

*A report is presented of international comparisons made to assess the trend and level of the infant mortality rate in the United States. Even when corrections are made for difference of definition and reporting, it appears that part of the excess in the neonatal mortality rate in the United States is real. Various aspects of the findings are discussed.*

## **INTERNATIONAL TRENDS IN INFANT MORTALITY AND THEIR IMPLICATIONS FOR THE UNITED STATES**

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**T**HE VIRTUAL halt in the downward trend of the infant mortality rate during the 1950's in the United States has been noted,<sup>1</sup> as well as the unfavorable position of this country with respect to the infant mortality problem as compared with the situation in other countries.<sup>2</sup>

For many years health authorities have pointed with justifiable pride to the high rate of decrease in the mortality loss in infancy. When the rate of decline first started to slow down this was not viewed with particular alarm. The change could be interpreted as inevitable since the steep decline could not continue indefinitely. But, the extent and duration of the slowdown has caused concern and sharpened interest in additional analysis of the course of the infant mortality rate.

The purpose of this paper is to examine international trends in infant mortality in greater detail to see whether the trend for the United States reflects a general phenomenon, and to see if the experience in other countries encourages hope for further important reductions in the infant mortality rate for the United States.

The infant mortality rates for the following countries were included in the study: Australia, Canada, Denmark, England and Wales, Finland, the Netherlands, New Zealand, Norway, Sweden, and Switzerland. These countries are characterized by comparatively low infant mortality rates for a long period of time.\* All of them have had for many years a well-developed vital registration system, and the definition of live birth and the reporting requirements for early infant deaths have been stable.

Data for these countries represent the most favorable set of statistics for study of comparative trends. However, there are certain problems of interpretation of the levels of mortality arising from differences in definition of live birth and fetal death, and from differences in statistical practice. In order to assess this problem, a questionnaire was sent to the countries included in the study to bring up to date the information on definitions and registration practices current in

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\* Another country which recorded low infant mortality rates for years is Iceland. Because of the small frequency of infant deaths (64 in 1960), the rates are subject to wide variations. Therefore, data for this country are not included in this study.

1950 as reported by the United Nations Statistical Office.<sup>3</sup> With a few exceptions, the definitions and practices remained as they were in 1950.

There are some differences in the criteria for the registration of an event as a live birth. The effect of these differences is to register an event in some countries as a live birth and an infant death, whereas in others a similar event would be registered and counted as a stillbirth. Although this difference has little effect on the live-birth statistics, it could affect the infant mortality rate and, particularly, the neonatal rate.

In most countries, "any sign of life" is taken as one of the criteria. In the United States, the criteria for registration specify a range of alternative evidence, such as breathing, heart action, pulsation of umbilical cord, movement of voluntary muscle, and so forth, whereas in most of the other countries the definitions lack specificity. Whether or not the specification of the various signs affects, registration of live births is not known, but it is probably minimal compared with other registration problems. A more important problem is the more restrictive definition used in Sweden wherein breathing is taken as the only criterion of life. An infant born that did not breathe but showed other evidence of life would be counted as a stillbirth in Sweden up to 1960.\* In the other countries represented in the study, this infant would be counted as a live birth and an infant death.

In a survey of lying-in hospitals in Sweden in 1956 reported by Soop,<sup>4</sup> some 17 per cent of the registered stillbirths showed other signs of life but did not breathe. This represented about 0.1 per cent of the live-birth total which is

\* This situation may also have been true until recent years in several of the provinces of Canada. However, the effect on the rates for Canada as a whole is believed to be negligible.

almost identical with the proportion found in about 20,000 live births that occurred in 1959-1961 in selected hospitals in the United States.†

On the basis of these figures, it would seem that the infant mortality rates for Sweden would be at least one point higher if the more inclusive definition of live birth adopted by other countries were used. For example, on a comparable definition of live birth, the infant mortality rate for Sweden in 1959 may be 17.6 per 1,000 live births rather than the rate of 16.6 which was recorded for that year. The effect may actually be greater, but as a maximum it probably is not much more than two or three points.

There is a problem in the interpretation of the infant mortality rate for the Netherlands. This involves the statistical practice of excluding from birth or death registration a live-born infant of less than 28 weeks gestation that dies before registration. If these deaths are included in the computation of rates, the neonatal mortality rate for the Netherlands in 1960 is 13.5 per 1,000 live births rather than 12.1, the recorded figure.‡ The corresponding figure for the total infant mortality rate is 17.9 instead of 16.5.

Another problem relates to differences in the registration requirements for fetal deaths. All of the states in the United States require registration of all fetal deaths or those of 20 weeks or more gestation, whereas the other countries confine registration to dead fetuses of 28 weeks or more gestation. Other things being equal, the effect of this difference in definition would generally be to re-

† These provisional and unpublished figures were provided through the courtesy of the collaborative project sponsored by the National Institute of Neurological Diseases and Blindness on cerebral palsy, mental retardation, and other sensory and nervous system disorders of infancy and childhood.

‡ Data provided through the courtesy of the Central Bureau of Statistics, the Hague, the Netherlands.

cord fewer fetal deaths in these other countries because of the tendency to underestimate gestation age slightly over 28 weeks to avoid registration of the fetal death.

One indication of this may be found in the experience in the United States. In the years past, the various states have changed from time to time the requirements for the reporting of fetal deaths. In general, the effect of the revision was to require registration of dead fetuses of lower gestation age. For example, in the early 1950's, seven states revised their laws to make reportable all products of conception regardless of gestation age. Prior to this, the law required the registration of dead fetuses after at least 20 weeks of gestation.

The effect of such changes in registration requirements has varied. In general, the number of fetuses, say, 20 weeks and over, increased after the change in the definition of a reportable fetal death. For the seven states referred to above, the increase varied from 0 to 50 per cent, and the average was 17 per cent.

It is difficult to assess precisely how many fewer fetal deaths of 28 weeks or more gestation would be registered in the United States if the laws required registration only of fetal deaths of at least this gestation age. However, the differences in registration requirements between the United States and other countries will probably have the effect of substantially fewer fetal deaths of 28 weeks or more being recorded in the foreign data. On the other hand, there is indication of substantial underregistration of fetal deaths in the United States.<sup>5</sup> This may very well be true for other countries, but no study of the fetal death registration problem has been made elsewhere.

In summary, the differences in definitions and statistical practices in two countries, Sweden and the Netherlands, may result in an understatement in the

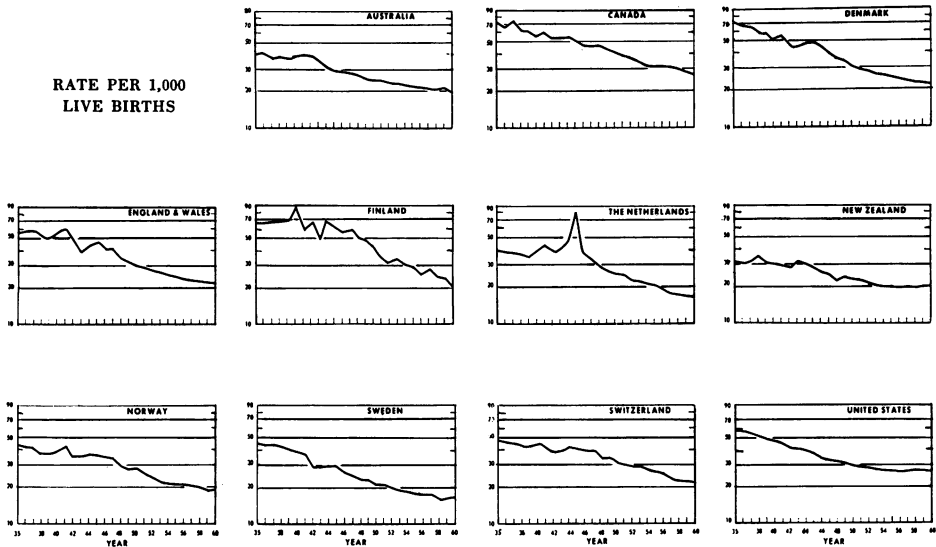
infant mortality rate of one to three points as compared with that of other countries, including the United States. There is greater uncertainty about measures of fetal loss. This, of course, also affects the perinatal mortality rate. Any international differences in these measures must be viewed with caution.

## Findings

### Infant Mortality

The infant mortality trends over the past 25 years are characterized by major declines in all the countries included in this study (see Figure 1 and Table 1). The progress in the reduction of infant loss does not reflect consistent and continuous decreases over the whole period. For some countries it is clear that war-time conditions exerted a great influence on the infant mortality rate, while for others it is not so certain why some of the reversals occurred. Other periods of stability or increases in the rate are also found. This makes difficult assessment of infant mortality rates over a short run. Nevertheless, certain time periods stand out as of particular importance in interpreting the course of the infant mortality rate.

In the United States, the infant mortality rate decreased at a rate of over 3 per cent per year during the period 1935-1950. Beginning about 1950 the rate began to level off. At first, it might have been dismissed as another temporary change, but this has persisted for a decade. Between 1950 and 1960, the total decrease in the rate was only about 10 per cent, and the annual rate of decrease was about one-third of the rate of decline in the previous period. The provisional figure for 1961 represents the lowest infant mortality rate ever recorded for the United States. However, neither this rate nor the preliminary returns for the first eight months of 1962 give a clear indication of resumption of a significant downward trend.



**Figure 1—Infant Mortality Rates: Selected Countries, 1935-1960**

The mortality trends for a number of countries of low mortality were interrupted by World War II. The wartime increases in the infant mortality rate were particularly severe for the Netherlands, Finland, and Norway and to a lesser extent for England and Wales. Major reductions in the infant mortality rate occurred in many countries the year after the war ended. This was followed by a period (1946-1950) of important decreases in all areas. The greatest reductions occurred in England and Wales, the Netherlands, Norway, and Finland (6 to 9 per cent per year). The infant mortality rates for Denmark, Sweden, and Switzerland declined at a rate of about 5 per cent per year. For Australia, Canada, New Zealand, and the United States, the rate of decrease was somewhat lower, but still significantly high (3 to 4 per cent per year).

The leveling off of the infant mortality rate in the United States very early in the decade past is not matched by the experience of any other country. How-

ever, a slowing down or cessation in the decline of the rate in more recent years may be observed for a number of other countries such as Australia, England and Wales, New Zealand, Norway, and Sweden. For example, the infant mortality rate for New Zealand has been virtually flat since 1953. In England and Wales and Australia, the rate of decline slowed up markedly beginning about 1955 to 1956. No clear, rapid downward movement in the infant mortality rate is evident in the past few years for Norway and Sweden.

Some of these changes may be the beginning of a period of prolonged stagnation in the infant mortality rate. However, it seems significant that the leveling off of the infant mortality rate for the United States started considerably earlier than in the other countries, when, in fact, some were still experiencing a major decline in the rate. The infant mortality rate for the United States would have to start decreasing much more sharply in the future to reverse the

Table 1—Infant Mortality Rates: Selected Countries, 1935-1960 (Exclusive of Fetal Deaths. Rates per 1,000 Live Births)

Year	England and Wales										United States
	Australia*	Canada†	Denmark‡	Finland§	Netherlands	New Zealand	Norway	Sweden	Switzerland		
1960	20.2	27.3		21.0	16.5	19.7		16.6	21.1	26.0	
1959	21.5	28.4	22.5	23.6	16.8	19.9		16.6	22.2	26.4	
1958	20.5	30.2	22.4	24.5	17.2	19.4	18.7	15.9	22.2	27.1	
1957	21.4	30.9	23.4	27.9	17.2	20.0	20.5	17.8	22.9	26.3	
1956	21.7	31.9	24.9	25.4	19.0	19.4	21.2	17.3	25.8	26.0	
1955	22.0	31.3	25.2	29.7	20.2	20.1	20.6	17.4	26.5	26.4	
1954	22.5	31.9	26.9	30.6	21.2	20.0	21.4	18.7	27.2	26.6	
1953	23.3	35.6	27.2	34.2	22.2	20.1	22.0	18.7	29.8	27.8	
1952	23.8	38.2	28.9	31.8	22.6	21.8	23.7	20.0	29.1	28.4	
1951	25.2	38.5	28.9	35.4	25.1	22.8	25.7	21.6	30.1	28.4	
1950	24.5	41.5	30.7	43.5	25.2	22.7	28.2	21.0	31.2	29.2	
1949	25.3	43.3	34.5	48.3	26.8	23.8	27.7	23.3	34.3	31.3	
1948	27.8	43.7	35.3	51.9	29.3	21.9	29.6	23.2	35.9	32.0	
1947	28.5	45.5	40.4	58.5	33.5	25.0	34.6	25.4	39.3	32.2	
1946	29.0	46.7	45.8	56.2	38.7	26.1	34.6	26.5	39.2	33.8	
1945	29.4	51.3	48.3	63.2	79.7	28.0	36.4	29.9	40.7	38.3	
1944	31.3	54.7	47.7	68.6	46.3	30.1	36.7	31.1	42.2	39.8	
1943	36.3	53.7	44.8	49.5	40.1	31.4	35.4	28.9	39.8	40.4	
1942	39.5	53.8	47.0	67.2	39.5	28.7	35.9	29.3	38.3	40.4	
1941	39.7	59.7	55.0	59.2	43.6	29.8	43.0	37.0	41.1	45.3	
1940	38.4	56.4	50.2	88.3	39.1	30.2	38.7	39.2	46.2	47.0	
1939	38.2	60.7	58.1	69.6	33.7	31.1	37.2	39.5	42.6	48.0	
1938	38.3	63.3	58.7	67.8	36.5	35.6	37.3	42.5	42.8	51.0	
1937	38.1	75.8	66.1	68.5	38.1	31.2	42.0	45.2	46.7	54.4	
1936	41.2	66.1	67.3	65.9	38.9	31.0	42.0	43.4	46.5	57.1	
1935	39.8	71.0	71.0	66.8	40.0	32.3	44.2	45.9	47.9	55.7	

\* Excludes full-blooded aborigines. Data tabulated by year of registration rather than occurrence.

† 1935-1949 excluding Yukon, Northwest Territories and prior to 1950 Newfoundland which became the tenth province, April 1, 1949. Data include events among Canadian residents temporarily in the United States. Exclude events among United States residents temporarily in Canada

‡ Excluding Faeroe Islands 1932-1948; Faeroe Islands and Greenland starting 1949.

§ Prior to 1951 data are for Finnish Nationals in Finland only. Beginning 1951 data are for Nationals temporarily outside country.

|| Excludes Maoris. By year of registration rather than year of occurrence.

SOURCE—Files of the Statistical Office of the United Nations and annual volumes of the National Vital Statistics Division, Public Health Service, Department of Health, Education, and Welfare.

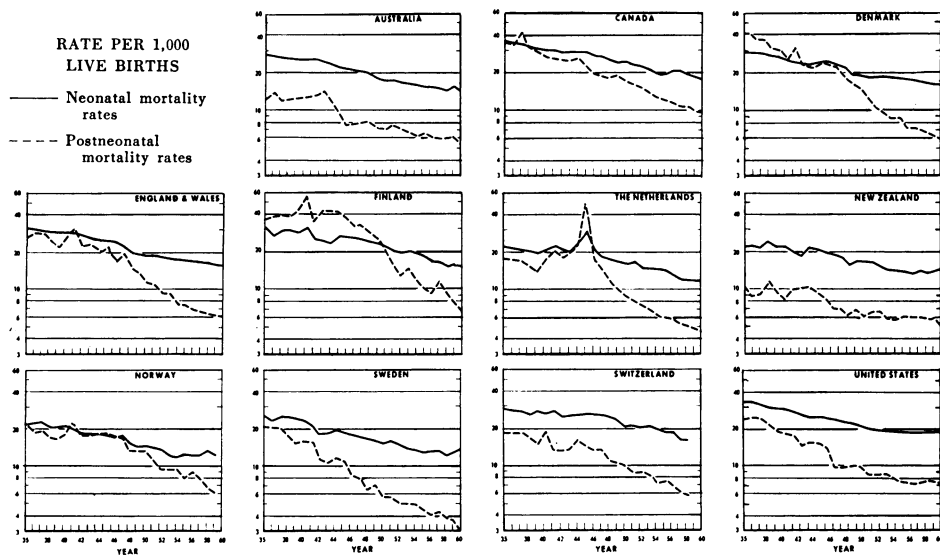


Figure 2—Neonatal and Postneonatal Mortality Rates: Selected Countries, 1935-1960

strong impression that the United States is lagging behind many countries in reducing the loss in infancy.

What makes the preceding much more important is that the comparisons involve countries with low infant mortality rates. Otherwise, one might be tempted to attribute the greater decline in the rates for the other countries to a period of "catching up." While differences in definition and reporting practices create certain difficulties for international comparisons, the infant mortality rates for Australia, Denmark, England and Wales, Finland, New Zealand, and Switzerland are almost certainly lower than that for the United States, and the rates for the Netherlands, Norway, and Sweden are very definitely lower.

#### Neonatal, Fetal, and Perinatal Mortality

To clarify the nature of the differentials in trends and levels of the infant mortality rates discussed above, the loss during early infancy and subsequent mortality during the first year of life

have been examined separately. Mortality shortly after birth is heavily influenced by prenatal circumstances with postnatal environmental conditions responsible for a small but significant part of the total mortality in this period. Before the end of the first year of life the relative importance of prenatal and postnatal factors and their effects on mortality rates is reversed.

For purposes of the present discussion, the time interval selected for the "early" deaths is the neonatal period (i.e., the first 28 days following birth). The loss during this period has for years accounted for two-thirds to three-fourths of the total mortality during the year following birth in the United States and most other countries. Accordingly, much of what has been said about the trend patterns in infant mortality holds for neonatal mortality (Figure 2 and Table 2). Perhaps the outstanding difference is the fact that the total infant mortality rates have generally undergone greater relative decreases.

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Table 2—Neonatal Mortality Rates: Selected Countries, 1935-1960 (Exclusive of Fetal Deaths. Rates per 1,000 Live Births) \*

Year	England and Wales				New Zealand	Norway	Sweden	Switzerland	United States
	Australia	Canada	Denmark	Finland					
1960	14.6	17.6		14.4	12.1		13.9		18.7
1959	15.3	18.4	16.2	15.7	12.0	12.4	13.0		19.0
1958	14.5	19.3	16.1	15.4	12.0	13.3	12.1	16.4	19.5
1957	15.4	20.2	16.3	16.6	11.9	12.3	13.5	16.6	19.1
1956	15.6	20.1	17.7	16.4	13.0	12.4	13.2	18.9	18.9
1955	15.5	19.3	17.9	18.6	14.1	12.5	12.9	18.9	19.1
1954	16.2	19.3	18.0	19.3	14.7	11.8	13.8	19.9	19.1
1953	16.5	21.4	18.6	19.7	15.0	12.6	13.8	21.2	19.6
1952	16.6	22.7	19.3	19.1	15.1	14.1	14.9	20.2	19.8
1951	17.5	22.6	18.3	19.7	16.8	14.4	15.9	21.3	20.0
1950	17.4	24.4	18.2	21.8	16.4	14.7	15.3	21.1	20.5
1949	18.0	24.1	19.1	23.1	16.8	14.5	16.2	23.6	21.4
1948	19.6	25.6	19.1	23.6	17.4	15.7	16.8	24.9	22.2
1947	20.5	26.5	22.0	24.9	18.5	17.5	17.5	25.8	22.8
1946	21.2	27.2	23.6	25.9	20.9	16.9	18.1	25.9	24.0
1945	21.8	28.6	24.9	26.0	29.8	18.1	19.1	26.4	24.3
1944	22.0	29.1	24.2	26.4	23.0	18.3	19.7	25.8	24.7
1943	24.0	29.6	22.9	22.9	20.4	18.0	18.4	25.8	24.7
1942	25.3	28.1	23.6	24.5	21.0	17.8	17.9	25.1	25.7
1941	26.6	30.6	23.7	24.7	22.7	20.0	21.4	27.9	27.7
1940	25.5	29.7	25.2	30.4	21.4	20.5	23.5	27.0	28.8
1939	25.8	30.7	27.5	28.0	19.8	20.4	24.2	27.7	29.3
1938	26.0	31.7	27.2	29.7	20.5	20.2	25.2	26.2	29.6
1937	26.3	34.2	29.0	29.4	20.9	22.9	25.0	28.0	31.3
1936	27.5	33.5	29.1	27.3	21.5	22.3	23.2	28.2	32.6
1935	27.5	35.0	29.1	30.2	22.5	21.6	25.6	29.3	32.4

\* For general notes see Table 1.

**Table 3A.—Fetal Death Ratios: Selected Countries, 1940-1960 (Fetal Deaths of at Least 28 Weeks Gestation or Unknown Gestation per 1,000 Live Births)\***

Year	England and Wales										United States†
	Australia	Canada	Denmark	Finland	Netherlands	New Zealand	Norway	Sweden	Switzerland		
1960		13.3	14.6	19.8	15.1	14.9	14.2	13.2	13.6	11.9	11.7
1959	14.0	13.5	14.6	20.8	13.4	15.8	14.4	14.8	14.8	12.4	11.9
1958	14.1	14.1	15.5	21.5	13.4	16.7	15.0	14.3	15.6	12.4	12.0
1957	15.3	14.4	15.3	22.5	14.1	16.9	15.8	14.7	15.6	14.1	12.0
1956	15.3	15.2	17.4	22.9	15.1	16.9	16.7	15.2	16.7	13.5	12.1
1955	15.2	15.4	17.9	23.2	14.4	17.0	15.7	14.9	16.7	14.3	12.6
1954	15.7	16.3	19.3	23.5	17.6	17.4	17.7	14.4	16.9	15.4	12.9
1953	16.4	16.5	19.0	22.4	17.6	17.5	18.8	15.5	17.9	15.1	13.4
1952	17.0	17.7	17.5	22.7	18.9	18.3	17.9	15.3	18.3	15.1	13.8
1951	18.6	18.1	18.3	23.0	18.0	18.3	17.7	16.1	19.3	15.8	14.3
1950	19.0	19.0	18.5	22.6	18.5	19.3	19.1	16.2	19.9	16.8	14.6
1949	19.2	19.5	16.8	22.7	17.3	19.3	17.8	16.4	20.1	16.6	15.1
1948	20.3	19.3	17.9	23.2	17.6	18.9	18.5	17.7	19.4	17.0	15.5
1947	21.3	20.4	17.4	24.1	19.1	20.1	19.9	18.4	21.2	16.0	16.1
1946		21.1	18.7	27.2	19.3	20.2	21.8	18.8	21.7	15.6	17.2
1945	27.3	22.6	19.4	27.6	21.1	19.2	22.8	19.9	24.0	16.1	18.5
1944	27.3	23.0	19.6	27.6	20.2	18.5	23.2	19.6	23.1	16.4	19.0
1943	27.4	23.4	21.3	30.1	20.9	18.5	26.2	20.7	21.8	16.5	19.3
1942	27.7	25.5	20.9	33.2	22.1	19.3	25.9	20.2	22.4	16.5	20.1
1941	27.5	26.2	23.0	34.8	20.9	21.3	26.9	20.6	24.5	18.5	
1940	27.0	26.4	25.2	37.2	20.6	25.1	28.6	22.0	28.6	20.5	

\* For general notes see Table 1.

† For 1942-1959, data include fetal deaths of at least 28 weeks gestation and a proportionate number of fetal deaths of unknown gestation. For 1940-1941, available data include all reported fetal deaths and are therefore not shown.



rate, the neonatal loss rate in the United States declined fairly steadily from about the mid-1930's until 1950 or 1951. Since then it has remained virtually stationary. In most of the other countries, the rate of decline spurted near the end or immediately after World War II, although the drop was not as sharp as for the total infant mortality rate. The decline persisted, in general, well beyond the year that the rate leveled off in the United States and, in fact, there are several countries where the rate seems to be continuing its descent (Canada, England and Wales, Finland, and Switzerland). In all of the others, a leveling off has occurred.

Because of the differential rates of decline there has been a major shift in the relative levels of the neonatal mortality rates. When the decline in the United States rate started to taper off (1950-1951), the neonatal rate in five countries (Canada, Denmark, England and Wales, Finland, and Switzerland) closely approximated the figure here. But now, the neonatal rates for all of the foreign countries shown in Table 2, except for Canada, are well below the rate for the United States.

As indicated previously, some care has to be taken in interpreting the significance of the large margin between the neonatal rate in the United States and the rate elsewhere because of variations in registration requirements and practices. In this connection, it is useful to consider the relative levels of fetal mortality rates (28 weeks or more gestation) and then to examine the perinatal mortality rates.

The need for bringing into the picture fetal loss becomes readily apparent when international comparisons of neonatal mortality rates are placed side by side with comparisons of fetal death ratios. In the United States, fetal death ratios have been substantially below the ratios in almost all the other countries, but the reverse is true for neonatal mortality

rates. It is not certain whether differences in registration requirements and definitions are entirely responsible for this situation. It may be that some of the pregnancies that are destined to end in a neonatal death in the United States terminate in a fetal death in other countries. The perinatal mortality rate takes care of both sources of incomparability. What it cannot do is to make allowance for differential rates of reporting completeness of fetal deaths.

Before turning to the perinatal mortality rate, it is worth noting that during the 1950's, the fetal mortality ratio for the United States continued to decline slowly but steadily in contrast to the virtual halt in the decline of the neonatal rate (Table 3A). This decrease, although quite modest (about 2 per cent per year), equaled or exceeded the relative decline in most of the other countries during the same period.

With regard to perinatal mortality rates, the margin among most of the countries, including the United States, has for years been quite small (Table 3B), and in view of the variation in registration completeness that may exist, it is difficult to attach great importance to some of the observed differences. It is significant, however, that whereas the rate for the United States in 1950-1951 was at the lower end of the range of perinatal mortality rates, now it is at the upper end of the range. (In 1950-1951, the rate was lower only in Norway; in 1959-1960, the rate was higher only in England and Wales.) Furthermore, this reversal can be attributed to the fact that the United States did not fare as well as other countries during the 1950's in reducing neonatal mortality.

The primary reason for examining perinatal mortality rates has been to search for artifacts that might explain the comparatively high neonatal mortality rate for the United States. From the preceding, it would seem reasonable to conclude that part but not all the excess

Table 3B—Perinatal Mortality Rates: Selected Countries, 1940-1960 (Neonatal Deaths Plus Fetal Deaths of at Least 28 Weeks Gestation or Unknown Gestation per 1,000 Live Births Plus Specified Fetal Deaths)\*

Year	England and Wales				New Zealand				United States†			
	Australia	Canada	Denmark	England and Wales	Finland	Netherlands	Zealand	Norway		Sweden	Switzerland	
1960		30.7		35.0	29.2	26.8	28.5		27.3			
1959	29.1	31.7	30.5	36.3	29.0	27.6	28.1	25.4	27.6			30.5
1958	28.3	33.1	31.3	37.3	28.7	28.6	28.4	27.4	27.5	28.6		31.2
1957	30.5	34.3	31.3	38.5	30.4	28.6	29.5	26.8	28.9	30.4		30.8
1956	30.7	35.0	34.8	39.3	31.3	29.7	29.9	27.4	29.7	32.1		30.8
1955	30.4	34.4	35.5	40.0	32.7	30.9	29.5	27.3	29.4	32.9		31.4
1954	31.7	35.3	36.9	40.8	36.7	31.9	31.8	26.1	30.5	35.0		31.8
1953	32.6	37.5	37.2	39.7	37.0	32.2	32.8	27.9	31.5	35.9		32.7
1952	33.4	40.0	36.5	40.6	37.6	33.1	32.8	29.2	32.9	35.0		33.4
1951	35.8	40.3	36.3	41.5	37.4	34.8	33.6	30.3	34.9	36.8		34.0
1950	36.1	42.9	36.4	40.7	39.9	35.4	35.4	30.6	34.8	37.6		34.8
1949	36.9	43.1	35.6	41.5	40.0	35.8	34.5	30.7	36.0	39.8		36.2
1948	39.5	44.4	36.6	42.5	40.8	36.0	34.0	33.1	35.9	41.5		37.3
1947	41.4	46.3	39.0	46.4	43.5	38.2	37.6	35.5	38.3	41.4		38.5
1946		47.7	41.8	50.7	44.6	40.7	40.4	35.4	39.4	41.1		40.8
1945	48.4	50.5	43.8	51.8	46.5	48.4	42.0	37.7	42.6	42.1		42.4
1944	48.7	51.5	43.3	51.1	46.1	41.1	43.3	37.6	42.3	41.8		43.3
1943	50.7	52.3	43.7	54.6	43.3	38.5	47.0	38.3	39.9	41.9		43.5
1942	52.4	52.9	44.0	59.4	46.1	39.9	44.1	37.7	39.8	41.2		45.2
1941	53.4	56.1	46.2	62.7	45.1	43.5	46.4	40.2	45.4	45.9		
1940	51.8	55.3	49.8	65.7	50.3	45.9	50.0	42.1	51.5	47.0		

\* For general notes see Table 1.

† For 1942-1959, fetal deaths include fetal deaths of at least 28 weeks gestation and a proportionate number of fetal deaths of unknown gestation. Comparable data are not available for 1940-1941.

could be attributed to registration practices, and it is highly likely that the United States has at present a less favorable mortality experience shortly after birth than most of the other countries studied.

#### Postneonatal Mortality

All the qualifications inherent in any discussion of differences in the loss in early infancy may be discarded when considering events after the first month of life. Comparisons can be made in a straightforward way not only of relative rates of decline but of the rates themselves. Review of the course of the postneonatal mortality rate in the United States indicates that a major reduction in the rate started several years before this country's entry into World War II (Figure 2 and Table 4). Little change occurred during the war years, but in the one year following the war (1945-1946), the rate dropped by about 30 per cent, probably due to the general availability of antibiotics. The decline definitely slowed down thereafter and has been at a complete standstill since 1954. This change in the trend of postneonatal mortality rate should not obscure the fact that today the rate is less than a third its size 25 years ago.

Major reductions in the postneonatal mortality rates have been quite general. The outstanding exception is New Zealand, where the rate 25 years ago was by far the lowest in the world. The rate of decline in this country has been negligible as compared with what has been happening elsewhere, although its loss rate is still one of the most favorable in the world.

Leaving aside New Zealand, patterns of change in the postneonatal mortality rate have varied appreciably among most of the countries. One point of similarity in several countries is the sharp drop in the rate immediately following World War II. The fundamental difference between the course of the rate

in the United States and its course in all countries other than Australia and New Zealand is that while the rate of decline slowed down here toward the end of the 1940's and finally came to a halt, the decline has continued at a brisk pace in these other countries.

As a result of the greater relative decreases elsewhere than in the United States starting the end of the 1940's, the postneonatal mortality rate in the United States must now be ranked as close to the highest in the group of low infant mortality countries under study. The rate for Sweden is less than half the figure for the United States, and the rate for the Netherlands is far below ours. It is only in Canada where the rate is still appreciably higher. This is in sharp contrast with what existed ten years earlier. Then, Denmark, England and Wales, Finland, Norway, and Switzerland, as well as Canada, recorded higher rates than the United States. Also, the excess in the mortality rate for these countries as compared with the United States was substantial.

#### Summary and Discussion

International comparisons have been made to assess the trend and level of the infant mortality rate in the United States. Countries selected for analysis have recorded the lowest infant mortality rates in the world for a long time.

In summary, the infant mortality rate in the United States dropped substantially over a 15-year period, until about 1950 when it started to level off. Other countries have also experienced a large-scale decline in their infant mortality rate with the downward trend continuing well into the 1950's for most of them. The rates for several countries besides the United States now appear to be leveling off.

A similar pattern is found in the trends of the neonatal mortality rates. In the case of the postneonatal mortality

Table 4—Postneonatal Mortality: Selected Countries, 1935-1960 (Exclusive of Fetal Deaths. Rates per 1,000 Live Births) \*

Year	England and Wales					New Zealand				United States		
	Australia	Canada	Denmark	Finland	Netherlands	Norway	Sweden	Switzerland	States			
1960	5.5	9.8		6.3	4.5	5.1	2.7		7.3			
1959	6.2	9.9	6.3	6.3	4.8	6.0	3.7		7.4			
1958	6.0	10.9	6.4	6.4	5.2	5.8	3.8	5.9	7.6			
1957	6.0	10.7	7.0	6.7	5.2	6.1	4.3	6.3	7.3			
1956	6.1	11.8	7.3	6.8	6.0	6.0	4.1	7.0	7.1			
1955	6.5	12.0	7.2	7.6	6.1	6.1	4.5	7.6	7.3			
1954	6.3	12.7	8.9	7.7	6.4	5.7	4.9	7.3	7.5			
1953	6.8	14.2	8.6	9.1	7.2	5.8	4.9	8.6	8.2			
1952	7.1	15.5	9.6	9.2	7.5	6.7	5.1	8.9	8.6			
1951	7.7	15.9	10.5	11.0	8.3	6.6	5.7	8.8	8.4			
1950	7.1	17.1	12.5	11.3	8.8	6.2	5.7	10.1	8.7			
1949	7.3	19.2	15.4	13.4	10.1	6.8	7.1	10.7	9.9			
1948	8.1	18.0	16.2	14.8	11.9	6.2	6.4	11.0	9.8			
1947	8.0	19.0	18.4	19.0	15.0	7.0	7.9	13.5	9.4			
1946	7.8	19.5	22.3	16.7	17.8	7.0	8.4	13.3	9.7			
1945	7.6	22.8	23.4	22.1	49.9	8.4	10.9	14.3	13.9			
1944	9.3	25.5	23.5	20.3	23.3	9.5	11.4	16.4	15.1			
1943	12.2	24.1	21.9	23.6	19.7	10.1	10.5	13.9	15.6			
1942	14.2	25.7	23.4	22.4	18.5	10.0	11.4	13.2	14.7			
1941	13.1	29.1	31.3	30.7	20.9	9.8	15.5	13.3	17.7			
1940	12.9	26.7	25.0	27.8	17.8	8.2	15.7	19.2	18.3			
1939	12.4	30.1	30.6	22.4	13.9	9.3	15.3	14.9	18.7			
1938	12.3	31.6	31.5	24.4	16.1	11.5	17.3	16.6	21.4			
1937	11.8	41.6	37.0	27.9	17.2	9.0	20.1	18.7	23.2			
1936	13.7	32.6	38.2	28.4	17.3	8.7	20.1	18.4	24.6			
1935	12.3	36.0	41.9	26.5	17.6	10.2	20.3	18.6	23.3			

\* For general notes see Table 1.

rate, a slowdown in the rate of decrease may have started in the United States even before 1950, following a long period of sharp decline. Elsewhere, with few exceptions, the postneonatal mortality rate has continued to undergo important reductions, until the present.

An increasing number of countries have been experiencing lower infant mortality rates than the United States. Also, the gap between the rate for the United States and the figures for countries with the most favorable experience has widened. The situation is generally similar for both the neonatal and postneonatal mortality rates. Some question can be raised about the reality of the gap between the neonatal mortality rate in the United States and the rates elsewhere. International differences in reporting requirements and practices could result in some live-born infants who die very soon after birth being classified as an infant death in the United States but as a stillbirth in other countries. Perinatal mortality rates, which combine neonatal deaths and fetal deaths at or after 28 weeks gestation, show much smaller differences among the countries than the neonatal mortality rates. However, the United States is at the upper end of this narrow range of rates and we can conclude that part of the excess in the neonatal mortality rate in the United States is real.

There is no comparable reason for questioning the magnitude of the differences observed in the postneonatal mortality rates. What might be asked is whether these rates have not already reached such a low point in most countries that small absolute differences appear large when expressed in relative terms. This holds for some of the differentials found, but the gap between the rate for the United States and those for a few countries is substantial even on an absolute basis.

The reasons for the leveling off of the infant loss rate in the United States at

a higher point than in many other countries are not readily apparent. However, since both the neonatal and postneonatal rates are involved, prenatal as well as postnatal circumstances are implicated and deserve attention. Certainly, highly intensive studies within the United States are called for. It would also appear that a useful approach would be to investigate differences in current practices among countries in the care of pregnant women and the newborn.

An additional approach would be to conduct a major study of the potential in reducing mortality from infectious diseases which still rank high among the causes of death after the neonatal period. Included among the environmental conditions that might have to be examined would be the emergence of resistant bacterial strains cited elsewhere as a possible deterrent to further decline in infant mortality due to infectious diseases.<sup>1</sup> In any event, an inquiry into international trends of mortality rates by cause of death would be a starting point. This would have to go beyond published data since diagnostic practices and the reporting of cause of death information may vary greatly among countries.

The effort required would be substantial. But, given the lag in reducing the infant mortality rate in the United States, such an effort appears warranted. The fact that there are other countries with much lower loss rates suggests that even without a major break-through in medical knowledge, a rapid reduction in infant mortality rates in the United States from the present level of 25-26 per 1,000 to a point below 20 per 1,000 is a realistic goal.

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registration may be expected to be better than most areas, Baumgartner, L.; Wallace, H. M.; Landsberg, E.; and Pessin, V. (Inadequacy of Routine Reporting of Fetal Deaths. *A.J.P.H.* 39:1549-1552 (Dec.), 1949) found 14 per cent of fetal deaths in the third trimester were not reported. Including unknown gestation age, the corresponding figure is 23 per cent. This study was based on data for 1943-1945, but it is not likely that significant changes have occurred since that time.

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## New Method for Measuring Water Pollution

A new relatively simple method of monitoring the levels of fresh water contamination which can be used almost everywhere has been developed at the University of North Carolina School of Public Health. The method consists of measuring the cholinesterase activity in the brains of fish from waters known or suspected to contain insecticides. When cholinesterase activity is depressed to about 20 per cent of normal, death usually occurs. In some species of fish, death may occur at higher levels, depending on the insecticide used, the concentration and other factors.

Researchers at the school worked out a table of normal values for cholinesterase activity in the brains of several species of fish and then by varying the time interval and the concentration of insecticides have been able to chart the extent to which fish can be exposed without lethal effects.

The data obtained by this method can be used to allow insect control to go on without harm to fish and other aquatic life; to monitor the safety of water used for recreation; or to detect any possible pollution of drinking water supplies taken from a lake.

Further information from Dr. Charles M. Weiss, professor, Department of Sanitary Engineering.