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THE SECOND YEAR DEATH RATE IN LESS DEVELOPED COUNTRIES

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So strongly does infant mortality affect the crude death rate of a population that it has become the accepted measure of general accomplishment in public health. In industrialized countries where all death rates are low, infant mortality is a valuable index. In less developed countries, where infant mortality and the crude death rate are both regularly high, infant mortality is also useful, although less broadly indicative because numbers of deaths among young children are less sharply restricted to the first year of life.

Deaths within the age group one through four years contribute heavily to crude death rates in technically underdeveloped countries. In the present discussion, these ages are considered synonymous with preschool age, although age at entering school is sometimes as late as seven years; and for some children, there are no schools. Preschool age extends until age five years. The term early childhood also refers to this age group. It is distinct from infancy, which is restricted to the first year of life. Second year children

are to be understood as those one year old and less than two years.

For the combined four years of early childhood, numbers of deaths in less developed regions often exceed one-half of infant mortality; they sometimes equal deaths of the first year; and occasionally, they are greater. This feature is in marked contrast to the situation in industrial areas where deaths in the preschool years amount to about 15% of those in infancy. Malnutrition is an important cause of death, both directly and through its synergistic action with infection[78]

Excessive numbers of deaths beyond the first year are not characteristic of developed regions. As a consequence, health workers of advanced countries and others trained there commonly apply the usual yardstick of infant mortality to assess the health status in less developed countries. It has limitations. The second year death rate is a decisive added element.

Ordinarily, the importance of that year is obscured by the standard demographic practice of recording deaths within the four preschool years as a group, with the result that each year is accorded equal importance. In less developed countries deaths in the second year regularly outnumber those in any other year of the preschool period by a wide margin; frequently, they exceed the remaining total. This disparity is also true of advanced countries, although to a lesser degree.

The aim now is to examine the second year death rate for those characteristics which distinguish its behavior in industrial and pre-industrial regions. Relationships are traced between numbers of deaths in the second year and the preceding year, and between that year and those immediately following. Biologic and social factors responsible for the greater death rates of the second year in less developed countries are identified and their significance evaluated with respect to public health effort toward control.

Sources of Information. For most countries of the world the standard sources of information about deaths in early childhood, such as the World Health Statistics Annual of the World Health Organization[101b], and the Demographic Yearbook of the United Nations[93a], give infant mortality in terms of deaths per 1,000 live births per year, and deaths and populations for the grouped years of one through four. Rates have expected differences in reliability from one country to another, with deficiencies most evident in the less developed countries. Many times, cited rates for these countries are restricted to special areas where reporting is adequate, or to selected urban areas or the capital city.

For almost all industrialized countries, deaths and populations are divided into separate years, from the first through the fifth. With an occasional exception, comparable information on less developed countries is lacking. Yet these are the regions where the second year death rate has its greatest significance.

A second source of information in this study has been the original local records in less developed countries where work in the area during other investigations made this possible. The comprehensive nutritional survey in Central American countries[49] is an example. Commonly, the dates of these various pieces of information vary because of the circumstances under which they were obtained. Other data became available through the courtesy of colleagues in many places, as from Fiji[12]. The information also varies with regard to geographical location, but in general, it is illustrative of broad regions, although by no means representative.

Adequate information from African countries below the Sahara is difficult to obtain[81]. The main reliance has been on hospital reports of deaths by age[61]. These have the limitations of a biased sample and a lack of knowledge about

population numbers upon which to base rates. They do give an idea of proportionate death rates by ages[70], and a suggestion of important causes[32], and they confirm the existence of high mortality[15,52]. Some information is drawn from reports in the literature; some from personal communications.

The most valuable source has been our own field studies in representative underdeveloped areas, where collection and interpretation of deaths was an integral part of operations, and population numbers were available through direct annual censuses. Two such studies were long-term and prospective: one in India[102], during the years 1954 to 1960, the other in Guatemala[75], from 1959 to 1964. Other field studies were descriptive and for periods of one year or less, three of them in the Arctic[39]. Investigations of this sort permitted evaluation of social and cultural influences on frequency and causes of deaths, and the impact of biologic factors.

Infant Death Rates. Infant mortality is everywhere, without exception, heavily weighted by excessive numbers of deaths in the first month of life. The prevailing behavior during the greater part of the first year is thus defined to advantage by separating the neonatal period of the first 28 days from the remaining 11 months which are designated as postneonatal, and determining individual rates for the two. Neonatal mortality may be refined further by specifying deaths in the first seven days of life. Table 1 shows that for selected countries, whether developed or underdeveloped, with rates low or high, neonatal deaths are primarily a function of the first week of life[66]. This is the most hazardous period of human existence. No other birthday is surrounded so heavily as the first by deaths. The rates in the table are proportional: on the basis of total live births during one year; and not by life table methods which give deaths among persons at risk[14], or by age-specific rates through population census.

The United States is considered typical of industrialized countries. The significant figures here are that 90% of neonatal deaths fell within the first seven days of life, and that 72% of all

TABLE 1.—DEATHS AND DEATH RATES PER 1,000 LIVE BIRTHS, SELECTED COUNTRIES, FIRST YEAR OF LIFE, BY AGE AT DEATH

Age at Death	*United States 1963*[101b]	*Barbados 1959*[84]	*Rural Guatemala 1959–64*[4]	*Rural India 1957–59*[42e]
Neonatal				
0 – 6 days				
Deaths	67175	161	30	71
Death rate	16.4	22.6	37.9	50.6
7 – 27 days				
Deaths	7473	51	21	37
Death rate	1.8	7.2	26.5	26.4
0 – 27 days				
Deaths	74648	212	51	108
Death rate	18.2	29.7	64.4	77.0
Postneonatal				
28 days – 11 months				
Deaths	28742	294	66	118
Death rate	7.0	41.3	83.4	84 2
Infant Mortality				
0 – 11 months				
Deaths	103390	506	117	226
Death rate	25.2	71.0	148.0	161.2

deaths in the first year were within the first four weeks[47,101b]. Reliance for similar data in less developed countries has mainly been on field surveys of which there are few. Official records in Barbados[84] for 1959 showed that 76% of neonatal deaths occurred within the first seven days, but of all infant deaths, only 35% were within the neonatal period. The Khanna Study[42c] in rural Punjab villages of India showed that 66% of neonatal deaths fell within the first seven days, and that total neonatal deaths were responsible for 48% of deaths in the first year. Still another field survey in rural Guatemala[4] gave results of 59% and 44% respectively.

The inverse ratio of deaths in neonatal and postneonatal periods in less developed countries is as striking as the greater magnitude of infant mortality as a whole. Indeed, this feature is in large part the reason for the higher rates. In the United States and in most other industrial countries, the proportion of neonatal to postneonatal deaths is about 2:1. In less developed countries it becomes more nearly 2:3. This is the key to the significance of the second year death rate. The atypical postneonatal period continues through the next year and sometimes longer, because the social and environmental conditions responsible for its origin are maintained.

The causes of deaths in the three periods noted are more or less distinctive. Immaturity, birth injuries, congenital anomalies, asphyxia and atelectasis of the newborn, and tetanus neonatorum in less developed countries characterize the initial week. This is the hard core of infant mortality, where preventive measures have restricted effect, except in the case of tetanus, and therapy is of limited efficiency. Most deaths from tetanus and fatalities from late effects of causes originating in the early period, are features of the remainder of the first month, as are some immediately acquired infections. The deaths of the last eleven months are chiefly from infectious diseases acquired postneonatally, and a progressively increased incidence of malnutrition.

The inverse ratio does not arise from lesser numbers of neonatal deaths. Indeed, they are more frequent in less developed countries, although more as a result of the quality of medical care than because of any greater case incidence. The change in ratio comes about from undue numbers of infectious and nutritional disorders in the last six months of infancy.

Deaths in Early Childhood, Ages 1 to 4 Years. A second readily available death rate for young children of most communities is the annual average for combined ages of the second through the fifth year of life, until age five years. The countries presented in Table 2 were selected primarily to illustrate relationships between deaths among preschool children and deaths in infancy in situations where childhood death rates are high, low, and intermediate; and so far as possible, they represent world geographical distribution.

The rates for European and North American countries are highly reliable; information is available for all of them. Vital statistics are also available for representative regions of Latin America and Asia, with the usual limitations of incomplete coverage and lessened general reliability. Rates for Oceania have variable value. Those for Australia and New Zealand are of the quality of European countries; those of the islands leave much to be desired[11,46]. The countries of Africa below the Sahara give difficulty. For most of the newly constituted countries, information is fragmentary and sometimes little more than estimates. Other than for the Bantu population, useful information exists for South Africa.

In general, countries with low infant mortality have a proportionately low frequency of deaths in preschool years. In most instances, they have well de-

veloped health services. The less developed regions with high rates of infant mortality regularly have high rates in the preschool years, but variations do occur. In most instances, the rate in the second year is high and continues at excessive levels during subsequent early childhood, giving a high annual average for the four-year period: 34 deaths per 1,000 population of those ages in Guatemala[101b]; 34 in Egypt[101a]; and 45 in Dahomey[93a].

In other populations with comparably high infant mortality: for example, 124 deaths per 1,000 live births in Chile: the average annual death rate for children one to four years old was 8.9 per 1,000[101a]. In Costa Rica where infant mortality was somewhat lower but still high, it was 7.3 per 1,000[93a]; and in Portugal, it was 6.9[101a]. As in populations where average rates for the four years were high, the second year rate was regularly great and more

TABLE 2—INFANT MORTALITY AND AGE-SPECIFIC DEATH RATES 1 to 4 YEARS, PERCENT RATIOS, DEATH RATES AND DEATHS 1 to 4 YEARS/–1 YEAR; SELECTED COUNTRIES BY HIGH AND LOW RATES AND GEOGRAPHICALLY

	Under 1 year		*1–4 years*			
	Deaths	*Deaths per 1,000 live births*	*Deaths*	*Deaths per 1,000 population those ages*	*Death Rate 1–4 years/ Infant Mortality, Percent*	*Deaths 1–4 years/ Deaths under 1 year, Percent*
Asia						
1963 Taiwan[93a]	12095	28.5	7999	5.1	18	66
1963 Japan[101b]	38442	23 2	10097	1.6	7	26
1963 Philippines[93a]	56700	72.1	41215	8.8	12	73
Middle East						
1961 Egypt[101a]	80164	139.0	55619	33.8	24	69
1961 Jordan[101a]	4274	60.4	2700	11 3	19	63
1963 Israel[101b]	1051	22.7	178	1.0	4	17
Africa						
1961 Togo[93a]	10685	139.9	11275	44.9	32	106
1961 Dahomey[93a]	12242	110.5	13560	45.0	41	111
1963 Reunion[93a]	1158	70.3	479	9.9	14	41
Latin America						
1959 Chile[101a]	31442	123.7	7835	8.9	7	25
1963 Guatemala[101b]	18349	92.8	18463	33.9	37	101
1963 Venezuela[101b]	18137	53.8	5899	5.7	11	33
North America						
1961 Canada[101a]	12940	27.2	1998	1.1	4	15
1963 U.S.[101b]	103390	25.2	16571	1.0	4	16
Europe						
1960 Portugal[101a]	16576	77.5	5926	6.9	9	30
1963 Yugoslavia[101b]	31572	77.5	6676	4.5	6	21
1963 Italy[101b]	38552	40.1	5824	1.7	4	15
1963 Norway[101b]	1068	16.9	240	1.0	6	23
Oceania						
1963 Australia[101b]	4607	19.5	875	1.0	5	19
1963 New Zealand[101b]	1269	19.6	273	1.1	6	22
1964 Fiji[93a]	518	30.5	247	4 0	13	48
1964 Pacific Islands[93a]	105	38.1	35	2.8	7	33

than for any other, but during later preschool years the frequency of deaths declined more promptly, to give a lesser average. The suggestion is that environmental factors are responsible for these differences: in pattern of behavior and in absolute values. A likely possibility is malnutrition.

Column 5 of Table 2 shows the ratio of death rates at ages 1 to 4 years to death rates in infancy, expressed in percent. Wills and Waterlow[100] have advanced this ratio as an index of nutritional state in a community, a concept supported by others[55,83,97a] National ratios of less than 5% may be interpreted as representative of good nutritional conditions; those of 5% to less than 10% correspond to an intermediate position; and those ratios in excess of 10% and extending to as much as 40% are indicative of a deficient community nutritional state.

Countries in recognized difficulty may readily be sorted out by this index. The trouble lies with countries in the better categories. Norway, with an infant mortality of 16.9 and a 1 to 4 year death rate of 1.0 per 1,000 per year, falls within the intermediate group, while Italy with respective rates of 40.1 and 1.7 is within the better group. By this ratio, Yugoslavia with death rates of 77.5 and 4.5 per 1,000 per year is on a par with New Zealand and its rates of 19.6 and 1.1; in each instance, 6%.

In search of a more useful numerical expression, ratios were computed as shown in Column 6 of Table 2, based on total deaths instead of death rates, and also expressed in percent. This increased numerical values by threefold to four-fold. Although it permitted separation of values into four categories instead of three, the same difficulty persisted in distinguishing countries with good and poorer absolute rates and yet similar ratios.

Death Rates by Single Years, Ages 0 to 4. The ratio of deaths at 1 to 4 years to deaths under one year expressed as a percentage has theoretical deficiencies as an index of malnutrition in a community. Malnutrition of infants in less developed countries is little evidenced before age six months because children do well with the customary breast feeding[63,79,91]. The incidence of protein-calorie malnutrition, especially the lethal kwashiorkor, is mainly after the first year of life[67, 88,97b] and particularly in the second year. Some cases of kwashiorkor occur in the second half of the first year, and in some regions an appreciable number in the third year[50]. In both instances, the determining factor is the age when weaning is completed[74]. Thus, both sides of the equation are weighted with deaths which have little or no relation to malnutrition: the numerator with deaths of the fourth and fifth years; and the denominator still more with the many deaths of the first half year. To establish an index more directly applicable to malnutrition, deaths of children in a variety of countries, wherever adequate data were obtainable, were examined for frequency of deaths by single years during early childhood.

A field study of long duration in a rural area of northern India[42b] produced by monthly visits well authenticated records of 338 deaths. The investigation enlarged existing information from hospital studies[24,33,92] and officially reported deaths[87] and established the major mortality of the second year and the relatively high rates of all preschool years. The infant mortality, based on population under one year, was 186.9 per 1,000.

Age-specific death rates for individual years of early childhood are presented in Table 3. The Punjab has an evident high death rate in infancy. Rates continued at high levels in each of the succeeding four years, the second year rate being 72.2 per 1,000 population of that age, or 30 times the rate for the corresponding year among children of the United States. Infant

mortality was seven times greater. A highly significant feature was that 70% of all deaths within the 1 to 4 year period were in the second year.

In 1961 Egypt[101a] had an infant mortality of 139 per 1,000 live births in localities with organized health facilities. This rate was used in preference to the stated rates for the country as a whole which were materially greater and presumably less reliable. Although the 1 to 4 year death rate was only about one-fourth that of infant mortality, 33.8 per 1,000 children per year, the second year accounted for 59% of total deaths of the period, and of itself was 107 per 1,000 children of that age, a rate not greatly below that for infant mortality.

Guatemala has the highest birth rate among Central American countries: in 1963, 47.7 per 1,000 population, and an infant death rate of 92.8 per 1,000 live births, a distinctly high value. The

TABLE 3.—DEATHS AND DEATH RATES PER 1,000 LIVE BIRTHS PER YEAR, EARLY CHILDHOOD, BY YEAR OF AGE

Age (years)	*Population*	*Deaths*	*Deaths per 1,000 per year*	*Deaths/ All Deaths 1–4 years, %*
		*Rural Punjab, India[42c], 1957–59**		
– 1	1172	218	186.9	—
1	1164	84	72.2	70.0
2	1078	23	21	19.2
3	1114	9	8.1	7.5
4	1023	4	3.9	3.3
1 – 4	4379	120	27.4	—
		Rural Guatemala[49], 1958–64		
– 1	55709	5582	100.2	—
1	49168	2542	51.7	46.0
2	46585	1528	32.8	27.6
3	45174	908	20.1	16.4
4	44320	554	12.5	10.0
1 – 4	185247	5532	29.9	—
		Mauritius[101a], 1961		
– 1	26100	1618	62.0	—
1	22600	381	16.9	46 6
2	22100	210	9.5	25.7
3	22400	130	5.8	15.9
4	22400	96	4.3	11.7
1 – 4	89500	817	9.1	—
		Romania[101b], 1963		
– 1	291000	16270	55 2	—
1	291800	1634	5.6	51.8
2	313300	709	2.3	22.5
3	330300	457	1.4	14.5
4	236400	357	1.0	11.3
1 – 4	1281800	3147	2.5	—
		Sweden[101b], 1963		
– 1	112900	1735	15.4	—
1	104400	97	0.9	35.0
2	102000	75	0.7	27.1
3	102300	54	0.5	19.5
4	103800	51	0.5	18.4
1 – 4	412500	277	0.7	—

*Punjab, India, 1957–59: Population and death rates by census.

crude death rate for all ages was 17.2 per 1,000 population[101b]. Long-term field studies showed that 86% of rural children less than five years old had a deficiency in weight for age greater than 10% compared to a reference standard, and 5% had a deficiency of 40% or more. Within recent years[9], kwashiorkor has accounted for two-fifths of deaths at ages 1 to 4 years. The 1966 INCAP-OIR field survey[40] of a rural population of 1,179,366 gives deaths during the years 1958 to 1964 among preschool children by single years. The average annual infant mortality was 100.2 deaths per 1,000 live births. The number of deaths at preschool ages of 1 to 4 years was 5532, of which 46% were in the second year. Death rates in the subsequent three years continued at high levels with the characteristic progressive decline as age advanced. In a country with a high infant mortality, and an undue frequency of malnutrition, death rates in the second year of life approximated those of the postneonatal first year. In the succeeding three years, the rates continued regularly at about 32 times those characteristic of the United States for corresponding ages.

Infant mortality in Mauritius[101a] is at relatively high levels: in 1961, 62 deaths per 1,000 live births; not excessive, but still about three times that of industrialized countries. The pattern of deaths in the years of early childhood is much like that of Egypt or Guatemala, except that the ratio of 1 to 4 year deaths to infant mortality is far less, at 15%. Deaths of the second year still accounted for 47% of all fatalities within ages 1 to 4 years. Deaths in succeeding years remained at a high level, still 4 per 1,000 in the fifth year, as compared to 16.9 per 1,000 in the second year. Although Mauritius has lower death rates than most African countries and less than in many of the countries presented, the general pattern of behavior is still much the same.

Romania is another country with infant mortality at an intermediate level: in 1963, 55.2 per 1,000 live births. Yet it has a more favorable record of deaths in the preschool years[101b]. The differences in infant mortality between Romania and Mauritius are inconsequential. The distinctive feature is that in Romania, deaths for ages 1 to 4 years were only 2.5 per 1,000, compared to 9.1 in Mauritius. Despite the smaller numbers, deaths in the second year still accounted for 52% of the total during 1 to 4 years. The major gain was in the last three years of that age group, the usual course of events as conditions improve.

As a control and as a means for comparison, 1963 rates are cited in Table 3 for Sweden[101b], a country with an exceptionally good showing for childhood deaths at all ages. Infant mortality was 15.4 per 1,000 live births and the 1 to 4 year death rate only 0.7 per 1,000 population of those ages. The second year death rate was a mere 0.9. The examples given were selected on a basis of high and low infant mortality, but the several patterns presented were duplicated repeatedly among a hundred or more countries for which similar data were tabulated.

It is to be noted that in Sweden the proportion of deaths in the second year among all deaths at ages 1 to 4 years was still 35%; even under these admirable conditions, the second year rate is greater than in any other of the preschool years. That situation is not peculiar to Sweden. It holds for all other industrialized countries with good health services and low death rates, whether the information is derived demographically or by direct survey[64]

A second generalization is that death rates decline progressively with advancing age through the fifth year. Only a few exceptions were encount-

TABLE 4.—SECOND YEAR AGE-SPECIFIC DEATH RATES, SELECTED COUNTRIES, BY SPECIFIED YEARS

Annual deaths per 1,000 population, aged 1 year and less than 2 years

– 2	*2 – 4*	*5 – 9*	*10 – 24*	*25 – 49*	*50 or more*
Sweden[101b] 1963, 0.9	Czechoslovakia[101b] 1963, 2.0	Fiji[12] 1963, 5.4	Yugoslavia[101b] 1963, 10.6	India, urban Bombay[48] 1961, 25.9	Senegal[78] 1957, 61.0
United Kingdom[101b] 1963, 1.5	France[101b] 1963, 2.1	Puerto Rico[69] 1960, 5.6	Venezuela[101a] 1961, 11.0	Ceylon[16] 1953, 28.5	Guatemala[101b] 1963, 62.1
Norway[101b] 1963, 1.6	New Zealand[101b] 1963, 2.2	Romania[101b] 1963, 5.6	Portugal[101a] 1960, 16.4	Jordan[101a] 1961, 30.0	Guinea[78] 1955, 68.0
Finland[101b] 1963, 1.6	Austria[101b] 1963, 2.2	Philippines[101a] 1960, 5.6	Thailand[101a] 1960, 16.4	Mexico[60,101a] 1960, 30.9	India, rural Khanna[42c] 1957–59, 72.2
U.S.A.[101b] 1963, 1.6	Japan[101b] 1963, 2.5	Trinidad[101b] 1963, 6.2	Mauritius[101a] 1961, 16.9	El Salvador[101a] 1961, 31.7	Egypt[101a] 1961, 107.0
Australia[101b] 1963, 1.6	Greece[101b] 1963, 2.8	Singapore[101a] 1957, 6.5	Taiwan[101a] 1956, 18.5	Grenada[95b] 1961, 33.0	Gambia[62] 1949–53, 111.0
Canada[101a] 1961, 1.7	Poland[101b] 1963, 3.1	Hong Kong[101a] 1961, 8.0	Panama[101b] 1963, 19.3	St. Kitts[95b] 1960–62, 35.9	St. Vincent[95b] 1960–62, 147.6
Israel[101b] 1963, 1.7	Italy[101b] 1963, 3.2	Barbados[95b] 1960–62, 8.7	Antigua[95b] 1961–63, 21.1		
Netherlands[101a] 1960, 1.7	Hungary[101b] 1963, 3.2		Chile[101a] 1960, 24.3		
Scotland[101b] 1963, 1.8	Spain[82] 1961, 3.6				

ered. In St. Vincent[95b], the second year death rate of 148 exceeded the infant mortality of 110. In rural Senegal and in Guinea[78], where infant mortality was at extremely high levels, respectively 172 and 217, the second year rates were high. 61 and 68, deaths in the third year outnumbered those of the second year although by a small margin, and they were still 30 and 33 in the fourth and fifth years. These and other departures from usual experience may well relate to the bias inherent in samples drawn from clinic and hospital patients[2].

Global Range of Second Year Death Rates. For the selected countries presented in Table 3, the major portion of deaths within the collective ages of 1 to 4 years was in the second year, irrespective of whether rates were high or low. Seemingly, the second year has an individuality distinct from all others of early childhood, to an extent presumably determined by host-factors, but more likely, by social and hygienic features of the environment.

A wider experience of second year death rates is presented in Table 4. The values by countries range from 0 9 deaths per 1,000 children of that age in Sweden to 147.6 in the Caribbean island of St. Vincent.

Rates are divided arbitrarily to include in a first category those indicative of a satisfactory health achievement. Of two subdivisions, the first included annual rates less than 2 deaths per 1,000 children at least one year old and less than two years, and a second included rates from 2 to 4 per 1,000 inclusive. An intermediate rating, again with two subdivisions, was accorded regions with second year death rates of either 5 to 9 deaths per 1,000, or within a range of 10 to 24. Those rates between 25 and 49 deaths per 1,000 children of that age population were considered high, along with a second subgroup where deaths exceeded 50 per 1,000. The three broad divisions by no means correspond to a quantitative distribution among world populations, of necessity they are those for which data were available.

The countries with lowest rates are consistently within a narrow range from 1.5 per 1,000 for the United Kingdom to 1.7 for The Netherlands. Only Sweden of the countries cited has a lesser rate. namely, 0.9 death per 1,000 children of the second year.

Similarly, countries with second year death rates between 5 and 9 deaths per 1,000 children are closely grouped: from Fiji with 5.4 to Singapore with 6.5, except for Hong Kong and Barbados, where rates exceeded 8.0. As expected, the range is greater within the upper division of intermediate rates. Yugoslavia having a second year death rate of 10.6 and Chile, 24.3, although for most it was less than 20.

The first subgroup of countries with high rates centers around values of about 30 Those with excessively high rates extend from Senegal with 61 second year deaths per 1,000 to St. Vincent with 147.6. The African countries below the Sahara for which data were available, although recognizably incomplete and commonly from hospital and sampled populations, fell within this group, except for Mauritius.

Infant Postneonatal and Second Year Death Rates. A characteristic feature of high infant mortality in less developed countries is the inverse ratio between deaths in the neonatal period and deaths in the remaining eleven months of the first year, as demonstrated in Table 1. These two rates in the Khanna Study in India[42a] and in similar field studies in Guatemala[4] were in a proportion of 2.3 in place of the usual 2:1 of industrialized countries. Since causes of death in the postneonatal months of infancy and in the second year of life are so largely attributable to acute infectious disease and malnutrition, or to the synergistic combination of the two, mortality in the two periods can reasonably be viewed

as a continuum The behavior of the two fractions, in relation to each other or independently, is a further possibility as an index of community malnutrition

The two rates can be computed with accuracy by life table techniques, wherein deaths at successive intervals are determined according to existing survivors of an original cohort of newborns. The commoner and more practical proportional division of deaths within neonatal and postneonatal periods per 1,000 live births of the year, along with a second year rate based on census count, serves adequately for trial purposes. Where postneonatal deaths outnumber neonatal fatalities, as in infant mortality of less developed countries, a high ratio of second year death rate to postneonatal rate in terms of percent is clearly indicative of a serious and continuing health situation For Guatemala, as judged by the INCAP-OIR survey[49], this particular ratio was 52·59, or 88%. In the rural Punjab studies in India, it was 72:84, or 88%. Wherever the ratio is as high as in El Salvador, Mauritius or Egypt, malnutrition is likely to be a strongly contributing factor.

Since both rates respond concomitantly to improving health conditions, as evidence now to be introduced will show, the ratio tends to remain great and progressively loses value. Finland, for example, with highly favorable death rates in the first two years, has a ratio of 36%, and the exemplary Sweden, a ratio of 29%. Either the postneonatal rate alone or the second year rate seemingly has advantage over the ratio between the two The second year rate is more distinctive if malnutrition is the central concern, because it is less diluted with other factors.

Long-Term Trends in Deaths of the Second Year. The behavior of second year death rates in particular countries over a period of years gives an added understanding of environmental influences, of the relative consequences to community health of deaths in the first and second years, of the nature of opportunities for effective public health action In a classical study of mortality among young children in the city of Aberdeen, Scotland, over a period of 50 years, 1900 to 1949, Craig[20] emphasized that the physiology and pathology of the young child are characteristic, and differ from those of the infant and the school child. The diet is changing. Milk is no longer the chief food, although still important. Growth in weight and height is slowing down, but there are still striking advances in accomplishments, in movement and activity, in contact with the outside world, and in growth of personality and adjustment to environment. The preschool child is losing an immunity commonly acquired from the mother to certain infectious diseases and gaining his own protection from personal experiences with infectious agents of the environment, or through immunization. The body chemistry is still unstable and the young child remains sensitive to deficiencies in amount of food or specific nutrients. These deficiences are reflected in the mortality rates of the age period, more in the second year than in any other. The long-term trend of deaths in early childhood has been a continuing interest of Scottish physicians[7,20,58]. Gale[31], Douglas[26a,b] and others[27] have made equally informative analyses of English experience; Stuart[80] for the United States, and van Gelderen[36] for The Netherlands. Less comprehensive studies exist for other developed countries[34,53a,b], and useful reviews give information for numerous underdeveloped regions where facts are more difficult to obtain[10,25,56,57,72,95a].

Two countries were chosen in illustration of long-term behavior (Fig. 1): Sweden because of its current and continued good record, and Spain because it is a country with an early high infant mortality which is greatly diminished in the course of years. For reasons al-

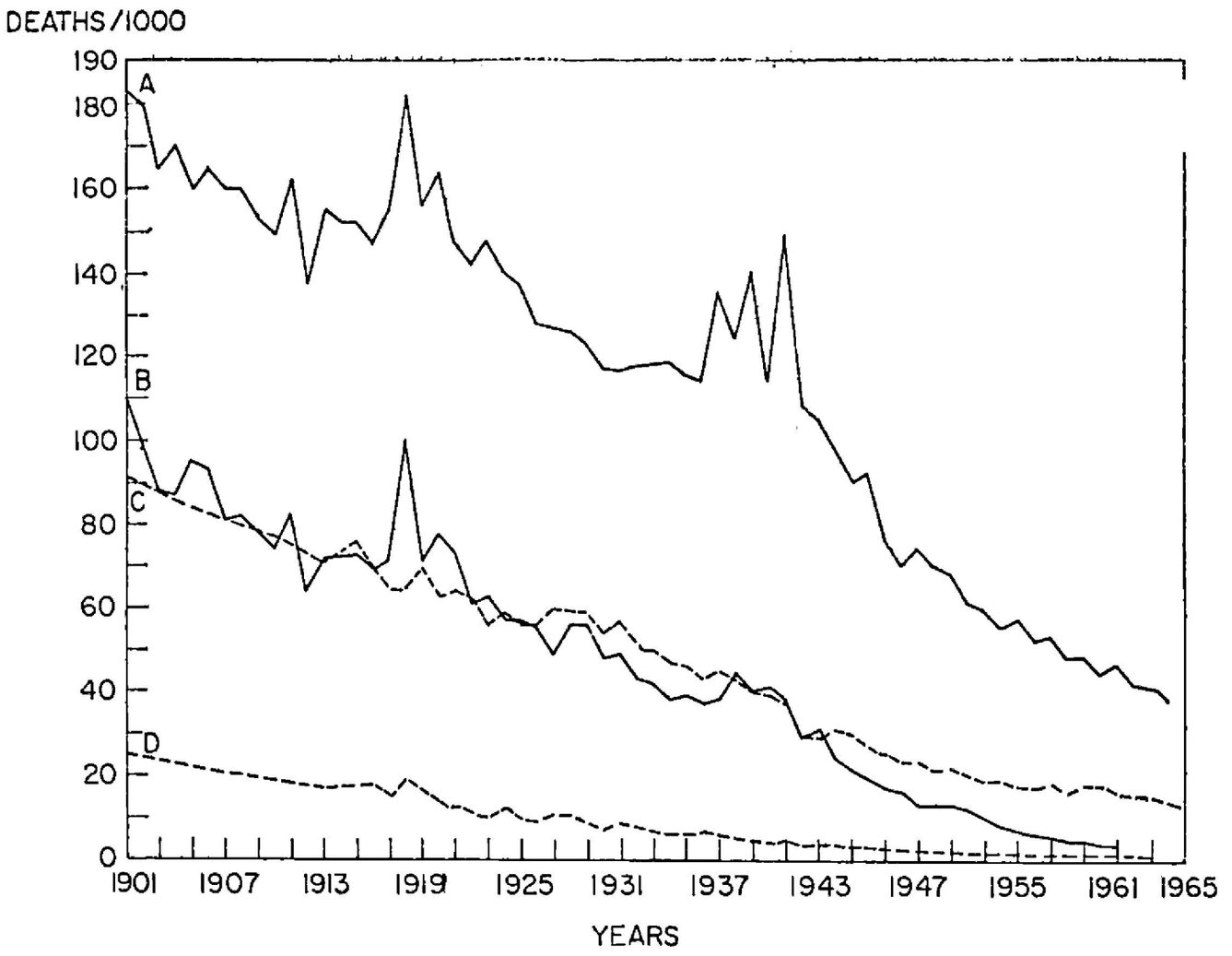

Fig. 1 —Deaths per 1,000 live births per year (A ——) and deaths per 1,000 children aged one year and less than two years (B ——), Spain 1901–1965; and infant mortality (C – – –) and second year death rate (D – – –), Sweden 1901–1965. Sources. Spain[93a,b,82,93a, 101a]; Sweden[71,89,93a,b,90,101a,b].

ready brought out, both infant and second year mortality are presented. An added practical reason for the choice of these two particular countries was that records in both instances date back to the beginning of the twentieth century. The specific data were collected from several indicated sources. For some few years, exact information was lacking from sources available to us. In an occasional instance, populations for calculation of rates are estimates from known births and deaths. An occasional individual annual death rate was derived by extrapolation from average short-term rates. The trends are little affected.

That Sweden had an infant mortality of 84.5 per 1,000 live births[71] in the twentieth century is hardly believable in view of its present enviable position: a 1965 rate of 13.4 per 1,000 live births[93a]. Indeed, the data for that country extend back to 1760, when infant mortality was recorded as 204.6 deaths per 1,000 live births[89]. The trend in rates has been steadily downward, with minor interruptions identifiable with the influenza pandemic of 1918, the depression years of the late 1920s, and the Second World War[54,85]. By 1965, infant mortality had declined to 15% of recorded values at the beginning of the century.

The trend of second year deaths in Sweden was in the same pattern, but for these deaths, the 1963 rate of 0.9 per 1,000 population was only 4% of the 1901 to 1910 figure. The response of this rate was sharper than that of infant mortality; the reaction was also more sensitive to improving health conditions than the postneonatal death rate. The spread between the death rates of

the first and second years was consistently great, as is usual for countries with good health facilities. Although the improvement was relatively much greater for the second year, the greater absolute values of infant mortality made the number of lives involved far greater for children of the first year than for the second: on the basis of present rates and those once prevailing, by about three-fold for each 1,000 children.

With an infant mortality in 1901 essentially twice that of Sweden, Spain had a decline in childhood death rates equally as definite, although interruptions to the trend by events previously noted were for Spain more exaggerated and generally more prolonged. As is usual with high infant mortality, second year rates were consistently nearer those of the first year. At the beginning of the century the second year death rate was 110 per 1,000 population per year[3a,13], and for many years it closely paralleled the infant mortality rate for Sweden. Indeed, the second year death rate of those days rivals the higher rates of infant mortality among less developed countries today, and for many it is greater. Although rates in Spain originally exceeded those in Sweden, the extent of decline has been similar, despite prevailing rates which are still high among European countries. The infant mortality in 1964 (37.9) was less than one-fourth of that at the beginning of the century. The decline in second year death rates from 110 per 1,000 in 1901 to the present 3.4 (1961) is no less than remarkable: about 1/32 of what it was, with the number of lives involved for each 1,000 children by present rates close to equal for the first and second years.

Ecologic Determinants of Second Year Deaths. The experience of the countries just detailed makes clear that although death is without doubt a biologic phenomenon, the factors determining frequency are more often sociologic.

Biologic factors relating to the host are reasonably listed as number and spacing of births, age of mother, multiple births, and immaturity. From the broader community viewpoint, they can be listed as the nature and activity of infectious agents, the changing age structure of populations, and the available food supply. Social considerations include urban and rural residence, illegitimacy, housing and standard of living, literacy and intelligence, family income, occupation, employment, and others. While some influences are primarily biologic and others sociologic or cultural, no one can be singled out with any surety as wholly of one or the other character[93b]. The explanation of high and low second year death rates, and the decline of infant and child mortality[101c] is therefore largely ecologic, the result of an interaction of elements variously contributed by host and environment, environment being interpreted in the broad sense of physical, biologic, and socio-cultural components[38a].

A greater frequency of infectious disease may dominate a particular situation[62], yet both frequency and ultimate outcome often relate to a strong degree to the existing nutritional state of the host, which in turn has cultural, social, and economic connotations[40,68].

Parity of the mother is a potential determinant of death in the first year of life[35]; death rates are high for first and late births. Conceivably this circumstance also holds for deaths in the second year. Age of mother is another factor, linked to parity and to the social features of knowledge and ability to provide proper infant care. A third allied consideration is the number of children present in a family at the time a child is born. In situations where death in early childhood is frequent, it may be the most decisive; all three are interrelated.

Large Families. Birth rates in less developed countries are high and families are large. A study of 1451 children born in rural Punjab, India[42b], during four years of a prospective field study, give an infant mortality for the first born of 189 per 1,000 live births. Rates for second pregnancies were less: 117. By the fifth pregnancy they equalled those for primiparas; and for advanced parities past the sixth, infant mortality was 206. The pattern of greater death rates for infants of first and late pregnancies was corroborated as expected by observed rates according to age of mothers: 166 infant deaths per 1,000 live births for mothers of ages 15 to 19 years; 130 for mothers 30 to 34 years old, and 271 for those 40 years old or more. These biologic factors were active primarily because of excess deaths in the neonatal weeks. Postneonatal deaths were much evener and indeed, in the Punjab experience, infants of the youngest mothers had fewest deaths at this time. Second year death rates for young mothers resumed, however, the pattern of neonatal deaths, suggesting action of some newly introduced factor, presumably social. This led to analysis of results, not by parity or age of mother, but by the number of living children in the family at the time a child was born. The findings are presented in Table 5.

Death rates were computed on a life table basis, which takes into account children observed from birth and losses incurred by death or other cause, mainly migration. The death rates of the neonatal period were evidently influenced by the biologic factors just noted[103a]. Those of the second year increased by reasonable progression from families with only one child to those with six or more. Such results are not difficult to understand. With the succession of one child after another, and the large families, care of the newborn in less developed countries is, of necessity, divided among many. And frequently, so must the food.

The effect is heightened presumably when the interval between births is short. The last born child is displaced from its favored place with the developing pregnancy of the mother, and his position becomes worse as the next baby arrives. It, in turn, is born to a mother who has been breast feeding a child in recent months and experiencing the other stresses incident to care of an infant.

Birth Intervals. The large number of births which occur within relatively brief intervals[29] is a feature of high birth rates and rapidly increasing populations in many less developed countries. In the Khanna Study, to which reference has been made[28,103b], new-

TABLE 5.—DEATHS AND DEATH RATES PER 1,000 CHILDREN OF THE FIRST AND SECOND YEARS OF LIFE, BY NUMBER OF CHILDREN IN THE FAMILY AT TIME OF BIRTH, INCLUDING THE PARTICULAR BIRTH, PUNJAB, INDIA, 1957–60[102]

	Neonatal			*Postneonatal*			*Second Year*		
Living Children	*Deaths*	*At risk (births)*	*Death rate*	*Deaths*	*Number at risk*	*Death rate*	*Deaths*	*Number at risk*	*Death rate*
1	33	312	106	26	279	93	10	175	57
2	16	289	55	18	273	66	8	170	45
3	21	263	80	23	242	95	14	156	90
4	13	238	55	22	225	98	14	145	97
5	6	147	41	16	141	113	6	81	74
6	6	104	58	4	98	41	8	71	113
7	7	59	119	5	52	96	4	34	118
8+	6	38	158	4	32	125	2	19	105
Unknown	0	1	0	0	1	0	—	0	—

TABLE 6.—MORTALITY OF 1479 CHILDREN BORN IN 11 PUNJAB VILLAGES, 1955–58, BY INTERVAL BETWEEN OBSERVED AND PRECEDING CHILD[108]

Interval between births in months	*Number of births*	*Neonatal mortality: deaths per 1,000 infants aged less than 28 days (N = 1479)*	*Infant mortality: deaths per 1,000 population aged less than 1 year (N = 1457)*	*Second year mortality: deaths per 1,000 population (N = 854)*
Primip.	231	95.2	175.4	68.7
0–11	34	88.2	205.9	105.3
12–23	432	97.2	201.9	54.9
24–35	491	57.0	132.2	89.0
36–47	175	57.1	137.9	57.7
48+	112	35.7	108.1	29.0
Unknown	4	0.0	0 0	0.0
Total	1479	73.7	160.6	67.9

born children were followed by monthly home visits through the second year of life. Table 6 shows birth intervals by months between the observed child and the preceding sibling, the mean being 31 months. Neonatal mortality rates, infant mortality, and the age-specific death rate for survivors to the second year are also given. Rates of the first year are true mortality rates, and not death rates based on births of that year. The group of children born of primiparous mothers could conceivably be used to judge deaths according to birth interval, in that they have no associated sibling. The comparison is not justified because neonatal and infant mortality rates for those particular children are well established as meaningfully greater than average. That was true in this series.

The 1,479 children were the babies born during the four years of the study and followed for at least one year. Those of the smaller group were observed for two full years. The interval between a birth and that of the preceding sibling was determined in most instances by history, although for later births in the study, the preceding child might also have been in the series.

Infant mortality rates for children of the two combined shorter intervals shown in the table, less than 24 months, exceeded those for primiparous children, which are regularly high. They were measurably above the average of 160.6 per 1,000 population for the series as a whole. Neonatal death rates were highest among children born at short intervals, less for those born at the usual interval of 24 to 35 months, and least when the interval was 36 months or more: $p < 0.01$ to 0.02. The rank order for entire infant mortality was of the same nature, with even greater significance ($p < 0.001$ to 0.01).

Deaths among 270 children born at short intervals and surviving the first year were not demonstrably more frequent during the second year than for children of the two longer intervals, although the usual clustering of deaths in the early months of the second year was more marked with the shorter intervals.

An even greater effect of short birth interval would be anticipated for the first born of the two siblings. Early weaning because of the ensuing pregnancy or arrival of the new infant brings a change of diet for the first child earlier than usual, a situation commonly associated with a peak incidence of acute diarrheal disease, the principal cause of death in the Punjab at ages 6 to 24 months. When spacing between births is short, a concern with the newborn baby comes at a critical time for the earlier born toddler.

Within the four years of the study, the instances where a second birth followed that of the index child of the series, and the child could be followed for the requisite time, were too few to give meaningful numbers of deaths. From the data which exist, the suggestion is that the effect of a short birth interval is more marked for the first child of a pair than it is for the second, as definite as that is. Neonatal deaths among the earlier born are irrelevant; as a group no short interval stress exists. For the second child to be born within the defined limit of two years, conception must occur at the latest by the time the first child is 15 months old. Short interval effect would thus be evident in the postneonatal period and still more in the second year after the new baby arrives. So far as the existing data justify, this seems to be the case and of sufficient moment to warrant further investigation. Retrospective information has limited reliability. The need is for prospective study of the kind presented in the incomplete observations of this investigation. To advantage, a study should record illnesses as well as deaths, for the effects may well extend beyond the deaths which occur.

Acute Diarrheal Disease. An undue prevalence of infectious disease is the main reason according to officially recorded deaths for the greater rates of the second year in less developed countries. The individual attack may well have its own significance; the repeated occurrence of a succession of illnesses (the number and the intervals between them) are perhaps equally important[30]. Acute diarrheal disease readily accounts to a great extent for the unique position of second year deaths in less developed regions[6,21,23]. Attack rates and deaths are so high at that time, and, to a lesser extent, at later preschool ages, that the disease in many countries ranks as the first cause of death for the population as a whole[38b]. Death rates for diarrheal disease in a study in rural Guatemala during the years 1950 to 1959 were 17 per 1,000 during the first year of life, most of them in the last half of the year; 36 in the second year; and 28 in the third. For the fifth year, the rate was 10, and thereafter it declined to low levels: 2.5 for school children, and 2 per 1,000 population for persons past 14 years[43]. Studies in many countries have demonstrated an association of diarrheal disease with weaning and a faltering nutritional state, to such an extent that the disease has been termed weanling diarrhea[41]. In this sense most deaths from diarrheal disease are due to a synergism of infection and malnutrition rather than to diarrheal disease alone.

Weaning Practices and Malnutrition. Children in less developed regions ordinarily do well in weight gain and in general growth and development during the first six months of life because of the almost universal practice of breast feeding[74]. As breast milk then fails to meet nutritional requirements in protein and calories, growth slackens and resistance apparently declines[22]. Essential food supplements are commonly lacking in sufficient amounts and nutritive quality. In Kenya[44], 47% of 243 young children who died in hospital were malnourished at the time of admission; nutritional state was worst among those in the second year of life, in late weaning.

The result is an increasing prevalence of diarrheal disease. Studies in Guatemala[40] and elsewhere[51,90] have demonstrated a direct relationship of deteriorating nutritional state to frequency and to severity.

The effect of malnutrition on infection is not restricted to diarrheal disease. It is manifest in measles[5,65,77], chickenpox[73], and others of the common specific communicable diseases of childhood as well as in infections in general[17,76], notably malaria. Malnutrition reaches its peak in the second year. It contributes in two ways to the high death rates which characterize less

developed countries at that time: first, through specific nutritional disorders such as kwashiorkor, marasmus, and others; and second, with equal significance, through the extent to which it exaggerates the effects of infection[37,60].

Sex Ratio of Second Year Deaths. The expected sex ratio for deaths of the second year is an essentially equal distribution between males and females[15]. A cultural influence intrudes in some societies to give much higher rates for females, as in India[42c], the Cocos Islands[80], the Middle East[18], and some other regions. The premium placed on sons in an agricultural economy is a dominant factor[19]. The main difference among children of the Punjab (Fig. 2) was during the weaning period, 6 to 24 months of age, when malnutrition is most pronounced. Although cultural customs and ideas may be motivating factors, the effect becomes evident in the matter of food.

Social Class. The caste organization of rural India provides a ready opportunity to judge the effect of social class on death rates of the first two years of life. The computations of Table 7 are by life table methods on the basis of 1,000 children born. The Jat or farmer caste is the higher social class, the Chamars or leather workers of low social class, while the castes classed as others are of mixed status, ranging from the bottom social class of sweepers to the high class Brahmins. Deaths per 1,000 person-years are in

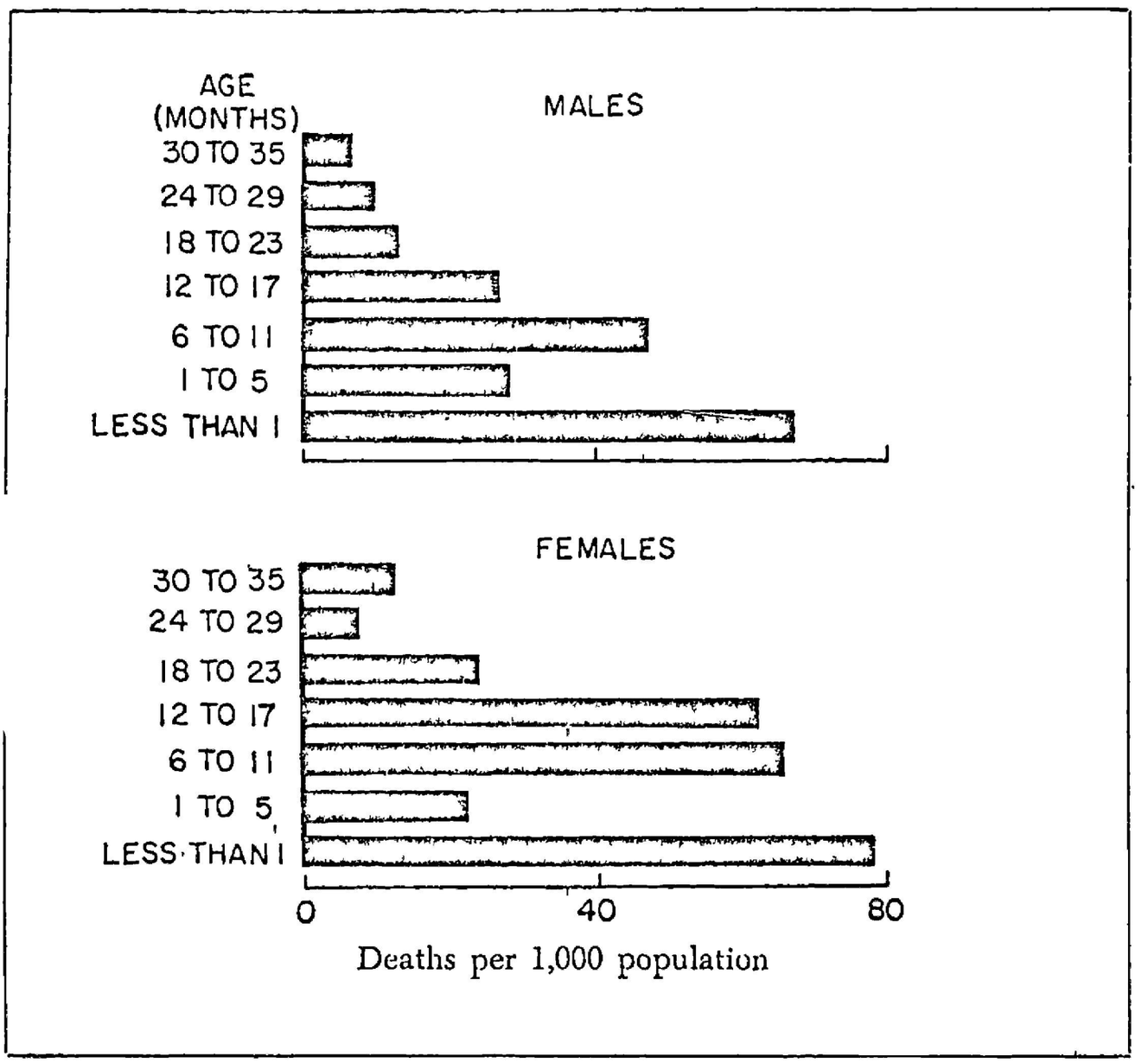

Fig. 2.—Death rates by age in months, male and female, based on 1451 newborns, 860 children in the second year of life and 431 in the third year of life; eleven villages of the Punjab, India, 1955–59[109].

TABLE 7.—DEATHS PER 1,000 PERSON-YEARS BY SOCIAL CLASS AND AGE, FIRST THREE YEARS OF LIFE, PUNJAB, INDIA, 1957–59[105]

	Jat Caste Farmers		*Chamar Caste Leather Workers*		*Other Castes*	
Age	*Alive at beginning*	*Deaths per 1,000 person-yrs.*	*Alive at beginning*	*Deaths per 1,000 person-yrs.*	*Alive at beginning*	*Deaths per 1,000 person-yrs.*
0–27 days	625	800.3	478	1252.4	348	1103.9
1–5 mos.	588	53.3	435	89.1	320	68.0
6–11 mos.	575	71.1	419	208.0	311	151.9
12–17 mos.	392	93.9	266	156.3	201	91.6
18–23 mos.	374	32.3	257	71.3	192	42.1
24–35 mos.	193	20.9	141	36.1	97	10.4

accord with social class. Other than for the neonatal period, high death rates center in the weaning period of 6 to 24 months (median for completed weaning is 19 months) irrespective of caste. The relation to malnutrition is strongly suggested.

Ethnic Differences in Second Year Deaths. Fiji has two major ethnic groups, the native Fijians and a population originating in India several generations ago. The Indians are in a moderate majority. Table 8 presents deaths and death rates for the three years 1963 to 1965 by racial group, by single years of age through the fifth year, and by sex[12].

The intent is to demonstrate differences in rates of death in early childhood among groups of independent ethnic origin living in a common environment. Such differences exist between Fijians and Indians. They are also described in Burma[99] where the Chinese and Indian minorities have lower mortality rates than the Burmese; they exist in Malaysia for the same two groups, and in Guatemala between Mayan Indians and Ladinos[49]. A further purpose was to assure that the observed dissimilarities are more deep-seated than racial, that they rest primarily in inherent social and cultural characteristics. The point is so generally accepted that Table 8 would not be included, except that it illustrates several other pertinent considerations about deaths in early childhood in less developed regions.

TABLE 8.—AGE-SPECIFIC DEATH RATES PER 1,000 POPULATION, FIJI, 1963–65[12]

	Fijians				*Indians*			
	Number of Deaths		*Deaths per 1,000*		*Number of Deaths*		*Deaths per 1,000*	
Age in years	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*
Under 1	287	213	27.2	22.0	416	389	32.0	31.1
1	88	105	8.5	11.3	50	35	3.8	2.8
2	51	27	5.6	3.0	21	17	1.6	1.3
3	31	22	3.2	2.6	12	15	0.9	1.2
4	20	17	2.2	2.1	18	14	1.4	1.1

In the first place, infant mortality in Fiji is at an exceptionally low level for a less developed country, despite whatever bias one may choose to entertain about deficiences in reporting; and Fiji has far from the elementary health facilities often postulated by the uninformed. Infant mortality between the two racial groups is not greatly divergent, although it does favor the Fijians. The major distinction is in death rates of the subsequent years, especially the second year. The Indian experience compares well with that of many advanced countries (Table 4) while the Fijian experience is at lower levels of the designated intermediate position. Sex differences in deaths are negligible among Indians as well as Fijians, a feature in strong contrast to the higher rates for girls (Fig. 2) in their native country. The strongest impression on the first visit was the general state of nutrition. Fiji has food. The result is a well-nourished Indian unfamiliar from extensive experience in rural India itself. Social and cultural influences enter into the observed death rates, but an environment where food is no luxury clearly affects results.

Food Intake and Second Year Death Rates. Second year death rates for selected countries are presented in Table 4, the selection being wholly on the basis of available data for individual years of early childhood. From the comprehensive information gathered by the Economic Research Service of the United States Department of Agriculture[94] these same countries were grouped by a graded scale according to average daily per-capita food consumption. The listed countries fell into strikingly equivalent graded categories for the several food classes: calories, total protein, animal protein, and fats. Correlations were determined.

By product-moment methods, for animal proteins $r = -0.746$; but it can be seen from Fig. 3 that the straight line trend deviates widely from the data which show a rapid decrease in death rates with increasing animal protein intake up to about 40 gm. per day, after which there is no further evidence of change. Rank correlation which eliminates the influence of distributions, gives an $r_s = -0.837$.

There is relatively little change in caloric values over the range of death rates, and there is evidence of the curvature previously noted with animal protein. No attempt was made to fit least-square trends; the Spearman coefficient was almost identical with the preceding ($r_s = -0.808$).

For fats, there was marked curvature, with a rapid decrease in death

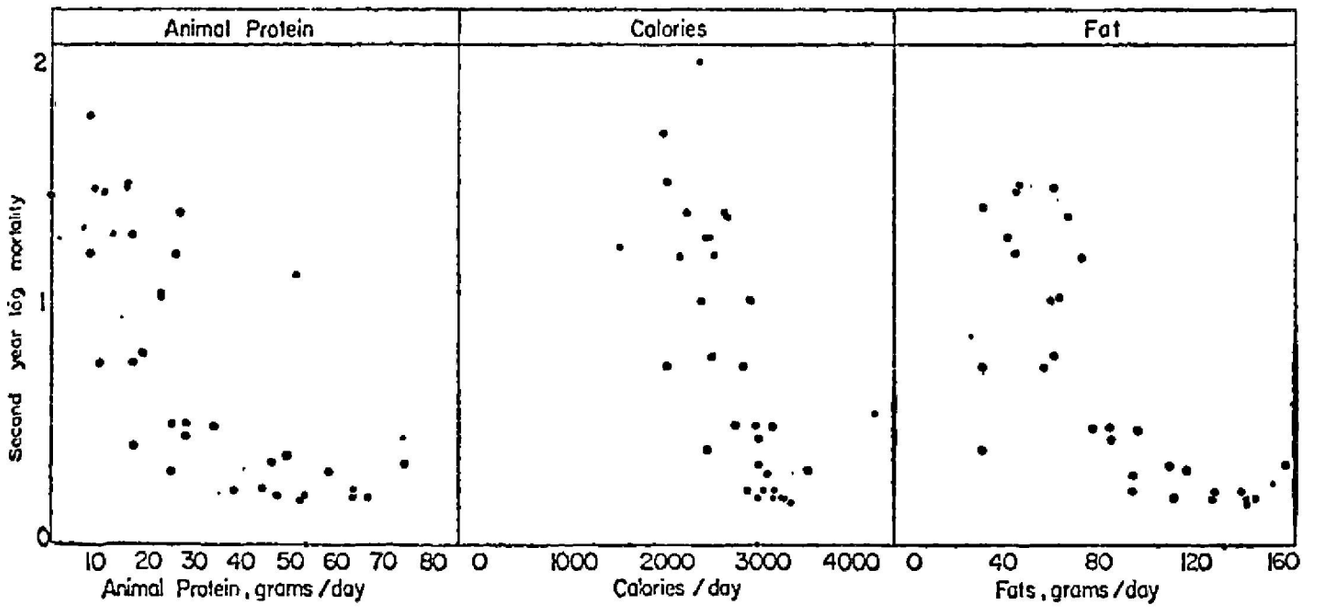

Fig. 3.—Rank order correlation coefficients, second year death rates and community food intake, selected countries of Table 4.

rates to about 100 gm. per day, and a level trend thereafter: $r_s = -0.829$ or almost identical with the preceding two values.

Earlier discussion has established that vital statistics in many of the areas covered are untrustworthy. The data on dietary intake may be presumed to be even worse. The question at issue is whether or not, on the basis of available data, the second year death rate provides a workable index of community nutritional state. In no sense is the aim to establish a relationship between deaths of one year olds and the food they get. What they get may or may not be closely related to community values. Previous discussion has presented numerous biologic and social factors within populations of less developed countries which impinge on death rates in the second year of life. The immediate interest is in community food intake.

Total proteins seem to be less connected with mortality of the second year than are the three other factors, among which it is impossible to distinguish. It could be that none of these factors is directly connected with forces of mortality at this time of life, but that they are a sort of index to over-all quality of living composed of a complex of interrelated variables.

At the same time it is clear that these dietary components are definite indicators of health status. A coefficient of 0.83, by this analysis, accounts for 69% of over-all variance, leaving 31% connected with independent variation.

Comment. Deaths in the second year of life in all societies regularly exceed those of any other of the preschool years one through four. In less developed countries they commonly account for one-half of deaths during those years and sometimes for as much as 77%. Even in advanced regions under the best conditions, appreciably more than one-third of preschool deaths are in that year.

The rates for second year deaths in less developed countries are inordinately greater than those for industrial regions, not uncommonly by as many as 30 times. If the neonatal first four weeks are eliminated, death rates of the second year commonly rival those of infant mortality in magnitude and in specific attributes. Usually, the singular significance of the second year is masked by the practice of computing death rates for grouped ages of one through four years. In the greater part of the world, today's toddler experiences the morbidity and the mortality of his counterpart in nineteenth century Europe. The heightened rates of the postneonatal period are projected into the second year, often to an equal degree, and occasionally they are greater.

The main causes of death in the second year of life in less developed countries are those characteristic of the postneonatal period of infancy; and these, in turn, differ strikingly from the causes dominant in the neonatal first four weeks. Infectious disease and malnutrition are the chief considerations. In the second year, however, malnutrition assumes more importance; the specific nutritional disorders of kwashiorkor, marasmus and others, and still more the synergistic interaction with acute infections, give heightened incidence and enhance clinical severity of infectious processes. Multiple causal factors are active in the origin and behavior of both groups of diseases; some primarily biologic, others social or cultural. Whatever they are they have in common the agency of nutrition, food supply and feeding practices. The one year old child is still an immature organism bound to small quantities of food, while the older child can compensate to an extent for nutrient deficiencies by increased quantity of food. After the second year, death rates decline progressively to lower levels, although

with varying promptness, under the influence of identifiable features of the environment among which food stands high.

Infant mortality is a proved and useful index of the quality of community health services. It suffices alone for developed regions with low death rates in early childhood. It has recognized value in less developed areas with their greater mortality, but fails adequately to reflect that important part of health difficulties which comes into play at a later date, and depends heavily on the malnutrition associated with weaning after breast feeding and during the immediately subsequent months.

The second year death rate is proposed as a practical index of community malnutrition. In a sense, it is a better index than infant mortality of general social and environmental health, for it is less diluted with extraneous factors. The correlation with stated national food intakes is good and in areas where field studies have been made, coincides with clinical and epidemiological observations of nutritional deprivation. It is a practical measure. If reporting of deaths is good and populations known, that is fine[1]. If not, a reasonable measure of second year deaths is obtainable by sampling surveys[83] and by acquiring knowledge of births and deaths in the preceding year. Where that is beyond capability, Wilkinson[98] has accepted restricted accuracy and used retrospective questioning of mothers to obtain numbers of children born and those who have died, from which to calculate child mortality rates of the first five years of life.

Deaths in early childhood, 1 to 4 years, have long held secondary interest to infant mortality and to the problems of the school child. They warrant greater emphasis in policies which guide activities in maternal and child health. Death rates at these ages, more than at any other age, respond promptly to improved social conditions: in Great Britain their decline anticipated that of infant mortality by 40 years[31]. They react sensitively to war years, economic depressions, and other times of social stress.

The diseases mainly responsible, infections and malnutrition, are largely preventable. The promise of public health accomplishment is good. In country after country in past years the percent reduction in second year death rates has far exceeded progress toward a reduced infant mortality[59]. Even with the lesser over-all rates, the number of deaths concerned is impressive.

The loss of children in the second year has economic and social significance. A child who has reached the second year is the product of a favorable selection from the inevitable stresses of the year following birth. Much effort has been expended during that year in care and training. Sentimental attachment has increased. A high morbidity at this time has a demonstrated effect on physical growth and development; many defects of later years are traceable to disease in the preschool years[20]. Within recent times a growing concern has developed about the effect of such illnesses and their attendant malnutrition on mental growth and development, especially with appreciation of the accelerated capacity for learning and conditioned behavior which comes with the second and third years[8].

The extent of the health problems in less developed regions is determined usefully by a knowledge of second year deaths. The more urgent demand is for studies of morbidity. They give a concept of costs which extend much beyond death.

Summary. Second year death rates in a less developed country commonly rival the infant mortality of the region, especially that part of infant mortality after the neonatal first four weeks where causes of death characteristi-

cally are individual and distinct. After age 6 months and through the second year, the main causes of death are infectious disease and malnutrition. At that time protein-calorie malnutrition is at its height and a deteriorating nutritional state favors frequency and severity of infection. The almost universal practice of breast feeding no longer meets nutritional needs, and supplementary feeding is ordinarily inadequate. Both malnutrition and infectious disease are largely preventable; they are susceptible to public health control . The second year death rate complements infant mortality as a means for measuring social and environmental health in less developed regions, and suggestively has a more specific usefulness as an index of community malnutrition.

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