,230	17.36
55 to 59 years..	0.16618	7,119	0.03589	43,044	207,615	0.80341	642,502	14.27
60 to 64 years..	0.23040	8,655	0.05191	37,565	166,719	0.73271	434,887	11.58
65 to 69 years..	0.30591	8,811	0.07210	28,910	122,156	0.63123	268,268	9.28
70 to 74 years..	0.39767	7,968	0.10016	20,066	79,552	0.54193	146,112	7.28
75 to 79 years...	0.52956	6,411	0.14738	12,099	43,350	[3]0.31870	66,560	5.50
80 years and over.....	1.00000	5,688	0.21507	5,688	23,210	0.0	23,210	4.08

[1]Proportion of persons born during the previous 5 years presently between age 0 and age 4.
[2]Proportion of persons between age 0 and age 4 alive 5 years later.
[3]Proportion of persons age 75 and over alive 5 years later.

Table I. Life Table for Males, Indonesia: 1961

Age interval	Probability of dying between age x and age x + n	Number of deaths between age x and age x + n	Death rate of life table population between age x and age x + n	Number of persons living at exact age x	Number of persons living between age x and age x + n	Proportion of persons between age x and x + n alive 5 years later	Total years lived after exact age x	Expectation of life, average number of years of life remaining for those alive at exact age x
x to x + n.....	$_nq_x$	$_nd_x$	$_nm_x$	l_x	$_nL_x$	$_nP_x$	T_x	e^o_x
0 to 1 year.....	0.15082	15,082	0.16691	100,000	90,317	[1]0.80312	3,809,100	38.09
1 to 4 years....	0.11863	10,073	0.03235	84,918	311,361	[2]0.90196	3,718,783	43.79
5 to 9 years....	0.03841	2,882	0.00795	74,845	362,329	0.97171	3,407,390	45.55
10 to 14 years..	0.03682	2,650	0.00750	71,962	353,171	0.96147	3,045,061	42.31
15 to 19 years..	0.04081	2,831	0.00811	69,312	339,367	0.95664	2,691,891	38.81
20 to 24 years..	0.04559	3,052	0.00949	66,481	321,811	0.95220	2,352,525	35.38
25 to 29 years..	0.04971	3,153	0.01049	63,429	309,316	0.91807	2,027,182	31.96
30 to 34 years..	0.06546	3,995	0.01321	60,277	293,251	0.94084	1,718,167	28.50
35 to 39 years..	0.06153	3,677	0.01333	56,981	277,905	0.92886	1,424,914	25.01
40 to 44 years..	0.07907	4,215	0.01645	53,304	256,278	0.90979	1,149,009	21.56
45 to 49 years..	0.10366	5,089	0.02182	49,090	233,160	0.87828	892,731	18.19
50 to 54 years..	0.13308	6,296	0.03071	44,001	204,779	0.83098	659,572	14.99
55 to 59 years..	0.20037	7,655	0.04410	37,705	170,167	0.75726	454,793	12.06
60 to 64 years..	0.29292	8,832	0.06853	30,050	128,878	0.65807	284,626	9.44
65 to 69 years..	0.40072	8,543	0.10073	21,219	84,811	0.51211	155,748	7.31
70 to 71 years..	0.53167	6,791	0.14770	12,776	45,979	0.38609	70,937	5.55
75 to 79 years..	0.68821	4,119	0.23152	5,985	17,789	[3]0.28792	24,958	4.17
80 years and over.....	1.00000	1,866	0.26031	1,866	7,168	0.0	7,168	3.84

[1]Proportion of persons born during the previous 5 years presently between age 0 and age 4.
[2]Proportion of persons between age 0 and age 4 alive 5 years later.
[3]Proportion of persons age 75 and over alive 5 years later.

Table J. Life Table for Females, Indonesia: 1961

Age interval	Probability of dying between age x and age x + n	Number of deaths between age x and age x + n	Death rate for life table population between age x and age x + n	Number of persons living at exact age x	Number of persons living between age x and age x + n	Proportion of persons between age x and x + n alive 5 years later	Total years lived after exact age x	Expectation of life, average number of year. of life remaining for those alive at exact age x
x to x + n.....	$_nq_x$	$_nd_x$	$_nm_x$	l_x	$_nL_x$	$_nP_x$	T_x	$\mathring{e}_x$
0 to 1 year.....	0.13646	13,646	0.11997	100,000	90,993	[1]0.82259	1,081,819	10.85
1 to 4 years....	0.10321	9,001	0.02810	86,354	329,301	[2]0.91203	3,993,826	46.25
5 to 9 years....	0.03877	2,999	0.00860	77,352	375,112	0.97285	3,673,525	47.49
10 to 14 years..	0.03661	2,722	0.00716	74,353	364,926	0.96213	3,298,413	44.36
15 to 19 years..	0.03368	2,812	0.00809	71,631	341,196	0.95835	2,933,187	40.95
20 to 24 years..	0.04361	3,000	0.00892	68,789	330,183	0.95507	2,582,382	37.54
25 to 29 years..	0.04621	3,010	0.00946	65,788	321,366	0.95227	2,245,899	34.14
30 to 34 years..	0.04968	3,118	0.01019	62,778	306,027	0.94688	1,921,533	30.67
35 to 39 years..	0.05733	3,419	0.01180	59,631	289,772	0.93708	1,618,506	27.14
40 to 44 years..	0.06918	3,906	0.01438	56,212	271,439	0.92215	1,328,734	23.64
45 to 49 years..	0.08718	4,576	0.01827	52,307	250,482	0.89756	1,057,196	20.21
50 to 54 years..	0.12079	5,766	0.02564	47,731	221,824	0.85380	806,715	16.90
55 to 59 years..	0.17565	7,371	0.03840	41,966	191,954	0.79249	584,891	13.87
60 to 64 years..	0.21367	8,130	0.05311	34,594	152,121	0.71952	389,937	11.27
65 to 69 years..	0.32296	8,450	0.07720	26,465	109,155	0.63692	237,816	9.09
70 to 74 years..	0.41000	7,261	0.10420	17,711	69,714	0.53060	128,361	7.25
75 to 79 years..	0.18818	5,105	0.13816	10,450	36,949	[3]0.36997	58,646	5.61
80 years and over.....	1.00000	5,345	0.21636	5,345	21,698	0.0	21,698	4.06

[1]Proportion of persons born during the previous 5 years presently between age 0 and age 4.
[2]Proportion of persons between age 0 and age 5 alive 5 years later.
[3]Proportion of persons age 75 and over alive 5 years later.

Table K. Population and Deaths by Age and Sex, Indonesia: 1961 and 1971

Numbers in thousands, rates per thousand population

Age and sex	1961		1971	
	Population	Deaths	Population	Deaths
Males, all ages.....	19,413	1,201	63,218	1,375
0 to 4 years.....	9,120	590	11,075	641
5 to 9 years.....	8,181	65	9,497	72
10 to 14 years.....	4,739	36	8,111	50
15 to 19 years.....	1,755	40	7,705	60
20 to 24 year	4,304	40	4,387	38
25 to 29 years.....	3 873	39	4,362	41
30 to 34 years.....	3,470	39	3,916	41
35 to 39 years.....	2,960	39	3,486	43
40 to 44 years.....	2,397	39	3,064	47
45 to 49 years.....	1,814	40	2,533	52
50 to 54 years.....	1,351	42	1,945	56
55 to 59 years.....	1,008	45	1,350	57
60 to 64 years.....	723	50	872	56
65 years and over.....	718	98	915	121
Females, all ages.....	50,682	1,083	61,455	1,258
0 to 4 years.....	8,881	509	10,785	551
5 to 9 years.....	8,053	64	9,348	70
10 to 14 years.....	4,906	37	7,965	49
15 to 19 years.....	4,936	40	7,579	57
20 to 21 years.....	4,504	40	4,554	37
25 to 29 years.....	4,086	39	4,550	40
30 to 31 years.....	3,752	38	4,127	39
35 to 39 years.....	3,168	37	3,714	41
40 to 44 years.....	2,515	36	3,360	45
45 to 49 years.....	1,850	34	2,767	48
50 to 54 years.....	1,390	36	2,109	51
55 to 59 years.....	1,058	41	1,441	52
60 to 64 years.....	774	43	963	50
65 years and over.....	809	89	1,193	129
Male crude death rate.....	24.3		21.8	
Female crude death rate.....	21.1		19.5	

Source: Population figures are census counts, evaluated and adjusted at the International Statistical Programms Center (U.S. Bureau of the Census, Evaluation of the 1961 and 1971 Censuses of Indonesia by Age and Sex, forthcoming). Deaths are computed using central death rates from the 1961 and 1971 Indonesian life tables (tables G, H, I, and J).

CONCLUSION: POSSIBLE EFFECTS OF A DECLINE IN MORTALITY IN INDONESIA

Mortality trends in Indonesia during the early and mid-1960's were directly affected by deterioration in public health services and declines in nutritional levels. There are indications, however, that since 1968 public health services have strengthened and nutritional levels have risen. As a result, mortality has probably begun to decline.

In the future, mortality is expected to continue declining. The speed of the decline will depend upon the pace of economic development and upon the impact of improved nutrition and public health programs.

A sustained mortality decline will affect the size and composition of the population. For instance, if mortality declines and fertility remains constant the age structure will change in that the proportion of youth and old people will increase. There will then be relatively fewer people in the economically active ages and relatively more school children and elderly. Consequently the cost of education and social security per worker will increase.

If mortality continues to decline, average nuclear family size will tend to increase—since more children will survive—producing pressures on family incomes. Historically in Indonesia, the response to these pressures has been agricultural—increased use of irrigation and multiple-cropping systems, clearing of new land on hillsides close to the village, and the establishment of new villages in the hills and cleared forests[22]. Demographic responses were less important—fertility remained high and little migration from Java to the other more sparsely settled islands occurred.

There is presently little fertile land remaining in Java that could be opened to cultivation. Therefore, in the future agricultural responses to the pressures of increased family size will be less important than in the past. Responses will have to come in the form of reduced fertility, rural-urban migration, or migration from Java to outlying islands.

A continuation of the mortality decline in Indonesia—without a simultaneous fertility decline—can increase pressures on income on both a national and family level. A simultaneous fertility decline, however, would relieve many of these pressures and allow for better conditions for economic and social development.

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APPENDIX

CONSTRUCTION OF THE INTERCENSAL LIFE TABLE

The method used to construct the intercensal life table was the census survival technique. The base data were the preliminarily evaluated and adjusted results of the 1961 and 1971 censuses of Indonesia. It was assumed that international migration during the intercensal period was negligible.

The census survival ratios for the period 1961 to 1971 are:

$$(1) \quad {}_{10}SR_x = \frac{{}_5P_{x+10}^{1971}}{{}_5P_x^{1961}}$$

where x = age group (x, x+4), x = 5, 10, 15, ... 65. The last age group is open; ${}_5P_x^j$ = population in age group (x,x+4) at year j; and ${}_{10}SR_x$ = 10-year census survival ratio for age group (x, x+4) in 1961 to age group (x+10, x+14) in 1971.

Since the base data are adjusted censuses, the 10-year survival ratios will form a smooth series.

The 10-year survival ratios were reduced to 5-year survival ratios through the equation

$$(2) \quad {}_5LSR_{x+2.5} = \sqrt{{}_{10}SR_x}$$

where ${}_5LSR_x$ = 5-year survival ratio for age group (x, x+4) to age group (x+5, x+9). All other symbols are as in equation (1).

That is, the square root of each 10-year survival ratio is estimated to be the 5-year survival ratio for the central 5-year age group. For example, the square root of the survival ratio from age group 20-24 in 1961 to age group 30-34 in 1971 is estimated to be the survival ratio from age group 22½-27½ to 27½-32½.

To restore conventional age groups to the survival ratios, we estimate

$$(3) \quad {}_5LSR_{x+5} = \frac{{}_5LSR_{x+2.5} + {}_5LSR_{x+7.5}}{2}$$

where ${}_5LSR_x$ = adjusted 5-year survival ratio for age group (x,x+4); and all other symbols are as in the previous equations.

This series, LSR, is the first estimate of life table survival ratios (${}_5L_{x+5}/{}_5L_x$) for age groups 5-9 through 65-69.

From these survival ratios, a life table was generated beginning at age 10. This gave first estimates of ${}_5q_x$ for ages 10 through 65. Based on this series of ${}_5q_x$ the Coale-Demeny West model life tables were used to make preliminary estimates of ${}_5q_0$ and ${}_5q_5$. A new preliminary life table beginning at age 0 was then generated.

The next step in the computation had three aims: 1) to re-estimate ${}_5L_5$; 2) to estimate ${}_5L_x$ for ages greater than 65; and 3) to smooth the ${}_5L_x$ series for ages 10 through 65. To accomplish these aims, a linear transformation was performed through the logit function[1] between the series of ${}_5L_x$ from the preliminary life table and the series ${}_5L_x$ from the 1970 life table for the Indian population of Malaysia.[2]

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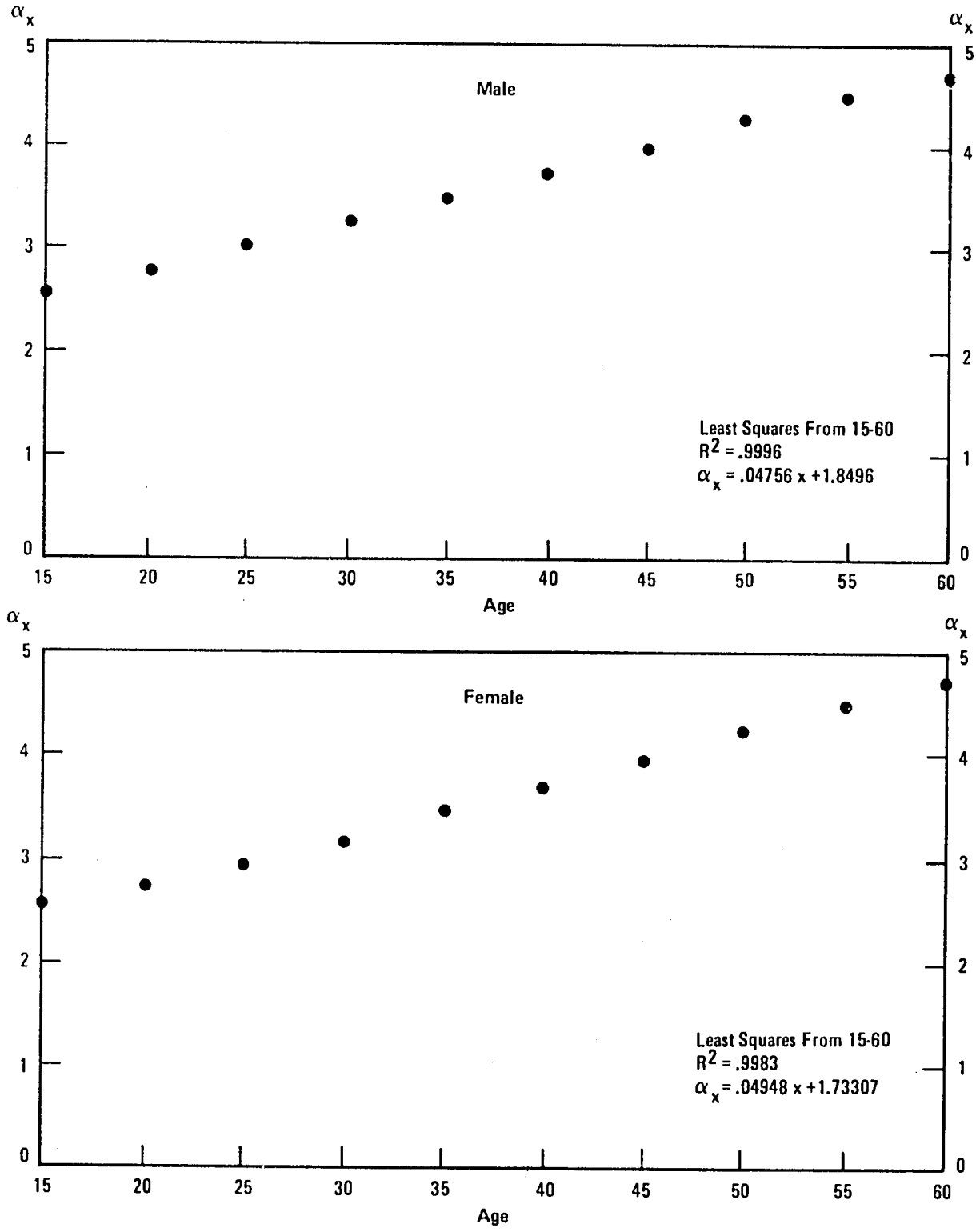
[1] For a discussion of uses of the logit function, see William Brass and Ansley Coale, "Methods of Analysis and Estimation" in William Brass, et. al., *The Demography of Tropical Africa*, Princeton University Press, Princeton 1968, pp. 127-135; and Norman Carrier and John Hobcraft, *Demographic Estimation for Developing Societies*, Population Investigation Committee, London School of Economics, London 1971, pp. 42-47.

[2] Malaysia, *Abridged Life Tables - Malaysia 1970*, Kuala Lumpur 1974, pp. 39-40.

Figure A-1. Observed Values of α_x and Equation of Least Squares Fit to Observed Values



The linear transformation is defined as

$$(4)\quad \text{logit}\left[{}_5N_x\right] = \alpha_x + \text{logit}\left[{}_5N^M_x\right]$$

where

$$(5)\quad \text{logit}\left[x\right] = 1/2 \ln \frac{1-x}{x} \quad \text{and}$$

${}_5N_x = 10^{-6} \cdot {}_5L_x$ is taken from the preliminary Indonesian life table; and

${}_5N^M_x = 10^{-6}\ {}_5L_x$ is taken from the Malaysian life table.

The Indian population of Malaysia was chosen as a model because the pattern of mortality exhibited by their life tables was similar to the preliminary Indonesian life table. Figure A-1 charts α_x against x for age groups 15-19 through 60-64. It is clear from the diagram that between these age groups, α_x is nearly a straight line. That is, the mortality of the Indonesian population deviates from the mortality of the Indian Malaysians in such a way that the differences of the logits of the respective ${}_5N_x$ series form a straight line with respect to age x. By least squares, the equation of this straight line was computed and an adjusted series of α_x was obtained for age groups 5-9 through 80-84.

By applying this series to equations (4) and (5), an adjusted series of ${}_5L_x$ was formed containing smoothed values between age groups 15-19 and 60-64 plus smoothed, extrapolated values for age groups 5-9, 10-14, 65-69, 70-74, ..., 80-84.

Only final estimates of infant (${}_1q_0$) and child (${}_4q_1$) mortality were still lacking. Questions on children ever born and children surviving are available for all of Indonesia from the 1971 census and from the 1964-65 sample survey. The Brass technique[3] for estimating infant and childhood mortality from this type of data has been applied by other demographers and the results are presented in table A-1.

The results are reasonable both in level and trend and can be considered to be an indication of the level of infant mortality in Indonesia.

[3] Brass, et. al., *op. cit.*, pp. 104-120.

Table A-1. Infant Mortality Rates From Application of Brass Technique to Two Surveys

Region	1964-1965 Sample Survey	1971 Census
Indonesia	153	136
Java	150	130
Other Islands	157	147

Source: For the 1964-1965 Sample Survey, Demographic Factbook of Indonesia, op. cit., pp. 115a-116b; for the 1971 Census, McNicoll and Mamas, op. cit., p. 14.

To estimate the life table infant mortality rate ${}_1q_0$, ${}_4L_0$ was first estimated and subsequently l_1 which implies ${}_1q_0$.

From the series of ${}_5L_x$ (x = 5, ..., 80) already estimated, it was possible through Beers multipliers[4] to estimate l_x for all ages 5 and above and hence to compute ${}_5q_5$.

A linear regression equation was then computed between ${}_5q_5$ and ${}_4L_0$ from a group of 10 Latin American life tables with a level of mortality similar to that of Indonesia. The Latin American countries were chosen as the basis for the regression because they 1) probably had the most reliable life tables from less developed regions and 2) reflected fairly well the relationship between infant-childhood and adult mortality thought to exist in Indonesia.[5] Through this regression equation ${}_4L_0$ was estimated.

The value of l_1 was estimated indirectly in the following manner: If k_0 and k_1 are the separation factors for the first year of life and second through fourth years of life respectively, then

$$(6)\quad {}_1L_0 = k_0 l_0 + (1-k_0)\ l_1$$

$$(7)\quad {}_4L_1 = k_1 l_1 + (4-k_1)\ l_5$$

[4] For a short discussion of Beers multipliers, see U.S. Bureau of the Census, *The Methods and Materials of Demography* by Henry S. Shryock, Jacob S. Siegel, and Associates, U.S. Government Printing Office, Washington, D.C. 1971, p. 688.

[5] The life tables used, Bolivia 1950, Brazil 1950, Costa Rica 1927, Guatemala 1950, Haiti 1950, Honduras 1950, Nicaragua 1950, Panama 1940, and Venezuela 1941, were taken from Eduardo Arriaga, *New Life Tables for Latin American Populations in the Nineteenth and Twentieth Centuries*, Institute of International Studies, University of California, Berkeley 1968.

By solving for $_1l_1$ in equation (7) and substituting into equation (6) we obtain

$$(8)\quad {}_1L_0 = \left\{(1 - k_0)\left[{}_4L_0 - (4-k_1)\,l_5\right] + l_0 \cdot k_1\, k_0\right\} \Big/ (1 - k_0 + k_1)$$

Only $_1L_0$, k_0 and k_1 are unknown in this equation. Therefore, with knowledge of k_0 and k_1 we know the value of l_1 since (by rearranging equation (6)):

$$(9)\quad l_1 = \frac{{}_1L_0 - l_0 \cdot k_0}{1 - k_0}$$

If we assume that the population central mortality rate ($_1M_0$) and the life table central mortality rate ($_1m_0$) for the first year of life are equal, then

$$(10)\quad {}_1m_0 = {}_1M_0 = \frac{l_0 - l_1}{{}_1L_0}$$

and $_1M_0$ is uniquely determined by k_0 and k_1.

If we use Keyfitz's[6] empirical equation

$$(11)\quad k_0 = 0.07 + 1.7 \cdot {}_1M_0$$

as a second restrictive criterion, then there are only a limited number of sets of k_0 and k_1 that satisfy equations (8), (9), (10), and (11).

The number of sets of separation factors that will satisfy the above equations is further reduced by assuming that,

$$(12)\quad k_0 \geq .10$$

$$(13)\quad k_1 \geq 1.10$$

$$(14)\quad \left| k_0^f - k_0^m \right| \leq .02$$

$$(15)\quad \left| k_1^f - k_1^m \right| \leq .02$$

where k_i^f and k_i^m are the female and male separation factors respectively.

In the case of Indonesia these further restrictions reduced the possible sets of separation factors to seven nearly identical sets. The median of the seven sets was chosen and l_1 computed through equation (9). The estimated values of infant mortality rates (tables B and C) were similar to those estimated through the Brass technique (table A-1).

With the existence of a complete series of l_x values, the remainder of the life table was calculated by conventional means.

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[6] Nathan Keyfitz, "Finding Probabilities From Observed Rates or How to Make a Life Table", *American Statistician*, Vol. 24, 1970, pp. 28-33.

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