

John Fulton

Mortality Decline in Thailand, 1937-1970 : An Exploration of Registration Data through a Demographic Survey

CHARACTERISTICS of mortality decline in the developing nations are often masked by problems associated with gross underenumeration of registered deaths. Data on deaths are often unusable in the available form. Attempts at evaluating such data may be hampered by the absence of sources of independent data, and may lead no further than the estimation of crude rates. Demographic survey data, where available, provide excellent opportunities to evaluate figures on registered deaths, thereby increasing their utility.

A recent case in point is the Survey of Population Change, 1964-1967, undertaken in Thailand. By the early 1960's it had become evident to the Thai government that a decline in mortality rates by large proportions had occurred in the intercensal period, 1947-1960, and that registry data had failed to detect its magnitude. This failure provided impetus for the demographic survey mentioned. It was national in scope, and took the form of an alternate registration system to the one then in effect. Results from these two independent systems were combined using the Chandra-Deming formula to produce overall estimates of mortality and fertility, (Thailand, 1970). The results of this survey provide an opportunity to evaluate underenumeration error in death data from the registration system, and ultimately, to describe the mortality decline which occurred in Thailand.

Because of the richness of the survey data available, it was decided to evaluate underenumeration by sex and age group, in the hope of finding sex-age groups for which deaths are more highly enumerated than for the population as a whole. Such a finding would be helpful not only in adjusting Thai registry data over time in an effort to describe mortality decline, but also in approaching the evaluation and use of registry data elsewhere. It was further decided to evaluate the stability of underenumeration error as a function of sex and age over time, if such a function was found to exist in the middle 1960's, This evaluation would aid attempts to adjust Thai registry data over time on the basis of underenumeration error found in the data of about 1965.

The above investigation was facilitated by characteristics of Thai census data, needed as the bases of mortality rates. The enumeration of population is a long-standing tradition in Thailand which dates back to 1911. The frequency of enumerations, about one in every ten years, is convenient in studying mortality trends over time. Underenumeration in the most recent censuses has not been severe except for the 0-4 age group, and Thai age data are very accurate, (Fulton, 1975). Furthermore, the four censuses of greatest importance to investigate mortality decline, namely those of 1937, 1947, 1960 and 1970, have been evaluated and adjusted for underenumeration where necessary, (Bourgeois-Pichat, 1959; United Nations, 1966; Fulton, 1975).

Methods and Results

Mortality rates derived from Survey of Population Change data are central to this investigation, and as such, their precision is of importance. The size of the survey's sample, about 174,000, is certainly adequate to calculate crude mortality rates with excellent precision. However, as Thai mortality had declined substantially by 1965, the precision of sex-age-specific mortality rates is more questionable, because the size of the base population by sex-age group is small in relation to the existent mortality regime. (See Fulton and Ristow, 1975&.) To avoid proceeding with potentially imprecise data, a maximum likelihood statistic, (Fulton and Ristow, 1975a) was used in conjunction with survey data to choose a model mortality schedule from the 96 model mortality schedules published by Coale and Demeny (1966) which most closely fit the survey data for each sex. The schedules chosen were model North, level 16 for the females, and model North, level 17 for the males. (These schedules correspond to expectations of life at birth of 57.5 years, and 56.3 years, res-

pectively.) Previous work has demonstrated the appropriateness of model North for use in Thailand, (Fulton, 1975).

To compare registry data with survey data for 1965, the registry figures on deaths by sex and age must be converted to sex-age-specific mortality rates, which require knowledge of the distribution of the Thai population by sex and age in 1965. These data were provided by projecting corrected population figures for 1960 (United Nations, 1966) forward five years using vital rates derived from the Survey of Population Change. Once the base population had been established, the number of deaths in each sex-age group for the three years 1964, 1965, and 1966 were averaged, and mortality rates computed. With the exception of 0-4 age group, the registry data on number of deaths are grouped by ten years of age. This standard grouping was adopted throughout the study, data converted to this standard where necessary.

The sex-age-specific mortality rates so derived were compared with those of the model schedules previously referred to by dividing the former by the latter. These proportions, representing the completeness of enumeration in each sex-age group, are listed in Table 1. The sex groups yield similar patterns of completeness of enumeration over age groups from 0-4 to 65-74, although at different levels. Referring to Table 1 we see that for both sexes enumeration is about half complete in the youngest age group, .52 for males and .43 for females. With the exception of a small decrease in the male 15-24 group,

TABLE 1—PROPORTION OF COMPLETE ENUMERATION OF DEATHS BY SEX AND AGE, 1965

<i>Age Group</i>	<i>Males</i>	<i>Females</i>
0-4	.52	.43
5-14	.68	.52
15-24	.61	.60
25-34	.66	.65
35-44	.86	.75
45-54	.97	.75
55-64	.95	.69
65-74	.80	.62

completeness of enumeration generally increases with age, peaks in the 35-54 range for females, the 45-54 range for males, then decreases with age. At all ages the male data are more completely enumerated than the female data.

Having found a simple pattern of completeness of enumeration by sex and age, analysis proceeded to mortality data at the four census dates 1937, 1947, 1960, and 1970 to investigate the stability of the pattern over time. In the absence of demographic survey data at these points, registry data were used to select model mortality schedules for use in the analysis. Only the age group 45-54 was used to select the closest-fitting model schedules, because it had been the most completely enumerated age group in 1965. The registry data for this group were converted into mortality rates using the technique previously described for the 1965 data, and then adjusted for underenumeration according to the 1965 results. Data were crudely adjusted by multiplying by a sex-specific factor, 1.25 for females, and 1.11 for males, which roughly correspond to 20 and 10 percent underenumeration, respectively. It was felt that the least variance in completeness of enumeration over time would be characteristic of the most highly enumerated group, given the range in completeness of enumeration of .5 to 1, and hence that the least error in the selection of model schedules attributable to adjustment for underenumeration would be made by using the 45-54 group. (See Blalock, 1972, regarding the variance of proportions.) Thus data for 1937, 1947, 1960, and 1970 were adjusted according to error found in the 1965 data, and used to select closest-fitting Coale and Demeny (1966) model mortality schedules. Model North was retained, because it was felt that the appropriateness of this model increases in the period preceding the large scale anti-tuberculosis drive initiated by the Thai government in the 1950's. By a process of simple linear interpolation the model schedule whose appropriate age-specific mortality rate came closest to the adjusted registry rate in consideration was chosen as closest fitting.

Once model schedules had been chosen in the above fashion for the four census dates, they were compared with the unadjusted registry rates for those dates by dividing the latter by the former. The results are presented in Table 2. These proportions of completeness of underenumeration of deaths by sex and age have been standardized by dividing them by the analogous proportion of the 45-54 age group, both to facilitate comparison of the shape of the function over time, and to emphasize the role of the 45-54 group in selecting the model mortality schedules used to compute the proportions. Clearly, the general shape

TABLE 2—STANDARDIZED,* PROPORTION OF COMPLETE ENUMERATION OF DEATHS BY SEX AND AGE AT DIFFERENT CENSUS DATES

Date Age Group	1937		1947		1960		1970	
	M*	F*	M	F	M	F	M	F
0-4	.44	.49	.33	.37	.54	.64	.41	.47
5-14	.53	.54	.64	.65	.63	.76	.59	.68
15-24	.82	.97	.76	.85	.55	.83	.58	.69
25-34	.80	.95	.92	1.02	.60	.95	.64	.75
35-44	.89	.98	.98	.99	.85	1.10	.88	.92
45-54	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
55-64	.78	.78	.88	.88	.99	.91	1.02	.96
65-74	.69	.72	.78	.78	.89	.79	.91	.88

*M=Males F=Females.

a—Standardized by dividing all proportions by the proportion at age 45-54, thus making the value of this group always equivalent to 1.0.

of the function is stable over time, despite minor fluctuations from the overall pattern by isolated age groups. (Some of these fluctuations may be attributable to the different techniques used to adjust the census data at the four dates for minor underenumeration.) This stability adds credence to the procedure by which the model mortality schedules were chosen for the census dates.

The expectation of life corresponding to the four sets of model North mortality schedules thus chosen are presented in Table 3. Notice that for 1937, 1947 and 1970 the male and female schedules differ by about three years expectation of life at birth. This difference is consistent with the expectation of Coale and Demeny (1966). For the year 1960 the difference is off by about three years, or one level of mortality, to use the Coale and Demeny term. This overall consistency may be interpreted to mean that the relationship between the completeness of enumeration of male and female data in the 45-54 age group has been relatively stable over time, which adds further support to this age group in the selection of the four sets of model mortality schedules.

If selection of these schedules has been correct, the figures in Table 3 indicate that mortality decline began slowly in the 1937-1947 period, increasing

TABLE 3-EXPECTATION OF LIFE AT BIRTH FROM MODEL NORTH SCHEDULES MOST CLOSELY FITTING ADJUSTED THAI REGISTRY-DERIVED MORTALITY RATES AT DIFFERENT CENSUS DATES

<i>Date</i>	<i>Males</i>	<i>Females</i>
1937	32.0	35.0
1947	34.5	37.5
1960	51.5	57.5
1970	56.3	60.0

SOURCE: Coale and Demeny, 1966.

expectation of life at birth by about two and a half years, then accelerated dramatically in the 13 years 1947-1960, increasing expectation of life at birth by about 20 years. Finally, the decline decelerated in the 1960-1970 decade, adding another two and a half years to expectation of life at birth.

Clearly, the figures in Table 3 most open to doubt are those attributed to 1937 and 1947, the two dates farthest from the criterion date of 1965. Fortunately, mortality data for these years have been independently evaluated by Bourgeois-Pichat (1959), although only on the basis of crude rates. Thus, for the purpose of comparison with Bourgeois-Pichat's estimates of mortality for these dates, analogous crude rates were computed for 1937 and 1947 using the sex-age-specific mortality rates from the selected schedules and the sex-age distributions of population from the censuses. These rates, along with others computed for 1960 and 1970 and the rates estimated by Bourgeois-Pichat for the period 1920-1955 are plotted in Figure 1. Rates for the period 1935-1970 are also listed in Table 4.

The two rates for 1937 are in close agreement, 31.1/1000 and 30.2/1000. Disagreement is evident for 1947; the model based rate, 26.2/1000, is considerably lower than Bourgeois-Pichat's estimate of 30.2/1000. However, the model based rate is fairly consistent with Bourgeois-Pichat's estimates prior to 1945 and after 1947. In addition Bourgeois-Pichat is of the opinion that the registration of births and deaths in Thailand was disrupted following World War II.

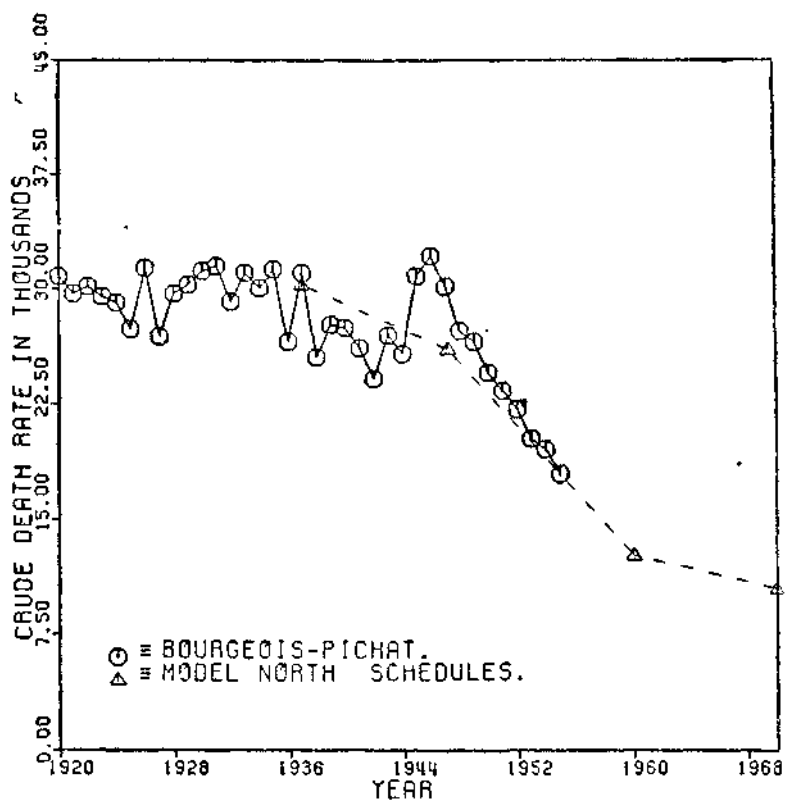


Fig. 1. Adjusted crude death rate for Thailand, 1920-1955, by Bourgeois-Pichat, and crude death rates computed using model North mortality schedules.

Thus, it is probably more important that the model based rate is consistent with the pre-1945 and post-1947 figures than with the 1947 estimate. The agreement of these two independently calculated sets of rates for 1947 lends further support to the particular selections of model schedules for these years.

Table 5 contains mortality rates for broad age groups, 0-14, 15-64, and 65+, derived from model North schedules selected for the four census dates. (Female data alone are listed for the sake of brevity.) Quite obviously, the greatest proportionate change in mortality rates occur red in the 1947-1960 period. The changes in the preceding and succeeding periods are somewhat similar, although overall the 1960-1970 proportionate change exceeded the 1937-1947 change by a small amount. In all three periods the greatest pro-

TABLE 4—ADJUSTED CRUDE DEATH RATE FOR THAILAND, 1935-1955, BY
BOURGEOIS-PICHAT, AND CRUDE DEATH RATES COMPUTED USING
MODEL NORTH MORTALITY SCHEDULES

<i>Date</i>	<i>Estimates by Bourgeois-Pichat</i>	<i>Model-based Estimates</i>	<i>Date</i>	<i>Estimates by Bourgeois-Pichat</i>	<i>Model based Estimates</i>
1935	31.3		1946	32.2	
1936	26.6		1947	30.2	26.2
1937	31.1	30.2	1948	27.3	
1938	25.6		1949	26.6	
1939	27.7		1950	24.6	
1940	27.5		1951	23.4	
1941	26.2		1952	22.2	
1942	24.2		1953	20.3	
1943	27.0		1954	19.6	
1944	25.8		1955	18.0	
1945	30.9		1960		12.8
			1970		10.6

SOURCE: Bourgeois-Pichat, 1959.

portionate change was made by the 0-14 group, while the least was made by the 65+ group. In general the ratio of the former to the latter is about three or four to one, while the ratio of the former to the 15-64 group ranges from about 1.4 to one for 1947-1960 to about 1.8 to one for 1960-1970.

Disproportionate change in mortality rates by age in the absence of change in fertility rates should alter the age structure of the population by increasing the proportion of population in the youngest age groups at the expense of the older age groups. (See, for example, Arriaga, 1970.) There is good reason to believe that the currently high fertility rates of Thai women (Knodel and Prachuabmoh, 1973) have remained unchanged over a long period of time.

TABLE 5—FEMALE MODEL MORTALITY RATES AT DIFFERENT CENSUS DATES FOR BROAD AGE GROUPS, AND PROPORTIONATE CHANGE" IN RATES BETWEEN DATES

Age Group	Date			
	1937	1947	1960	1970
0-14	.03919	.03482	.01173	.00986
15-64	.01588	.01473	.00776	.00705
65+	.10175	.09777	.07630	.07418

Age Group	Period		
	1937-1947	1947-1960	1960-1970
0-14	-.11	-.66	-.16
15-64	-.07	-.47	-.09
65+	-.04	-.22	-.03

a—Computed as follows :

$$\frac{(\text{Rate at time 2}) - (\text{Rate at time 1})}{(\text{Rate at time 1})}$$

SOURCE: Coale and Demeny, 1966.

Bourgeois-Pichat's adjusted crude birth rates for the 1920-1955 period remain remarkably close to 50/1000 the entire time. (Bourgeois-Pichat, 1959.) His figures, although fluctuating slightly from year to year, do not reveal a noticeable trend for the birth rate in the period 1937-1955 (in which year his estimates stop). Therefore, if the mortality decline outlined in Table 5 is correct, one expects the age structure of the Thai to have become younger in all three intercensal periods. Further, one expects the greatest change in age structure to have occurred in the 1947-1960 period.

The figures in Table 6 reveal a small but constant change in the age structure of the Thai population over the years 1937 to 1970. In all periods the 0-14 group changed proportionately at the expense of the 15-64 group, as was expected from the disparity between these two groups in proportionate change of mortality rates in all periods. Changes in the 65 + group are small and not consistent in direction. This inconsistency is probably attributable to the small size of this segment of the population in relation to the other two, and the re-

TABLE 6—PERCENT AGE DISTRIBUTION OF POPULATION AT DIFFERENT CENSUS DATES, AND CHANGE IN PERCENTAGE POINTS BETWEEN CENSUS DATES

<i>Age Group</i>	<i>Date</i>			
	<i>1937</i>	<i>1947</i>	<i>1960</i>	<i>1970</i>
0-14	42.7	43.0	44.7	44.8
15-64	54.5	54.4	52.5	52.1
65+	2.8	2.6	2.8	3.1

	<i>Period</i>		
	<i>1937-1947</i>	<i>1947-1960</i>	<i>1960-1970</i>
0-14	+0.3	+ 1.7	+0.1
15-64	—0.1	—1.9	—0.4
65+	—0.2	+0.2	+0.3

SOURCES: 1937, 1947: Bourgeois-Pichat, 1959.
 1960: United Nations, 1966.
 1970: Fulton, 1975, male projection revised.

lative difficulty experienced in enumerating this group, (Fulton, 1975). As expected, the greatest change in age structure, modest nonetheless, came in the 1947-1960 period, when the 0-14 group gained 1.7 percentage points at the expense of the 15-64 group. Thus Thai age data support the figures on mortality decline found in Table 5.

Discussion

Underenumeration of deaths in Thailand follows a simple pattern by sex and age which may be related to the social status of the decedents. Diligence in death reporting may rise with the social status of the deceased. In addition, knowledge of the death of a person may be more widespread as the deceased is of higher social status. As the knowledge of a death is more widespread, it is possible that the probability of death reporting increases.

For example, male deaths are more highly enumerated than female deaths. Status differentiation by sex certainly exists in Thailand. "The father is head

of the family and inheritance is through him," (Embree, 1950, p. 6.). Only males enter the Buddhist monkhood, an important institution in Thai society, (Kaufman, 1960, p. 148).

Status differentiation by age is common to most societies, including Thailand. Certain times in the span of life mark important changes in the social status of the individual, which on the whole increases with age. Important changes in status occur when the child enters school (at about eight years of age), (Kaufman, 1960, p. 147), when a male enters the monkhood, (Kaufman 1960, p. 148), and when a female gives birth to her first child, (DeYoung, 1955, p. 58). Although elderly parents are respected, (Phillips, 1965, pp. 157-159,) it is unclear whether or not they lose status when they relinquish important responsibilities to their children, (DeYoung, 1955, pp. 66-67). For example, when an elderly (age 60 and above) man transfers the important responsibilities of farming to his son, it is unclear which one of them is considered the head of household and thereby benefits from the status ascribed to that role. Finally, one might note the existence of a Thai law which admonishes adults to support their elderly dependents, (Vanaputi, 1972).

Status differentials at death are apparent in Thai funeral practices. The most elaborate (best) funeral the deceased can have in this predominantly Buddhist society includes cremation after elaborate and lengthy (sometimes three months or more) ceremonies conducted by Buddhist monks. (Kaufman, 1960, pp. 147-159.) However, "not all cremations are long delayed. A relatively rapid and modest cremation is given to female members of a family and children." (Kaufman, 1960, p. 157.) When burial is rarely resorted to, it is done in the case of a baby or child, (DeYoung, 1955, p. 73). If there is a difference in the status of elderly versus mature adults, however, it is not demonstrated in funeral practices.

An alternate explanation for the dip in death reporting at ages "*beyond* maturity (45-54), is the change in the social meaning of death which comes with old age. Adults who have achieved the significant age of 60 (five twelve-year cycles of the Thai calendar) begin preparing themselves for death through a marked increase in religious devotion. People at this age tend to retire from the full activity of adulthood, ceding much responsibility for their own livelihood, as well as the livelihood of their families, to their children, as mentioned previously. The societal impact of the death itself is lessened both to

the extent that it is expected, and to the extent that the deceased has transferred societal positions of consequence, such as "head of household" to others. Thus, the transition from life to death is blurred by societal preparation for death.

The rationale of the Thai registration law as presented to the people in a 1972 citizen's handbook supports the distinction between expected and unexpected deaths explored above. "When a person dies, you must report to the district office within 24 hours. . . . This is because the authorities want to know whether he died of natural causes, or was killed, or died of an epidemic to which they must respond." (Vanaputi, 1972.) One might interpret this to mean that the authorities are interested in death reporting in order to be notified of deaths which are important to them in defense of the law, and in the protection of population from disease. Deaths of the elderly from natural causes might be considered of less consequence to the authorities, and thereby require less reporting diligence, than deaths defined in a socially different way.

The structure of the law itself, as it existed in 1972, supports the distinction between deaths from "natural" and other causes. If a person dies at home, his or her family is required to register the death. If a person dies away from home, all those who witness the death or aid in caring for the corpse are responsible for reporting the death, in addition to that person's family, (Vanaputi, 1972). To the extent that unexpected deaths of mature adults have a greater probability of occurring away from home than the "natural" deaths of the elderly (or children, for that matter), they are given greater importance under the law through the involvement of greater numbers of people, and perhaps more importantly, people outside the immediate family.

Although we have just begun to tease out characteristics of the mechanisms connecting death reporting differentials with other social phenomena, the stability over time in patterns of underenumeration argues for the plausibility of a connection between them. Similar research with data from other societies, especially those culturally distinct from the Thai, may prove revealing in this respect. The relationship between reporting of deaths and social status of the deceased or the social meaning of death associated with the age of the deceased would appear more plausible if found across cultures.

Even though it is difficult to attribute stable patterns in underenumeration to particular social causes with certainty, the existence of such patterns, nonethe-

less, is quite useful. They have been exploited herein in an attempt to describe mortality decline in Thailand 1937-1970. Evidence available to evaluate the results, i.e., independent estimates of the crude death rate in 1937 and 1947, and changes in the age structure of the Thai population in the periods considered, have supported their plausibility.

Between 1937 and 1970 Thailand experienced a mortality decline which added 25 years to the expectation of life at birth of the average Thai. The bulk of this decline, as well as the bulk of change in age structure, occurred between 1947 and 1960. Although cause of death statistics cannot reveal the true determinants of the decline, other sources attribute improvements in health to anti-malaria and anti-tuberculosis campaigns run by the national government in the 1950's, (Henderson, 1971, p. 96).

Two important consequences of the decline have been a decrease in the average age of the population and an increase in the rate of its growth from about two to about three percent a year. The latter holds the greatest social significance for the Thai. At the current rate of growth the population will double in about 25 years; it is doubtful that any nation can sustain population growth of this magnitude for very long without experiencing severe consequences. Thus, as a consequence of the mortality decline, reduction of fertility has become an important challenge to Thailand.

The deceleration in mortality decline in the 1960-1970 decade is doubtless indicative of future change in Thai mortality. The quick gains in expectation of life have occurred; further deceleration in declining mortality is very probable. Expectation of life at birth in Thailand is now at a level where every year added to expectation of life at birth will become increasingly costly. However, the point has not been reached where public health measures will no longer contribute to noticeable gains in longevity.

Undoubtedly, more can be done to immunize the population against infectious diseases. The finding that model North provided the closest fit to Thai mortality as late as 1965 may indicate that more thorough immunization against tuberculosis is necessary. If cause of death data are at all reliable, it is evident that much can be done to decrease infant and early childhood mortality; immunization of infants and increased efforts at disinfection of water for human consumption might contribute to noticeable decreases in mortality at these ages, (Thailand, 1971).

Finally, the generally optimistic picture of mortality in Thailand should not be allowed to mask the regional differences in expectation'of life which existed in 1965, (Fulton, 1975). In this vein, a second "Survey of Population Change" currently under way will be useful to investigate trends in regional mortality differentials over the past ten years. It will also aid in gaining additional insight into the causes of underenumeration in the registration system. Efforts to link the patterns of underenumeration described in this study to other social phenomena might prove useful in reforming the system as it now exists.

Acknowledgements

The author wishes to thank Gerry Hendershot and Aphichat Chamrathirithong for their criticism and suggestions. Aphichat was kind enough to translate sections of the Citizen Handbook for me. Substantial portions of this paper were read at the Annual Meeting of the Population Association of America, Montreal, Canada, April, 1976.

References

1. Arriaga, Eduardo E., 1970, *Mortality Decline and its Demographic Effects in Latin America*, Institute of International Studies, University of California, Berkeley.
2. Blalock, Hubert M., 1972, *Social Statistics*, McGraw-Hill, New York.
3. Bourgeois-Pichat, Jean, 1959, *An Attempt to Appraise the Accuracy of Demographic Statistics for an Underdeveloped Country : Thailand*, United Nations Seminar on Evaluation and Utilization of Population Census Data in Latin America, Working Paper No. 1, Santiago, Chile.
4. Coale, Ansley J. and Paul, Demeny, 1966, *Regional Model Life Tables and Stable Populations*, Princeton University Press, Princeton, New Jersey.
5. De Young, John E., 1955, *Village Life in Modern Thailand*, University of California Press, Berkeley, California.
6. Embree, John P., 1950, Thailand—A loosely structured social system. In : Hans-Dieter Evers. 1969. *Loosely Structured Social Systems : Thailand in Comparative Perspective*, Yale University Southeast Asia Studies, New Haven, Connecticut.
7. Fulton, John P., 1975, Evaluation of selected aspects of the 1970 Census of Thailand, *Unpublished Master's Thesis*, Brown University.
8. ___ and Richard, Ristow, 1975«, "A Maximum Likelihood Approach to Selection of Model Mortality Schedules from Empirical Data." (Mimeographed).
9. ___ and___, 19756, The Problem of Precision in Mortality Data Derived from Demographic Surveys : A Proposed Solation, *The Philippine Statistician* (Forthcoming).
10. Henderson, John W. *et al.*, 1971, *Area Handbook for Thailand*, Department of the Army Pamphlet 550-53, U. S. Government Printing Office, Washington, D.C.

11. Kaufman, Howard Keva, 1960, *Bangkhuad, A Community Study in Thai/and.*. Augustin, Inc., Locust Valley, New York.
12. Knodel, John and Visid, Prachuabmoh, 1973, *The Fertility of Thai Women*, Institute of Population Studies, Chulalongkorn University, Thailand.
13. Phillips, Herbert P., 1965, *Thai Peasant Personality; the Patterning of Interpersonal Behavior in the Village of Bang Chan*, University of California Press, Berkeley, California.
14. Thailand. National Statistical Office, 1970, *Report : the Survey of Population Change, 1964-1967*.
15. Thailand. National Statistical Office, 1971, *Statistical Yearbook, Bangkok, Thailand*.
16. United Nations, 1966, *An Evaluation of the Demographic Statistics of Thailand*, Unpublished (mimeographed) paper.
17. Vanaputi Chalor, 1972, *Citizen Handbook. Reprinted in the memory of Rijjpitra*, Bangkok, Thailand.