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VITAL and HEALTH STATISTICS

ANALYTICAL STUDIES

International Comparison of Perinatal and Infant Mortality:

The United States and Six West European Countries

Comparison of the components of perinatal and infant mortality in the United States with those of six west European countries, including their registration systems, demographic characteristics, mortality experience, and certain selected aspects of medical and obstetric care.

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John W. Gardner
Secretary

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William H. Stewart
Surgeon General

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PREFACE

This report is one of a group of analytical studies designed to delineate the perinatal and infant mortality problem in the United States. Since 1950, there has been a notable change in the trend in infant mortality—rates are no longer declining at their former pace in this country as well as in a number of other countries.

Although the primary concern is perinatal and infant mortality in the United States, it was felt that much could be learned from the experience of other developed countries with advanced medical systems. The National Center for Health Statistics contracted with investigators in some west European countries to analyze their own infant and perinatal mortality experience. Completion of these studies culminated in the Conference on the Perinatal and Infant Mortality Problem of the United States which was held in Washington, D.C., May 13-14, 1965. The present report is a direct result of the conference: it compares the experience of six west European countries and the United States with regard to this important problem.

The author is indebted to the investigators and the vital statistics offices of the countries included in this report. Much of the European data which is included was derived from the following:

Backer, J. E., and Aagenaes, Ø.: "Infant Mortality Problems in Norway"

de Haas-Posthuma, J. H., and de Haas, J. H.: "Infant Loss in the Netherlands"

Douglas, C. A.: "Perinatal and Infant Mortality in Scotland"

Hirst, K. M., Butler, N. R., and Dawkins, M. J.R.: "Infant and Perinatal Mortality in England and Wales"

Matthiessen, P. C., Trolle, D., and Zachau-Christiansen, B.: "Infant and Perinatal Mortality in Denmark"

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IN THIS REPORT, the perinatal and infant mortality experience of the United States is compared with that of a group of west European countries having advanced medical systems and well-established vital statistics systems. The countries selected for study were Denmark, England and Wales, the Netherlands, Norway, Scotland, and Sweden. In 1964, the infant mortality rate for the United States was highest among the seven countries, and 75 percent higher than the lowest rate, that for Sweden. Even when the comparison was limited to white infants in the United States, its rate was 52 percent higher than that for Sweden. Clearly, the higher rate in this country cannot be attributed entirely to nonwhite infants.

In each of the countries, trends for the components of perinatal and infant mortality have declined more slowly since 1950 than between 1935 and 1950. Furthermore, in recent years the perinatal mortality rate for the United States has declined more slowly than those of all of the other countries except Norway.

In the United States, mortality in the first 24 hours of life has failed to decline in tandem with the rates of decline in fetal mortality or in the components of the remainder of the first year of life. Since 1950, the experience of the United States suggests increasing trends in neonatal mortality for postnatal asphyxia and atelectasis, and the cause group which includes hyaline membrane disease and respiratory distress syndrome. In addition, the United States ranks high in postneonatal mortality for diseases of the respiratory and digestive systems and for accidents.

Associations between leveling trends or decelerated rates of decline and the available demographic information and patterns of medical and obstetric care do not fully explain the changes which were noted. More intensive clinical and epidemiologic study of certain causes of death, low birth weight, and prematurity, along with national data on medical care and obstetric practices and more detailed comparisons of vital records and registration systems are needed to clarify the situation, to offer leads to further investigation, and to direct program planning.

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INTERNATIONAL COMPARISON OF PERINATAL AND INFANT MORTALITY

Helen C. Chase, Dr. P. H., *Office of Health Statistics Analysis*

I. INTRODUCTION

One of the notable health accomplishments in the 20th century has been the decline in infant mortality. Over the first half of the century the rapid decline in mortality among infants became an accepted component of the Nation's health. In the past decade, it has become difficult to adjust to the idea that infant mortality in the United States is no longer declining at its former rate.

In 1960, Moriyama[1] called attention to an apparent basic change in the infant mortality trend which began around 1950. No longer were the rates continuing downward at their former pace. The trend for the country as a whole was a reflection of the mortality of white infants which constituted about 86 percent of the live births in 1950, but applied to nonwhite births as well. It appeared that the change occurred a few years earlier for postneonatal mortality than for neonatal mortality for both white and nonwhite infants. Data for a number of other countries suggested similar configurations.

Shapiro and Moriyama[2] expanded on these observations in 1963 by comparing the components of perinatal mortality and postneonatal mortality for 11 countries of low mortality. The rates for a number of countries continued to decline until the midfifties and then appeared to follow the leveling trend observed 5 years earlier for the United States. Similar patterns were observed for neonatal mortality. The change in rate of decline for postneonatal mortality occurred before 1950 in the United States while the rates for other countries continued their decline throughout the period covered by the report, i.e., through the early 1960's.

The deceleration of the rate of decline in infant mortality is not peculiar to the United States. Although the change seems to have occurred here around 1950, in other countries the phenomenon seems to have occurred a few years later. For example, similar changes in trend have appeared in data for Australia, Canada, Czechoslovakia, England and Wales, New Zealand, Norway, Scotland, and Sweden. Since 1960, a similar change is suggested by data for France as well.

In an attempt to identify problem areas and to lend direction to future investigations, the National Center for Health Statistics entered into contracts with investigators from the Netherlands in 1962, Norway and the United States in 1963, and Denmark, England and Wales, and Scotland in 1964. Each investigator undertook a study of the infant mortality experience of his own country and prepared a report on the subject. The contract reports included a common core of tabulated data which would be useful for comparative purposes.

The present report represents a consolidation of data for the six countries mentioned above and for Sweden. Except for Sweden and the United States, it is based chiefly on the reports submitted by the contractors. Often, their information was supplemented by data derived from official publications and special studies. Information for

Sweden was obtained from official publications from Sweden and the World Health Organization, and for the United States from the Division of Vital Statistics, National Center for Health Statistics.

SELECTED COUNTRIES

According to the latest information from the Statistical Office of the United Nations, in 1964 infant mortality in the United States exceeded that in a number of other countries:

Sweden	14.2
Netherlands	14.8
Norway	16.4
Finland	17.0
Iceland	17.7
Denmark	18.7
Switzerland	19.0
New Zealand	19.1
Australia	19.1
England and Wales	19.9
Japan	20.4
Czechoslovakia (provisional)	21.2
Ukrainian SSR	22.0
France	23.3
China (Taiwan)	23.9
Scotland	24.0
Canada	24.7
United States of America	24.8

All six of the countries selected for comparison with the United States had rates which were lower than that experienced in this country. Three of them (Sweden, the Netherlands, and Norway) had the lowest infant mortality rates in the world.

The selected countries have many factors in common with the United States. All are in the north temperate zone and climatically are subject to pronounced seasonal variations. Their populations are predominantly white although some of the countries have experienced immigration of nonwhite groups since World War II. They have shared a common industrial expansion which had its beginnings in the 19th century. All were deeply affected economically by the great depression of the 1930's. Since the close of World War II, these countries have continued to industrialize and have experienced a rising standard of living and generally favorable economic conditions. All have experienced relatively stable governments in this century except for the war periods. They were physically affected by World War II to varying degrees: Denmark, the Netherlands, and Norway became occupied countries and all but Sweden were belligerents.

The United States has shared similar developments. The depression had a significant effect on the Nation's economy. Since then, industrialization has continued. The Nation has enjoyed a rising standard of living and generally favorable economic conditions for a long period of time. The physical damage associated with bombings or invasions of the Second World War did not reach the mainland of the United States, but a large segment of its young adult male population served in the Armed Forces at home and abroad.

Population

The selected countries are quite variable in area, population size, and density (table 1). When the land area and population are considered jointly, England and Wales and the Netherlands are relatively densely populated; Norway, Sweden, and the United States are relatively sparsely populated; and Denmark and Scotland occupy a midposition.

All of the countries have experienced population growth. Except for the war years, they have shared a pattern of generally declining mortality, with particular advances in communicable disease control. Birth rates declined in the first quarter of the 20th century at the same time that industrialization progressed. During the depression of the 1930's, the crude birth rates varied from 13.8 for Sweden to 20.2 for the Netherlands.

From 1935 to 1950, the trend lines of the birth rates for these seven countries presented somewhat similar contours (fig. 1). There were irregular, but marked, increases reaching their maxima toward the close of World War II or soon thereafter. The highest rates for Sweden were in 1944 and 1945, for Denmark in 1945 and 1946, for the Netherlands and Norway in 1946, and for England and Wales, Scotland, and the United States in 1947. Following these peaks, the rates for all seven countries showed some decrease with the United States retaining the highest position through 1964. Since 1950, there have been marked differ-

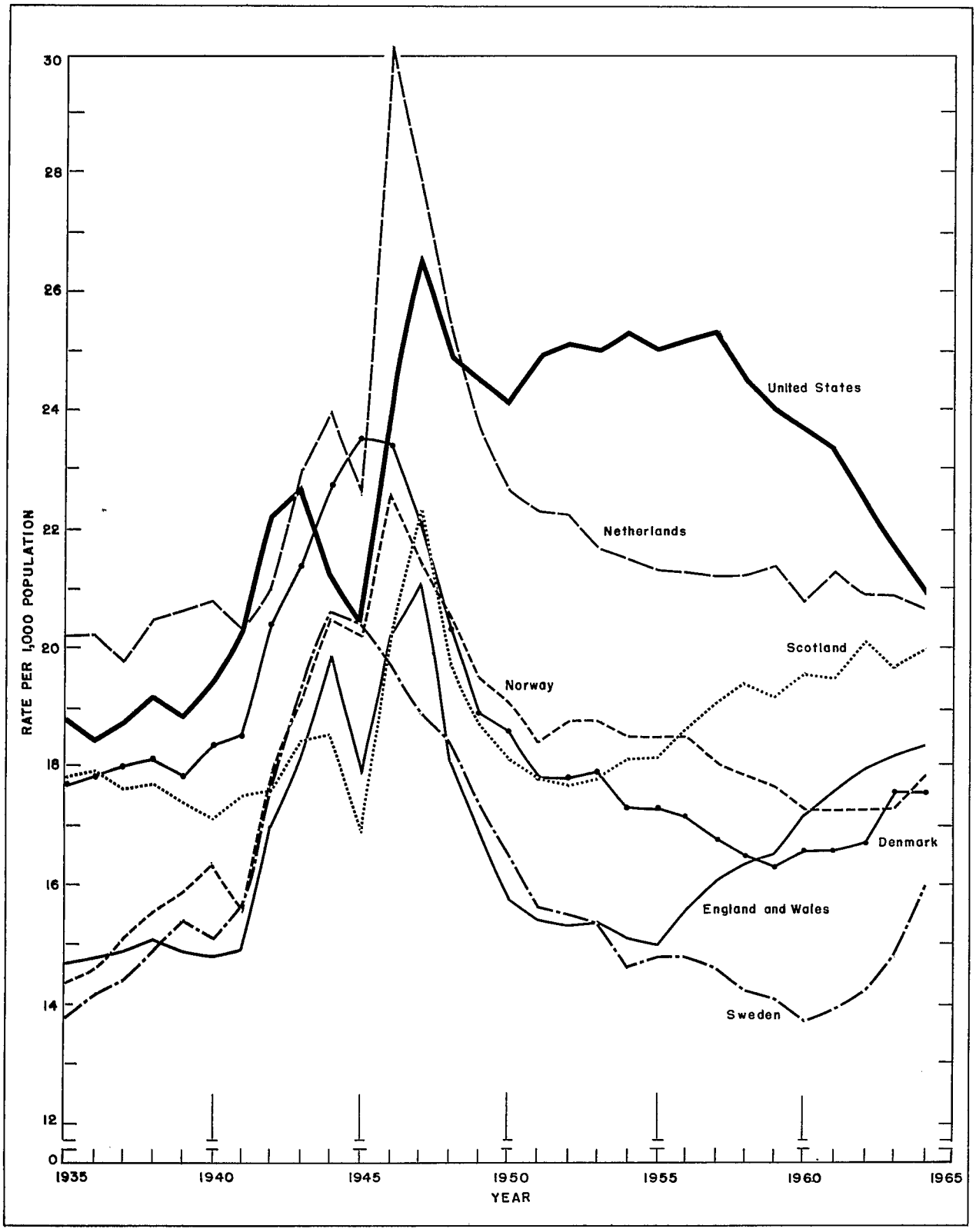


Figure 1. Crude birth rates: selected countries, 1935-64.

Table 1. Land area, population density, 1948 and 1962, and census population, 1960 or 1961: selected countries

Country	Land area (square miles in thousands)[1]	Population density per square mile[1]		Population in thousands[2]
		1948	1962	1960
Denmark	17	254	280	[3]4,585
England and Wales	58	746	800	[3]46,072
Netherlands	13	754	909	11,462
Norway	125	26	28	[3]3,591
Scotland	31	171	171	[3]5,179
Sweden	174	39	44	7,495
United States	[4]3,615	49	52	179,323

[1]SOURCE: United Nations, Statistical Yearbook, 1949-50 and 1963.

[2]For the United States, data are from the U.S. Census of Population, 1960. For all other countries, data are from the U.N. Demographic Yearbook, 1963.

[3]1961 population.

[4]As of 1962.

ences in the trends. The rates for England and Wales, and Scotland have exhibited increases since 1955. The rates for Denmark, the Netherlands, Norway, and Sweden declined from about 1950 to 1955. Since then, the rates for the Netherlands and Norway have been relatively more stable, while those for Denmark and Sweden suggest increasing rates. The rates for the United States increased irregularly from 1950 to 1957 and since then have declined sharply.

At present, the crude birth rates for Denmark and the Netherlands are approximately equal to those in the midst of the depression in 1935. In the remaining countries (England and Wales, Norway, Scotland, Sweden, and the United States), the rates are considerably higher than those of 1935.

Crude birth rates are affected by the age distribution of women in the population, their age at marriage, and their childbearing patterns. Marriage rates and live birth rates are considerably higher in the United States than in the other countries for young women under 20 and 20-24 years of age. To facilitate comparison among the seven countries, the age-adjusted birth rates for females 15-49 years of age are shown in table 2. During the 1950's, the highest rates were observed for the Netherlands and the United States, but their positions relative to each other have reversed, with the United States assuming the highest rate. In recent years, the rate for Scotland has been approaching them. In 1962 the rates for Sweden and Denmark were approximately 65-75 percent of those of the United States.

The age structures of the populations of these selected countries are affected by the dy-

Table 2. Age-adjusted birth rates[1]: selected countries, 1950, 1957, and 1962

Country	1950	1957	1962
Denmark	78.7	78.0	77.6
England and Wales	67.0	75.1	86.9
Netherlands	94.2	94.0	96.8
Norway	76.6	86.3	88.2
Scotland	78.1	83.6	92.2
Sweden	70.1	69.4	68.6
United States	91.5	112.7	105.4

[1]Rates per 1,000 females ages 15-49 years. Births are adjusted to United States standard population of females, distributed by age, as enumerated in 1950 census, using the direct method.

Table 3. Percentage distribution of enumerated population, by age: selected countries and years

Country	Year	Age				
		All ages	Under 20 years	20-44 years	45-64 years	65 years and over
		Percentage distribution				
Denmark	1950	100.0	33.2	36.1	21.6	9.1
	1960	100.0	33.5	32.3	23.6	10.6
England and Wales	1951	100.0	28.3	36.5	24.1	11.0
	1961	100.0	29.8	32.6	25.7	11.9
Netherlands	[1]1950	100.0	37.3	35.8	19.2	7.7
	1960	100.0	38.6	32.7	20.1	8.7
Norway	1950	100.0	30.6	37.8	22.0	9.6
	1960	100.0	33.0	32.3	23.7	10.9
Scotland	1951	100.0	31.7	35.9	22.4	10.0
	1961	100.0	32.8	32.8	24.0	10.4
Sweden	1950	100.0	29.4	37.2	23.2	10.2
	1960	100.0	29.9	32.6	25.5	12.0
United States	1950	100.0	33.9	37.6	20.3	8.1
	1960	100.0	38.5	32.3	20.1	9.2

[1]Based on estimated population.

SOURCE: United Nations, Demographic Yearbook, 1955 and 1962.

namics of population growth (table 3). Each country has shown an increase in the proportion under 20 years of age in the decade between 1950 and 1960. Arithmetic increases ranged from 0.3 percent for Denmark to 4.6 percent for the United States. Simultaneously, each of the countries experienced relative declines in the childbearing segment of the population 20-44 years of age. In the older adult years, 45-64 and 65 years and over, the proportions increased with one exception; the United States showed a small decrease in the group 45-64 years of age.

Medical Care

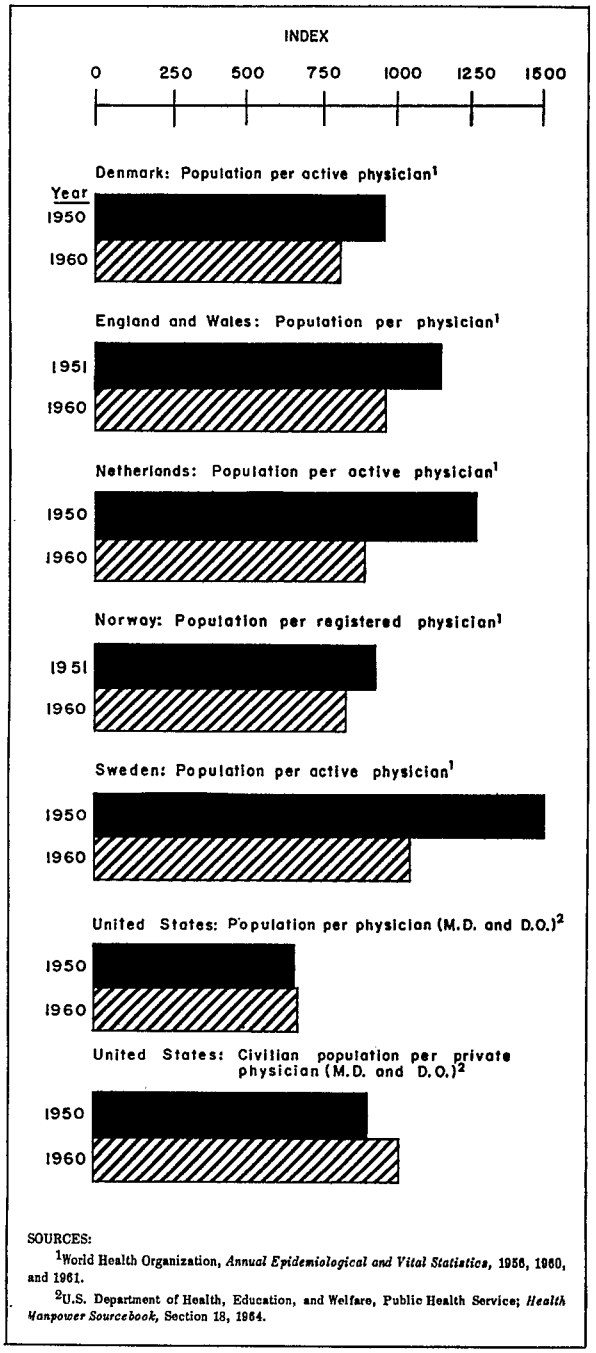
Differing philosophies have resulted in pronounced contrasts between the west European countries and the United States with regard to the financing of medical care. Each of the European countries has enacted its own plan of social insurance to provide medical and/or cash benefits. These programs vary in their benefits for sickness, maternity, and family allowances (see appendix).

In contrast, the usual pattern in the United States is privately financed prepaid hospital or medical insurance for maternity and sickness. Government-sponsored sickness or maternity benefits are less fully developed than in the west European countries. The Federal Government has enacted legislation to provide medical care for certain groups: railroad employees, merchant seamen, veterans, welfare and social security recipients, and so forth. In addition, four States (California, New Jersey, New York, and Rhode Island) have enacted disability insurance for em-

ployees of industry and commerce. In this country, there are no goyernment-sponsored plans providing family allowances for civilians other than those provided to welfare recipients. Only New Jersey and Rhode Island include some form of maternity benefits in their disability insurance plans.

During World War II, the supply of physicians to civilians was limited for most of the countries considered in this report. However, by 1950, the major emphasis of the medical profession was once again nonmilitary. At the same time, population increases in this postwar period challenged the rate of increase of new physicians. The decade from 1950 to 1960 showed decreased population to physician ratios for Denmark, England and Wales, the Netherlands, Norway, and Sweden (fig. 2). On the other hand, for the United States the ratio of population to physician remained relatively unchanged (672 and 675 per physician) and the ratio of civilian population to private physician increased from 914 to 1,018. Nevertheless, among the countries selected, the United States retained a favorable position with regard to its population to physician ratio.

In the United States, over 96 percent of births were delivered in hospitals in 1960, and it is assumed that virtually all of these were attended by physicians (obstetricians, general practitioners, residents). Some of the European countries have quite different patterns (table 4). Of particular interest is their continued use of a corps of trained nurse-midwives for normal deliveries. In the Netherlands, only 27 percent of live births were delivered in hospitals in 1960. This proportion is low because, in addition to other factors, the insurance system will not reimburse a family for hospital costs for a normal delivery. Of all births in that country in 1963, 35 percent were attended by midwives and 65 percent by general practitioners or obstetricians.[3] In Norway, about 95 percent of births occur in hospitals or maternity wards. Confinements are generally conducted by midwives without medical assistance although it is available for deliveries in hospitals



SOURCES:

[1]World Health Organization, *Annual Epidemiological and Vital Statistics*, 1956, 1960, and 1961.

[2]U.S. Department of Health, Education, and Welfare, Public Health Service; *Health Manpower Sourcebook*, Section 18, 1964.

Figure 2. Ratio of population to physicians: selected countries, 1950 and 1960.

Table 4. Percent of births, live births, and fetal deaths occurring in hospitals: selected countries, 1960

Country	Births	Live births	Fetal deaths[1]
	Percent in hospitals		
Denmark[2]	---	---	---
England and Wales[2]	64.7	64.3	83.3
Netherlands[2]	---	27.0	56.9
Norway [2,3]	94.3	94.3	94.4
Scotland[4]	74.4	---	---
Sweden[2]	---	99.3	---
United States[5]	96.6	96.6	93.9

[1]Fetal deaths of 28 weeks and over gestation plus those with gestation not stated.

[2]Returns to questionnaire on "Registration and Statistical Practices Related to Fetal Deaths and Infant Deaths" sent to selected countries from the National Center for Health Statistics, spring 1962.

[3]Includes small maternity wards.

SOURCES:

[4]Scottish Home and Health Department, Scottish Health Statistics, 1963, Edinburgh, Her Majesty's Stationery Office, 1964, p. 52.

[5]U.S. Department of Health, Education, and Welfare, Public Health Service; Vital Statistics of the United States, 1960, Vol. I and Vol. II, Part A.

if needed.[4] In Scotland, about 20 percent of births in 1963 occurred at home, but less than 1 percent of these was delivered without the services of a general practitioner. In England and Wales, 33 percent of all births occurred at home. From a special study it is estimated that doctors delivered 14 percent of all births while midwives delivered 53 percent and pupil midwives delivered another 28 percent.[5] Recently, there has been increased interest in the United States in training nurse-midwives to attend normal deliveries. Less than 500 nurse-midwives were known to exist in the United States in 1963, and few of them are actively engaged in midwifery.

II. EVALUATION OF BASIC DATA

The purpose of this report is to compare the perinatal and infant mortality experience of the United States with that of a number of west European countries in order to obtain guides for future study or action. The primary source of information for studying the infant mortality of nations is their vital statistics. Since registration of marriages is not of immediate interest, the following comments relate to live birth, fetal death, and death registration only.

The vital statistics systems of the six west European countries are well established and of long standing (table 5). It was 1933 before the level of registration of births and deaths in all of the States of the United States was considered sufficiently complete and accurate to permit inclusion of their statistics in national data. At that time, the data included 48 States and the District of Columbia, and these were augmented by data for the States of Alaska (1959) and Hawaii (1960) as they achieved statehood.

Table 5. Date of compulsory national civil registration law governing registration of live births, deaths, and stillbirths: selected countries, as of January 1, 1950

Country	Live birth	Death	Stillbirth
Denmark	1646	1646	1646
England and Wales	[1]1875	[1]1875	1927
Netherlands	1811	1811	1811
Norway	1685	1685	1685
Scotland	1855	1855	1939
Sweden	1686	1686	1686
United States[2]	1933	1933	1933

[1]Civil registration was introduced in 1837, but it was not until 1875 that registration became a statutory duty imposed on the informant.

[2]Completion of the birth and death registration areas, respectively. No national registration law.

SOURCE: United Nations, Handbook of Vital Statistics Methods, Studies in Methods, Series F, No. 7, April 1955, pp. 20-21.

The methods of registering vital events vary among the countries included in this study. Some of these differences are relatively unimportant while others may have a significant effect on the vital statistics. In most instances, quantitative measures of the effect of specific practices are unavailable and reliance must be placed on subjective estimates.

DEFINITIONS OF LIVE BIRTH

The distinction between a live birth and fetal death is one of the basic decisions in vital registration. This decision concerning a specific birth determines whether it is included among live births, among fetal deaths, or excluded from both. Definitions of vital events to be included as live births are subject to national variation, and in the United States to some variation at the State level. The definitions rest on specifying which signs of life constitute classifying a newborn infant as live born.

Over a period of decades the League of Nations and the World Health Organization have attempted to promote uniform vital statistics through recommended definitions which could be used as models. In 1925, the recommendation of the League of Nations Health Committee mentioned only "breathing" as a criterion of live birth. However, at an earlier date, professional organizations in England and the United States were already advising that evidence of life should include action of heart, breathing, or movement of voluntary muscles.

In 1950, the Third World Health Assembly adopted the recommendation of the Expert Committee on Health Statistics with regard to defini-

tions of live birth and fetal death.[6] A live birth was defined as follows:

> *Live birth is the complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of pregnancy, which, after such separation, breathes or shows any other evidence of life, such as beating of the heart, pulsation of the umbilical cord, or definite movement of voluntary muscles, whether or not the umbilical cord has been cut or the placenta is attached; each product of such a birth is considered live born.*

The definition of fetal death was recommended to complement that of live birth:

> *Foetal death is death prior to the complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of pregnancy; the death is indicated by the fact that after such separation, the foetus does not breathe or show any other evidence of life, such as beating of the heart, pulsation of the umbilical cord, or definite movement of voluntary muscles.*

These definitions of live birth and fetal death omitted mention of duration of pregnancy and terms such as abortion, miscarriage, or stillbirth.

Despite the action of the World Health Assembly, changes in the laws of the various countries were not achieved immediately or uniformly. For example, the change in definition of live birth to include "beating of the heart, pulsation of the umbilical cord, or definite movement of voluntary muscles" in addition to "breathing" as evidence of life was not adopted in Sweden until 1959. Even at present, Denmark has no legal definition of "signs of life." Furthermore, changes in law or regulation are not immediately transposed into action. Practices followed by physicians or midwives regarding their understanding, interpretation, and implementation of the law are difficult to assess. European practice continues to prefer "stillbirth" to "fetal death."

The effect of these variations in definition appears to be relatively small for some countries. From English data for 1946-47,[7] it was estimated that limiting the criteria of life to "breathing" alone resulted in a decrease of 1.5 percent in infant deaths and a corresponding rise of 3 percent in stillbirths.

Table 6. Effect of WHO definition of live birth on components of infant deaths: Sweden, 1956

Event	Swedish practice		WHO definition	
	Number	Rate	Number	Rate
Live births	107,960	...	108,081	...
Perinatal deaths[1]	3,106	28.3	3,106	28.3
Stillbirths[1]	1,836	16.7	1,715	15.6
Deaths under 1 week[2]	1,270	11.8	1,391	12.9
Deaths under 28 days[2]	1,427	13.2	1,548	14.3
Deaths under 1 year[2]	1,871	17.3	1,992	18.4

[1]Rates per 1,000 births (liveborn and stillborn).

[2]Rates per 1,000 live births.

Sweden investigated the criteria of life in relation to the registration of the event as a live birth or as a stillbirth in that country.[8] According to the law prevailing in Sweden until 1959, fetuses of at least 35 centimeters in length which did not breathe after birth were considered stillborn. However, it was recognized that use of the word "breathe" was subject to varied interpretations. To some, it means a single gasp of breath; to others, regular breathing of some minutes. From the special study in Sweden, it was found that among the more than 1,800 stillbirths in 1956, about 700 infants died in birth. Information on criteria of birth was obtained on 646 of these, and 83 percent of them were born with no sign of life. Based on their gestation periods, this group corresponds to the WHO definition of "late" fetal deaths. The remaining 17 percent breathed or showed some other sign of life and should have been classified as live births and neonatal deaths by WHO definition. It is estimated that correction of these registrations should have decreased stillbirths by 7 percent, and increased the deaths under 1 week by 10 percent, neonatal deaths by 9 percent, and infant deaths by 7 percent (table 6).

INFORMANT

Consistent terminology is basic to an understanding of the differences in registration practices and the resulting statistics. The informant, as used here, is the person responsible for reporting the fact of the occurrence of the vital event. In the six west European countries which were considered, the parent (usually the father) is the informant and is responsible for reporting the birth or death of an infant. In the United States, the responsibility for notification of birth is usually placed on the attending physician, and for death, on the funeral director. In a few States, the responsibility has been placed on the hospital. This is a basic difference in registration between the United States and the European countries.

In the west European countries, there are certain financial advantages which promote registration by the informant. The maternity benefits and family allowances included in their social insurance systems represent significant personal advantages. Their administration is often predicated on the presentation of a birth certificate, thus stimulating registration on the part of the parent. In the United States, hospitals and physicians are generally paid by private insurance companies on presentation of a claim by the hospital or physician, or directly by the patient. In either instance, payment is not contingent on the presentation of a birth certificate. In this country, the parent is responsible for registration of a live birth only when the delivery is not attended by a physician or midwife.

ADMINISTRATION

Another source of difference is the administrative relationship between the agencies involved in the registration process and the statistical aspects of the vital registration system (table 7). In England and Wales and in Scotland, a single administrative agency has national responsibility for registration as well as the statistical end-product. This single organization structure has the advantage of responsiveness to the statistical needs of the system and administrative decisions. In the Scandinavian countries (Denmark, Norway, and Sweden), the responsible local registration agency is ecclesiastical. Historically, this system developed from recording services of baptisms and burials of parishioners into the registration of all births and deaths. The national statistical responsibility in each of these countries is in a Central Bureau of Statistics which, in Denmark and Sweden, is under the Ministry of Finance. In the Netherlands, local registration is conducted by the Registry of Civil Status and national statistical responsibility rests with a Central Bureau of Statistics in the Ministry of Economic Affairs. In the United States, with one exception (Massachusetts) the registration process is administered by the health authorities of the individual States and a few cities, and the responsibility for national statistics is in the Public Health Service of the U.S. Department of Health, Education, and Welfare.

The administration of the vital registration and statistical process by nonmedical agencies in the European countries has resulted in the development of auxiliary record systems to obtain medical information for health purposes.

Table 7. Agency of government reported to be responsible for civil registration function at local and national levels and for compilation of national statistics on live births, deaths, and stillbirths: selected countries, as of January 1, 1950

Country	Registration		Statistics
	Agency responsible at local level	Agency directly responsible at national level	Agency responsible at national level
Denmark-------	Parish Registry Civil Registry	None	Statistical Department (Ministry of Finance) National Health Service (cause-of-death statistics only)
England and Wales--------	Local Register Office (Subdistrict)	General Register Office	General Register Office
Netherlands---	Registry of Civil Status (Municipal)	None	Central Bureau of Statistics (Ministry of Economic Affairs)
Norway--------	Parish Registry	None	Central Bureau of Statistics
Scotland------	Local Registrar's Office (District)	General Registry Office	General Registry Office
Sweden--------	Parish Registry	Central Office of National Registration (Central Bureau of Statistics, Ministry of Finance)	Central Bureau of Statistics (Ministry of Finance)
United States-	Local Registrars and State Departments of Health	None	Public Health Service (U.S. Department of Health, Education, and Welfare)

SOURCE: United Nations, Handbook of Vital Statistics Methods, Studies in Methods, Series F, No. 7, April 1955, pp. 27-31.

Examples of such parallel activities are notification of stillbirths by physicians in hospitals or by midwives to health agencies in Denmark and Norway, and notification of stillbirths by midwives in the Netherlands. These parallel activities are used as cross-checks to assess completeness of notification and registration. In the United States, medical and legal purposes are accomplished by a single document, and ongoing opportunities for cross-checks are limited.

COMPARISON OF REGISTRATION METHODS

Three countries were selected for more detailed descriptions of their registration systems: the Netherlands, Norway, and the United States. They were selected to demonstrate basic differences in the informant, the administration of the system, and the kinds of information available for study. This should add to the understanding

of some of the subsequent data. Much of the information is drawn from the *Handbook of Vital Statistics Methods*,[9] reports of two of the contractors,[4, 10] and comments of the contractors.

Netherlands

In the Netherlands, only about 30 percent of live births occur in hospitals; about 60 percent of all births are attended by physicians (general practitioners or obstetricians) and the remainder by midwives. Notification of birth to the Registry of Civil Status must be made within 3 days of birth. The responsible informant is the father (or his deputy) who notifies the local registrar in the town hall of the child's birth. The informant is requested to provide the following information: date of birth, religion, nationality, name of physician or midwife attending the delivery, name of hospital (if any), single or multiple birth, parity, legitimacy, and Christian name of child; and name, age, date of present marriage, occupation, and residence of parents. The registrar prepares the certificate of birth and sends an enumeration card to the Central Bureau of Statistics.

Notification of birth to the Registry is the parents' responsibility and, except in cases of inability of the parents to act, neither the physician nor the midwife is involved. Consequently, it is impossible to obtain medical information for births from the civil registration system of the Netherlands. Information such as birth weight, gestation period, complications of pregnancy or labor, or congenital malformations is not available for live births but must be obtained from special surveys. This system prevails for all liveborn children surviving at the time of registration and covers over 90 percent of all births. Registration of this group is felt to be quite complete.

In those instances in which a liveborn infant dies before registration, the notifier (usually the funeral-undertaker) presents the confidential death certificate which was prepared by the physician and simultaneously provides information relating to the birth. From the death certificate prepared by the physician, some medical information may be obtained, e.g., cause of death, infant's birth weight and birth length, and duration of pregnancy. Complications of pregnancy or labor are available only when the physician considers them important in connection with the cause of death. It is believed that some liveborn infants (predominantly small prematures) who are considered nonviable by the physician may escape registration to spare the cost of a funeral. However, without registration no maternity benefit from the social insurance system would be granted. This grant is felt to be a stimulus to registration of these events. The number of omissions in registration is believed to be small, but the extent of undernotification is not known.

Registration of fetal deaths is required for those with gestations of 28 weeks or more. The father (or his deputy) registers the fetal death when he presents the fetal death certificate prepared by the physician. The certificate includes the cause of death and duration of pregnancy and labor, but it does not include birth weight. In a borderline case (26-28 weeks' gestation), there may be a tendency for the doctor to consider the event as an early fetal death in order to spare the family the trouble and cost of a funeral, but again without registration no maternity benefits would be granted.

In some instances, religious precepts may cause a fetus which dies late in labor to be considered a live birth in order to be baptized. This may shift some fetal deaths to early neonatal deaths but would not affect perinatal deaths. In other instances, liveborn infants of more than 28 weeks' gestation may die very soon after birth and be registered as fetal deaths. This may shift some early neonatal deaths to fetal deaths but, again, would not affect perinatal deaths. For the Netherlands, the net effect of these errors in notification and registration is believed to be a slight understatement of fetal and perinatal mortality although it has not been quantified.

Norway

In Norway, the official civil register of births and deaths is maintained by the clergy. Reporting of births must be made to church officials within 4 weeks of birth. The civil birth register consists of all liveborn and stillborn children (after 28 weeks of pregnancy) regardless of the religious denomination of parents. Reports of these events are forwarded to the Central Bureau of Statistics

which is responsible for the official vital statistics.

In contrast to the Netherlands where less than one-third of deliveries occur in hospitals, over 95 percent of deliveries in Norway occur in hospitals or maternity wards. Although notification of a legitimate birth (liveborn or stillborn) in Norway is the responsibility of the parent or other person present at delivery, if birth occurs in a hospital, clinic, or nursing home, the institution is responsible for notification to the official registrar. Notification of an illegitimate birth is the responsibility of the physician, midwife, or, in the absence of such attendants, the mother.

The notification of a legitimate birth contains facts related to multiplicity of the birth; parity; and the occupation, religion, birth date, place of birth, nationality, and year of marriage of mother and father. The notification of an illegitimate birth contains, in addition, the infant's length, birth weight, and period of gestation.

Notification of live births by parents and institutions and civil registration by the clergy is felt to be generally satisfactory in Norway. As in the Netherlands, certain financial benefits in the form of maternity benefits and family allowances depend upon official registration. Registration of stillbirths, however, is known to be somewhat deficient on the part of parents. Cross-checking of the registered event against the physician's or midwife's notification to the public health officer for stillbirths and deaths within 24 hours of birth is used to improve registration.

With regard to death, the physician completes a medical certificate of death which is given to the informant in a sealed envelope. Notification of death must then be made to a probate court, which issues the civil certificate for registration. The civil certificate (without cause of death) is presented to the local parish official who registers the death in the death register and forwards the certificate to the civil population registry. This civil certificate contains no information on the cause of death. The medical death certificate is signed by the probate court and sent to the public health officer in the community where the death occurred. Public registrars submit lists of deaths to the Central Bureau of Statistics, while the public health officers transmit medical death certificates containing the causes of death to the same Bureau. Death registration is felt to be fairly complete, but information on causes of death among infants born in the northern rural areas of Norway is still considered a problem.

United States

In the United States, births and deaths are registered by the health agencies of 49 States, the District of Columbia, and three independent cities (Baltimore, New Orleans, and New York City). In the 50th State, Massachusetts, vital events are registered by the Office of the Secretary of the Commonwealth. Vital registration is administered by individual State authorities under legislation enacted by the 50 State legislatures. Therefore, statements relative to registration must, to some degree, be generalizations. The period within which registration is required varies from 24 hours to 15 days.

In 1963, 97.4 percent of live births occurred in hospitals, and an additional 0.8 percent which occurred outside hospitals were attended by physicians. The responsibility for notification of birth is generally placed on the attending physician. In some States, the responsibility for reporting the occurrence of births is placed on the superintendent or administrator of the hospital in which delivery takes place rather than the attending physician. If there is no physician in attendance, the responsibility rests with the midwife, parent, or some other person in attendance.

Reporting the occurrence of a death for registration is usually the responsibility of the funeral director. It is he who presents the death certificate (which includes the medical certification prepared by the physician, medical examiner, or coroner) to the local registrar in order to obtain a burial permit.

Fetal deaths most generally follow the procedure for deaths, although States which require the registration of all products of conception have found it necessary to ascribe some of the registration responsibility for fetal deaths to physicians, hospitals, midwives, and parents as well.

Demographic information is obtained from one of the parents by the physician, hospital, or undertaker. Medical information is supplied by the physician or hospital. The first point of contact between a vital record and a registration official is a local registrar who receives the live birth, fetal death, or death certificate from

the physician, hospital, funeral director, or other person, as the case may be. These local registrars are usually nonmedical part-time deputies of the State registrars. They are sometimes civil officials such as county, city, town, or village clerks. In turn, local registrars forward the original vital records to State health departments where they are kept on permanent file, and State statistical reports are prepared. Microfilm copies are forwarded by the States to the Public Health Service, U.S. Department of Health, Education, and Welfare, which is responsible for the national vital statistics but has no statutory registration responsibilities.

Having registration and the administration of the vital statistics system in the hands of the medical profession and health departments results in a single document, and, in contrast to the west European countries, little responsibility is assigned to the parents. It obviates the necessity for dual notification by physicians and lay persons. Furthermore, it presents opportunities for obtaining medical as well as demographic information. The certificates of birth include birth weight, gestation (or sometimes first day of last menstrual period), number and order of multiple birth, parity, and often the complications of pregnancy, labor, and delivery, birth injuries, congenital malformations, and so forth.

Fetal death certificates, with a few exceptions, require the same information as birth certificates. In addition, fetal death certificates require the causes of fetal death.

Death certificates request information on causes of death in addition to demographic information but do not require detailed information about birth.

Registration is required for all live births and deaths. However, the requirements for the registration of fetal deaths vary widely among the States. All States but one base the requirement for registration of fetal deaths on gestation; the one exception (Kansas) requires registration of all fetal deaths weighing over 350 grams. Thirty-nine States and the District of Columbia relate their requirement for fetal death registration to a near-equivalent of 20 weeks (after 5th month, 20 weeks or more, or after 20 weeks); one State (Pennsylvania) requires registration at 16 weeks; and nine States and New York City require registration at all periods of gestation. Usually, national tabulations include fetal deaths of 20 weeks or more and those with gestation unspecified. This national minimum is 8 weeks earlier than the minimum for the west European countries. Wherever possible in this report, data for the United States have been limited to fetal deaths of 28 weeks or more and a proportion of those with gestation not specified to facilitate comparisons.

The completeness of registration of live births in the United States has been evaluated through comparison with records obtained by census enumerators. In 1950, 97.9 percent of infants born in January through March were found to have been registered as live births. There has been no national test of registration completeness of fetal deaths and deaths, and none for live births since 1950. The registration of live births and deaths is believed to be quite complete while registration of fetal deaths is probably quite incomplete.

REGISTRATION OF FETAL DEATHS

There is relatively little information available on the degree of underregistration of fetal deaths. The six west European countries included in the study require registration of fetal deaths at a minimum of about 28 weeks. Because of the dual notification in these countries, cross-checks have been made and inquiries initiated whenever discrepancies exist. This checking has promoted their confidence in the registration system and investigators have expressed their opinions that fetal death registration as required by law is good. Nevertheless, some incompleteness in registration on the part of parents in the Netherlands and Norway, at least, is admitted.

In the United States, it is generally conceded that fetal death registration is incomplete for the periods required by the several State laws. The nationwide minimum period of required registration is 20 weeks or some near-equivalent, 8 weeks earlier than the west European countries. There have been no national studies of the completeness of fetal death registration. Therefore, estimates of completeness must be based on special studies and inferences from routine data.

For the United States, estimates of the numbers of fetal deaths at all periods of gestation are available from a few sources. Three are selected here because their methods of collection should

Table 8. Estimates of completeness of fetal death registration, based on special studies: Onondaga County, N.Y., Kauai, Hawaii, and New York, N.Y.

Area	Year	Total	Gestation		
			Under 20 weeks	20-27 weeks	28 weeks and over
		Number of fetal deaths			
Onondaga County[1]	1951-52	1,456	1,083	135	238
Kauai[2]	1953-56	370	305	29	36
New York[3]	1950	16,405	12,629	1,377	2,399
New York[4]	1963	22,329	17,775	2,031	2,523
		Ratio to fetal deaths 28 weeks or more			
Onondaga County[1]	1951-52	6.12	4.55	.57	1.00
Kauai[2]	1953-56	10.28	8.47	.81	1.00
New York[3]	1950	6.84	5.26	.57	1.00
New York[4]	1963	8.85	7.04	.80	1.00
		Percentage distribution			
Onondaga County[1]	1951-52	100.0	74.4	9.3	16.3
Kauai[2]	1953-56	100.0	82.4	7.8	9.7
New York[3]	1950	100.0	77.0	8.4	14.7
New York[4]	1963	100.0	79.6	9.1	11.3
		Ratio of survey to registered			
Onondaga County[1]	1951-52	...	...	2.45	1.11
Kauai[2]	1953-56	1.95	2.21	1.61	1.06

SOURCES:

[1]E. R. Schlesinger et al., "Fetal and Early Neonatal Deaths in Onondaga County, New York," Public Health Reports 74:1117-1122, Dec. 1959.

[2]F. E. French and J. M. Bierman, "Probabilities of Fetal Mortality," Public Health Reports 77:835-847, Oct. 1962.

[3]C. L. Erhardt, "Reporting of Fetal Deaths in New York City," Public Health Reports 67:1161-1167, Dec. 1952.

[4]U.S. Department of Health, Education, and Welfare, Public Health Service; Vital Statistics of the United States, 1963, Vol. II, Part A.

give better indications of the degree of underregistration: Onondaga County, New York (1951-52), the Island of Kauai, Hawaii (1953-56), and New York City (1950 and 1963).

Three different methods of data collection were involved. In Onondaga County, a thorough review was made of all record sources in the hospitals located in that county.[11] This is a county with a high concentration of obstetric service, and a history of interest in maternal and child health studies. The investigation did not get reports from private physicians or individuals if the events did not come to the attention of the hospitals. In Kauai, physicians, hospitals, public health nurses, and the general public were requested to report each pregnancy as soon as it was noted.[12] The authors of the Hawaiian report comment on the level of obstetric and hospital care on the Island and compare it favorably with the general overall experience on the mainland. In New York City, registration or notification is required for all products of conception, and the city has been actively promoting the program for many years.[13]

The three sets of data show rather striking similarities when one considers the differences

in the populations, in time, and in methods of data collection (table 8). The higher ratios between fetal deaths of shorter gestations to those of 28 weeks or more in the Kauai data are to be expected because reports were solicited from the entire population. Neither the Onondaga County nor the New York City data contain such reports.

The results obtained from these surveys may be used to derive a rough estimate of registration compliance in the United States. The surveys provide ratios between fetal deaths identified using survey methods to registered fetal deaths for specified broad gestation intervals. A crude estimate of underregistration may be obtained by applying these gestation-specific ratios to fetal deaths registered in the United States for two groups of fetal death registration areas: (1) those which require the registration of all products of conception, and (2) all others. Having used this approach, the estimated number of fetal deaths which should be registered in accordance with the laws of the States, but which are not registered, amount to a minimum of 65 percent of those which are registered. However, the surveys indicate that the degree of underregistration decreases as the period of gestation increases. For gestations of 20 weeks or more, which is the interval for which data are shown in the annual national statistics, it is estimated that unregistered fetal deaths amount to perhaps one-third of registered fetal deaths. For more limited periods for which registration is required by the west European countries included in this report (28 weeks or more), unregistered fetal deaths are at least 10 percent of those registered.

If the idea is extended a step further, one can estimate only very roughly the total number of fetal deaths in the United States including those which are not required to be registered. Using two alternate estimates for those under 20 weeks, it would seem that the estimated number of fetal deaths of all gestations in 1963 in the United States is, at the minimum, three to five times the 94,000 which were registered in 1963. Yerushalmy and Bierman estimated all fetal losses to approximate 500,000 at a time when 75,000 to 80,000 were registered.[14] Other estimates run considerably higher.[15]

Several conclusions may be reached from these observations. First, even under present registration requirements, there is gross underregistration of fetal deaths in the United States.

Second, registration of events associated with hospitalization are more complete than those which are not. The Kauai data indicated that fetal deaths associated with hospital admissions (either for delivery or after delivery) were registered over 90 percent of the time. For those which were not hospitalized, the estimates are based on small numbers and should be regarded cautiously. The percent registered declined from 61 percent (11 of 18) of those under 20 weeks which were pathologically confirmed, to 2 percent (2 of 101) for those for which pregnancy was not confirmed by a physician.

Third, as one approaches the minimum period of required registration, the greater the degree of underregistration. During the decade 1950-60, a number of States in the United States changed their requirements for fetal death registration. Ten States changed the minimum level at which fetal deaths were required to be registered from 20 weeks (in one instance 5 1/4 months) to all periods of gestation. Data for Arkansas and Hawaii are incomplete and are omitted from the States which made such a change (table 9). One State (Pennsylvania) changed its requirement to a minimum of 16 weeks. For comparison, the four most populous registration areas in the country which made no such change are also shown.

It has been hypothesized that when registration is compulsory at some given period of gestation, it remains incomplete at gestations which are above, but close to that minimum level. By examining the ratio of intermediate fetal deaths (20-27 weeks) to late fetal deaths (28 weeks or more) before and after the changes, some indication is obtained of the incompleteness at the earlier period of gestation.

For each of the States which made a change in registration during the decade, the increase in the ratio of intermediate to late fetal deaths was marked. The increase was notable even when Pennsylvania changed from a minimum of 20 weeks to 16 weeks. On the other hand, for the four control States, the ratios remained relatively unchanged. The data indicate that a change in the minimum gestation at which fetal death registration is required results in substantial improvement even at those gestations which were for-

Table 9. Effect of changes in fetal death registration on completeness of registration: selected States of the United States and selected years

Change in registration requirement and area	Year of change	Registration requirement in year prior to change[1]	Ratio[2]	
			Before change	After change
Changed to all periods of gestation				
Vermont	1951	5 1/2 months	17.1	31.4
Mississippi	1952	After at least 20 weeks	22.3	31.4
Oregon	1952	After at least 20 weeks	26.0	36.8
South Dakota	1953	Reached 20 weeks	24.2	40.5
Colorado	1954	Reached 20 weeks	19.7	45.2
Georgia	1954	After at least 20 weeks	23.4	40.2
Maine	1955	After at least 20 weeks	18.6	36.5
Virginia	1960	Advanced to 20th week	31.0	48.8
Changed to 16 weeks				
Pennsylvania	1954	After at least 20 weeks	29.8	38.1
No change[3]				
Illinois	...	Advanced to 5th month	24.2	25.2
New York (excl. New York City)	...	After at least 20 weeks	24.2	26.7
Ohio	...	At least 4 1/2 months	35.1	34.7
Texas	...	Advanced to 5th month	27.0	30.6

[1]Minimum period of gestation for which fetal death registration was required.

[2]Fetal deaths of 20-27 specified weeks' gestation per 100 fetal deaths of 28 specified weeks or more.

[3]Data presented relative to control year 1954.

merly above the minimum requirement. These observations lead to the question, here unresolved, of the possible effect on the number of registered fetal deaths of 28 weeks or more gestation if the European countries were to change their minimum registration requirements to 20 weeks or more.

For the purposes of this report, the chief concern is the registration of those events with gestations of 28 weeks or more, since it is this group of fetal deaths on which comparisons will be based. For this gestation period, the Onondaga County and Kauai data indicate about 90 percent completeness. There are no data available for estimating the completeness of registration of fetal deaths in the other countries involved in this study.

STATISTICAL PRACTICE

In addition to variations in definitions and registration practices, the statistical management of data derived from the basic records is subject to variation from one country to another.

In the Netherlands, it had been the policy as early as 1924 to register all live births and to count those children who were dead at time of registration as both a live birth and a death.[16] However, in 1950, this policy was changed. Live births were still required to be registered, but those which were of less than 28 weeks' gestation and had died by the time of registration were excluded from tabulations of live births and deaths. This policy remained in effect for the period

Table 10. Effect of inclusion of live births with gestations of less than 28 weeks on components of infant mortality: Netherlands, 1962

Event	Excluding live births with gestations under 28 weeks		Including live births with gestations under 28 weeks	
	Number	Rate	Number	Rate
Live births	245,739	...	246,150	...
Perinatal deaths[1]	6,004	24.1	6,415	25.7
Stillbirths[1]	3,645	14.6	3,645	14.6
Deaths under 1 week[2]	2,359	9.6	2,770	11.3
Deaths under 1 month[2]	2,732	11.1	3,143	12.8
Deaths under 1 year[2]	3,763	15.3	4,174	17.0

[1]Rates per 1,000 births (liveborn and stillborn).

[2]Rates per 1,000 live births.

SOURCE: World Health Organization, "Study of the Effect of Including in Vital Statistics Live Born Under 28 Weeks of Gestation and Dying Before Registration," WHO/HS/Nat.Comm./161, April 24, 1964.

1950-63, but reverted to the earlier policy in 1964. Wherever possible, the data since 1950 have been revised to include the events omitted from vital statistics. These adjustments were possible for all tables except those by cause. An estimate of the effect of this change in statistical policy is shown in table 10. The differences in the numbers of deaths were sizable: 10.9 percent in infant deaths, 15.0 percent in neonatal deaths, and 17.4 percent in deaths under 1 week.

A second variation in statistical practice is the tabulation of deaths of infants who die within the first few days of life. Denmark, the Netherlands, and Sweden tabulate deaths which occur soon after birth on the basis of calendar days, i.e., those which die on the first day are those whose birth and death occurred on the same calendar day. England and Wales, Norway, Scotland, and the United States determine the number of hours between birth and death and tabulate as first-day mortality these deaths which occur during the first 24 hours of life. Because of the high level of mortality near to the time of birth, these differences in tabulating practice have a considerable effect on death rates for the first few days of life. A special inquiry in the Netherlands in 1958-59 showed that the deaths within 24 hours of birth exceeded the deaths which occurred on the calendar day of birth by 37 percent (table 11). A study in Norway yielded similar results: 40 percent in 1949-51 and 1959-61. Using a distribution of births by hours for the State of Indiana, and an exponential rate of dying under 1 day, Greenberg has estimated the differential for the United States to be about 28 percent.[17] These estimates proved helpful in considering mortality under 1 day in the several countries included here.

Table 11. Relationship of deaths occurring within 24 hours of birth to deaths occurring on calendar day of birth: Netherlands and Norway, selected years

Year	Deaths occurring:		Percent of deaths within 24 hours of birth which occur on calendar day of birth	Ratio of deaths occurring within 24 hours of birth to deaths occurring on calendar day of birth
	Within 24 hours of birth (col. 1)	On calendar day of birth (col. 2)	(col. 2) / (col. 1)	(col. 1) / (col. 2)
Netherlands				
1958-59	2,968	2,172	73.2	1.37
1958	1,439	1,084	75.3	1.33
1959	1,529	1,088	71.2	1.41
Norway				
1949-1951	1,281	916	71.5	1.40
1949	496	326	65.7	1.52
1950	386	305	79.0	1.27
1951	399	285	71.4	1.40
1959-1961	1,069	763	71.4	1.40
1959	381	271	71.1	1.41
1960	349	248	71.1	1.41
1961	339	244	72.0	1.39

SOURCE: Unpublished data from Central Bureaus of Statistics for the Netherlands and Norway.

COMPUTATION OF RATES

Infant Mortality

During periods of rapidly changing numbers of births, the computation of infant mortality rates based on deaths under 1 year and live births in the same calendar year gives biased estimates of the risk of death. If births are rising, the estimate of the risk of dying expressed by the infant mortality rate is artificially deflated. Conversely, the infant mortality rate is inflated in periods when births are declining rapidly.

These biases can be overcome by relating infant deaths to the number of live births which gave rise to the group subject to dying under 1 year of age ("related births"). England and Wales made it a practice to compute their rates based on "related births" for the period 1935 through 1956. The largest difference in the rates computed

by the two methods was in 1946 when the number of live births increased sharply. Infant mortality based on live births in the calendar year was 40.9 per 1,000, while infant mortality based on "related births" was 42.9.

When comparing a number of countries whose rates do not vary widely, such differences in the statistical practices of only one country may prove confusing. For that reason, the rates for England and Wales for the period 1935-56 have been recomputed based on live births in the appropriate calendar years. This method was used by all of the other countries.

Perinatal Mortality

The vital events which are to be included as perinatal deaths are based on gestation for fetal deaths and age at death for neonatal deaths. For ease of comparison, the perinatal mortality rates in this report have been computed as follows:

$$\frac{\text{Deaths under 7 days (or within 7 calendar days of birth)} + \text{Fetal deaths of 28 or more weeks of gestation}}{\text{Live births} + \text{Fetal deaths of 28 or more weeks of gestation}} \times 1{,}000$$

The early neonatal deaths for England and Wales, Norway, Scotland, and the United States are based on age at death, i.e., elapsed period since the hour of birth. For the remaining countries, early neonatal deaths are based on the number of calendar days which have elapsed since the date of birth. When the entire first week's events are combined the difference caused by this variation in statistical practice is relatively small.

Fetal deaths of 28 or more weeks of gestation are included in perinatal deaths. Until 1960, in Sweden the criteria for registering fetal deaths was based exclusively on fetal length, i.e., 35 centimeters or longer, rather than gestation period. Thereafter, the primary variable became the gestation period, i.e., after the end of the 28th week of pregnancy. In the absence of knowledge of the duration of gestation, fetal length is still used. For the remaining European countries included in this report, fetal deaths are required to be registered in the 29th week of pregnancy or later (Denmark), after the 28th week of pregnancy (England and Wales, Norway, and Scotland), or with gestation periods of 28 weeks or more (the Netherlands). The fetal death statistics used in this report include all of the registered events for these countries.

For the United States, the detailed official vital statistics are published for fetal deaths with gestation periods of 20 weeks or more beginning with 1942. The perinatal mortality rates in this report were standardized to include only those fetal deaths of 28 or more weeks of gestation and a proportion of those with the duration of gestation unspecified.

Fetal Mortality

The computation of the fetal mortality rates is subject to the same limitations outlined above. For this report, they have all been standardized so that they are probabilities and not ratios:

$$\frac{\text{Fetal deaths of 28 or more weeks of gestation}}{\text{Live births} + \text{Fetal deaths of 28 or more weeks of gestation}} \times 1{,}000$$

Neonatal Mortality

Earlier in the century, the neonatal period was considered the first month of life. Since months have varying numbers of days from 28 to 31, in more recent years the neonatal period has been defined to include the first 4 weeks of life. The difference caused by this change in definition is small since the risk of death declines rapidly from birth throughout the first month of life. Therefore, in this report, no distinc-

tion is made between neonatal rates based on the first month or the first 28 days of life.

Neonatal mortality rates and their components (under 1 day, 1-6 days, and 7-27 days) are computed per 1,000 live births.

Postneonatal Mortality

The postneonatal rates include the remainder of the first year of life, i.e., either 1 through 11 months or 28 days through 11 months of age, depending on the definition of the neonatal period. No distinction is made between postneonatal rates based on these two time periods in this report.

Problems of definition of live birth are minimal in this period, and death registration is probably more complete in the postneonatal than the neonatal period.

Postneonatal mortality rates are computed per 1,000 live births.

RELATIVE IMPORTANCE OF DIFFERENCES

Each of the sources of difference in the basic data was considered independently by the participants at the conference held in Washington in May 1965.[18] Where estimates of their statistical effect existed, it was felt that they were not sufficiently large to account for the observed differences in mortality. In some instances where evidence was unavailable, e.g., completeness of registration, it was pointed out that internal cross-checks and the impetus of social insurance benefits favored complete registration among the west European countries.

The estimates presented here will be referred to again as the mortality data are presented. Their magnitude will be considered in the light of their relationship to the observed differences between the infant mortality experience of the United States and the other countries.

III. PERINATAL AND INFANT MORTALITY BY AGE

INFANT MORTALITY

Infant mortality has long been considered an index of the level of health of a community. High rates are associated with low socioeconomic conditions, problems of environmental health, limited medical facilities and resources and concomitant low levels of prenatal and obstetric care at delivery, and low utilization of services even in those areas in which they are available.

The seven countries included in this study shared the achievement of markedly reducing their infant mortality in this century. Even since 1935, the reductions have been significant, ranging from 55 to 72 percent during that period (fig. 3 and table 12). The period of World War II (1939-45)

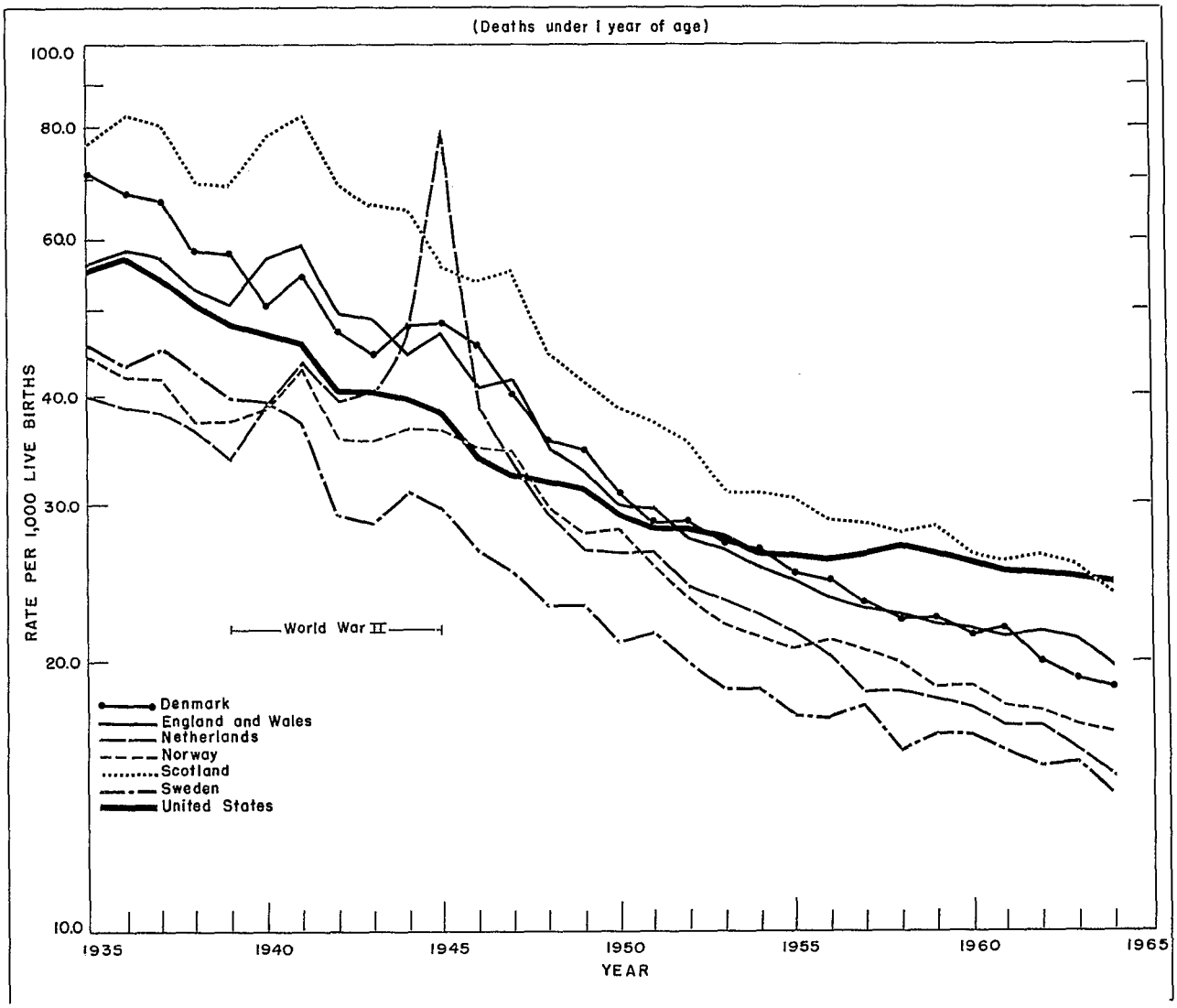


Figure 3. Infant mortality rates: selected countries, 1935-64.

Table 12. Infant mortality rates and percent reduction: selected countries, 1935, 1950, and 1962

Country	Infant mortality rate[1]			Percent reduction		
	1935	1950	1962	1935 to 1962	1935 to 1950	1950 to 1962
Denmark	71.0	30.7	20.0	72	57	35
England and Wales	56.9	29.9	21.7	62	47	27
Netherlands	40.0	26.7	17.0	57	33	36
Norway	44.2	28.2	17.7	60	36	37
Scotland	76.8	38.6	26.5	65	50	31
Sweden	45.9	21.0	15.3	67	54	27
United States	55.7	29.2	25.3	55	48	13

[1] Rates per 1,000 live births.

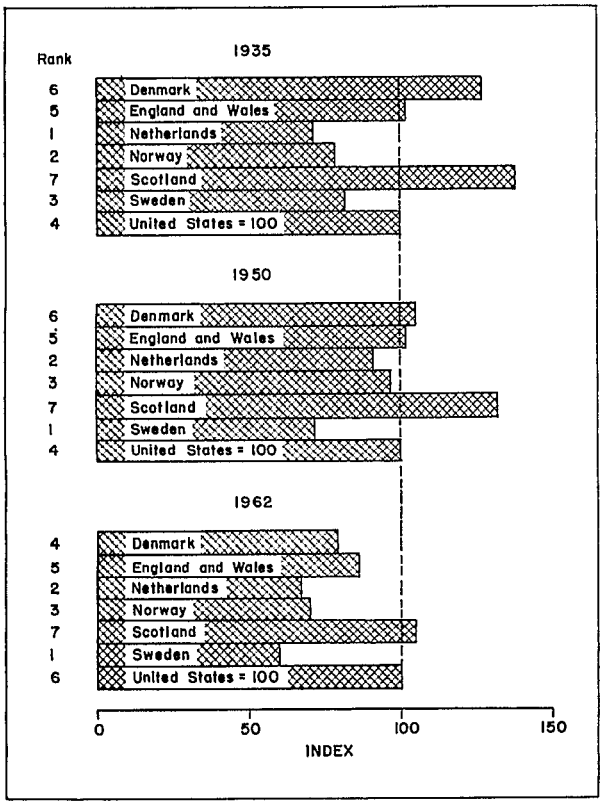


Figure 4. Ratios of infant mortality rates of selected countries to those of the United States: 1935, 1950, and 1962.

showed irregularities in the rates and the disturbance was especially notable in the Netherlands where the rate almost doubled in the year between 1944 and 1945. The following year the rate returned to its previous level.

Despite the exigencies of the depression and World War II, the rates of decline were most precipitous in the 1930's and 1940's. During this period, the United States assumed a midposition: in 1935 it ranked fourth among the seven countries, and in 1950 the rank was the same (fig. 4). Moreover, the countries which had rates lower than the United States in 1935 retained that position in 1950; this was the case with the countries with higher rates as well.

Since 1950, the relative position of the United States with regard to infant mortality has changed: it now ranks seventh among this group of countries, with a rate of 24.8 in 1964. The trend line for the United States has leveled off markedly, thus changing its relative ranking. Since 1950, the rate of decline has been less for the United States than for any of the other countries. The percent decline in the United States between 1950 and 1962 is only about one-half to one-third of the decline in the other six countries.

However, countries other than the United States are also showing evidence of a change in the trend line for infant mortality. For example,

the trend for Scotland since 1954 differs from that in earlier years, and the slope of the trend line for Norway since 1952 is less than it was in the period 1941-52. In recent years, the trend for Sweden as well seems to have leveled off. But infant mortality in Denmark, England and Wales, and the Netherlands appears to be declining steadily.

PERINATAL MORTALITY

The relative influence of specific causes of fetal and infant death varies with infant's age and the period surrounding birth is particularly hazardous. Placental and cord conditions in the fetus, and prematurity alone or in association with congenital malformations, birth injuries, postnatal asphyxia and atelectasis, or pneumonia of newborn are the leading causes of fetal and neonatal mortality. In the postneonatal period, pneumonia, congenital malformations, and accidents are the leading causes of death.

Causes of fetal and early neonatal death are closely related. The view has been expressed that in individual deliveries, it is often problematical whether a fetus will die *in utero* shortly before delivery, or whether the fetus will be born alive and succumb within the first minutes or hours after delivery. This view is allied to the concept of viability, i.e., the ability of the newborn to survive as a separate being once it has been delivered. Perinatal rates have been devised to permit consideration of fetal deaths and neonatal deaths simultaneously, and as the term is used in this report, it combines fetal deaths of 28 or more weeks' gestation and neonatal deaths under 7 days of age.

In the early 1960's as in 1942, the perinatal mortality rate of the United States was higher than those of the Scandinavian countries and the Netherlands; only England and Wales and Scotland had higher rates (fig. 5). However, for a brief period in the early 1950's, it was second lowest; only Norway claimed lower perinatal mortality rates. If the rates are ranked with the lowest rate in first position, the rank of the United States rose from fifth in 1942 to second in the early 1950's and fell back to fifth in the early 1960's. These changes were due to a temporary elevation of perinatal mortality in Denmark, the Netherlands, and Sweden in the early 1950's.

Perinatal mortality declined during the past three decades in each of the seven countries. However, for none of them has the rate of decline since 1950 equaled the decline of the earlier period. Between 1945 and 1955, there was an apparent increase in the rates for Denmark and a leveling off for England and Wales, the Netherlands, and Scotland. Since 1955, the trend for England and Wales and for Scotland has resumed a faster rate of decline. However, the rate of decline for the United States has not been similarly accelerated.

Fetal Mortality

Fetal death (or stillbirth) registration is probably less complete or accurate than the registration of infant deaths. Evidence from special studies shows that the registration of fetal deaths in parts of the United States is incomplete. From data of three such special studies, incompleteness was estimated to be 6, 11, and 14 percent for fetal deaths with gestation periods of 28 or more weeks.[11-13] Unregistered events for the country as a whole are probably somewhat higher since these estimates are based on data from three Registration Areas which are considered to have good registration systems.

Although similar estimates for the west European countries are unavailable, the registration of stillbirths in those countries was felt to be "good" by the contractors who prepared data used in this report. They pointed to the long history of registration in their countries and to cross-checks made between registered vital events and notifications made to health authorities as conducive to complete registration. Nevertheless, it was suggested that some understatement of stillbirths exists in the official statistics of Denmark, the Netherlands, and Norway, at least.

Two viewpoints were expressed on this subject at the Center's Conference on the Perinatal and Infant Mortality Problem of the United States. Since only stillbirths with gestation periods of 28 or more weeks are generally required to be registered in the west European countries, those investigators felt that registration at this period of fetal development is probably more complete than in the United States where the minimum period at which registration is generally required is 20

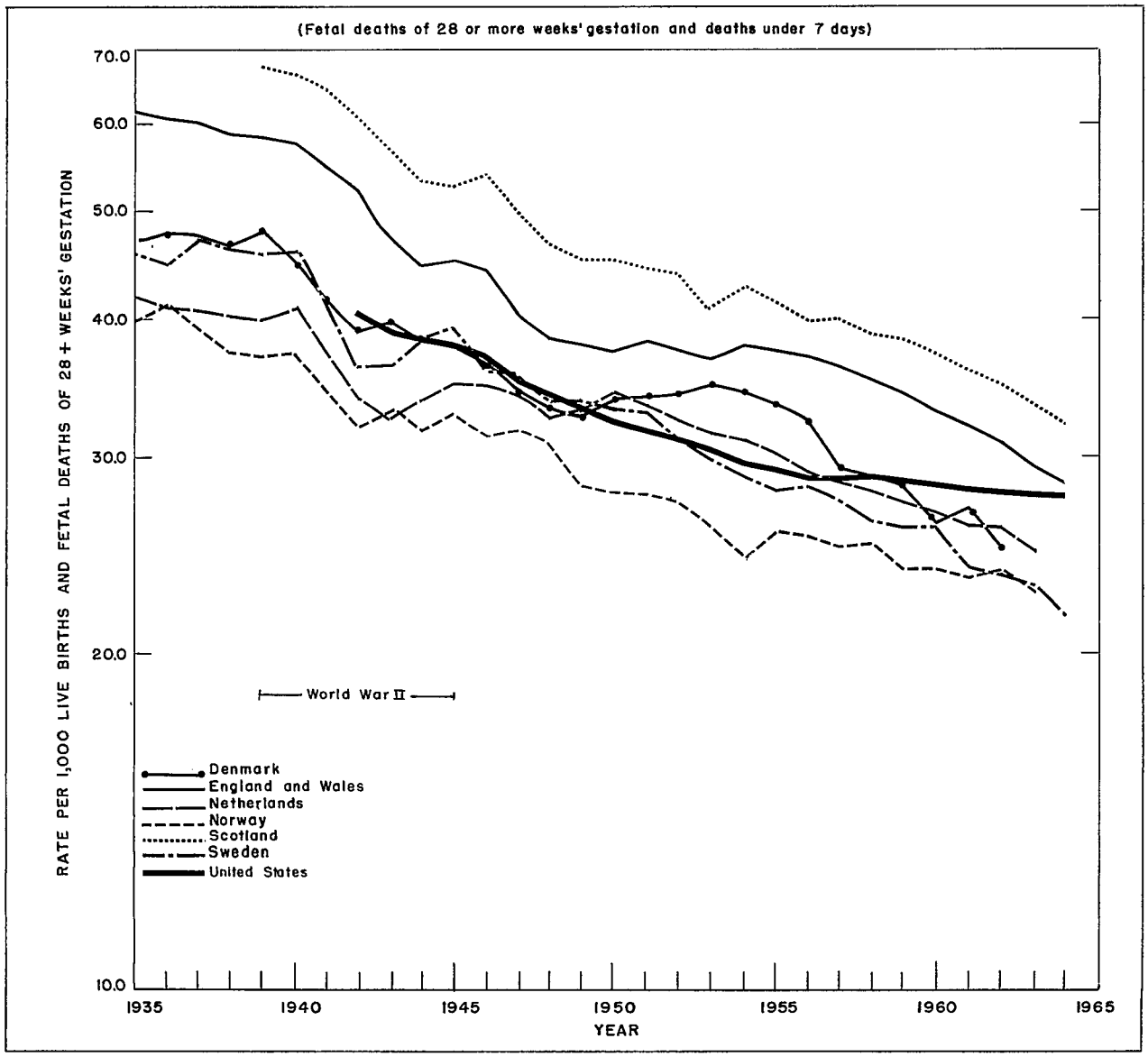


Figure 5. Perinatal mortality rates: selected countries, 1935-64.

weeks (or perhaps, 5 months), or— in some Registration Areas—regardless of the period of gestation.

On the other hand, in the United States under-registration could be estimated separately for those gestations of 20-27 weeks or 28 or more weeks for areas in which either the minimum requirement for registration was 20 weeks or no minimum period was specified and all products of conception were to be registered. The conclusion was that unregistered events increased as one approached the minimum cutoff point at which registration is required. Therefore it was hypothesized that in the gestation group of 28 or more weeks, fetal deaths would be more completely registered in the United States than stillbirths in the same period in the other countries. No firm conclusion could be reached. However, it seems

reasonable to assume that some understatement of stillbirths exists in the west European countries as well as in the United States, but its magnitude is unknown.

Fetal mortality has proceeded generally along a downward course since 1935 except in Denmark which exhibited higher fetal mortality during the years 1949 to 1956 (fig. 6A). Throughout these three decades, the highest fetal mortality was experienced in England and Wales and in Scotland. The rates for the United States were lowest through the major part of this time span (1945-63). However, since about 1956, there has been a leveling off of the trend for the United States with the result that by 1964, this country could no longer claim to have the lowest rate. In each of the other six countries, the declines between 1955 and 1963 appeared to be more precipitous than in the United States regardless of whether they were expressed in arithmetic or relative terms:

Country	Fetal mortality rate		Difference	Percent decline
	1955	1963		
Denmark	17.9	11.4	6.5	36.3
England and Wales	23.2	17.2	6.0	25.9
Netherlands	17.0	14.3	2.7	15.9
Norway	14.9	12.6	2.3	15.4
Scotland	24.6	19.1	5.5	22.4
Sweden	16.7	12.0	4.7	28.1
United States	12.6	11.3	1.3	10.3

These observations are based on recorded data, with no allowance for underregistration.

Assuming, for the moment, that no underregistration of stillbirths exists in any of the west European countries, what is the effect of the estimated underregistration in the United States? If underregistration across the country is assumed to be 15 percent throughout this period, and recorded events are increased by 12 percent to allow for this underregistration, the level of the trend line would be raised (fig. 6B). The span of consecutive years over which this country had the lowest fetal mortality would be reduced from 19 years (1945-63) to 5 years (1955-59). However, the rates would not nearly approach those for England and Wales and for Scotland. Even with an increase of 20 percent of registered events, which implies 50 percent underregistration in the United States and is highly unlikely, the rates for the United States would have remained significantly below those for England and Wales and for Scotland since 1942.

If some allowance is made for underregistration in the west European countries as well as in the United States, the relationships among the United States, England and Wales, and Scotland would be unchanged; fetal mortality in the United States would remain consistently below that of England and Wales and of Scotland since 1942. Any underregistration existing in Great Britain would only serve to increase the estimated difference between these countries and the United States. With regard to the other countries, the conclusions cannot be stated with as much confidence.

Even more difficult to assess are the differences related to definition. According to definition, registered live births in Sweden (until 1960) included only those infants who breathed, omitting those whose only sign of life was pulsation of the umbilical cord, movement of voluntary muscles, and so forth. These latter births were included in fetal deaths. Using English data for a basis, Stocks has estimated that the use of breathing alone as a criterion of live birth instead of the more encompassing definition would decrease infant deaths by 1.5 percent and increase fetal deaths by 3 percent.[7] Adjustment of the Swedish rates for this difference would not disturb the relative position of the United States.

Another factor which may be affecting fetal mortality is obstetrical care. In the United States, since World War II and more especially since 1950, there has been considerable effort to prolong gestation for those pregnancies which give indication of terminating prematurely. It has been hypothesized that this preventive care has increased the likelihood of producing a liveborn infant. Theoretically, if practice of the preventive regime were sufficiently widespread, it could result in lower overall fetal mortality rates. Existing data cannot be used to substantiate or refute this hypothesis because they reflect the combined effect of changes in legislation and improved registration, as well as the alleged effect of prolonging the period of gestation.

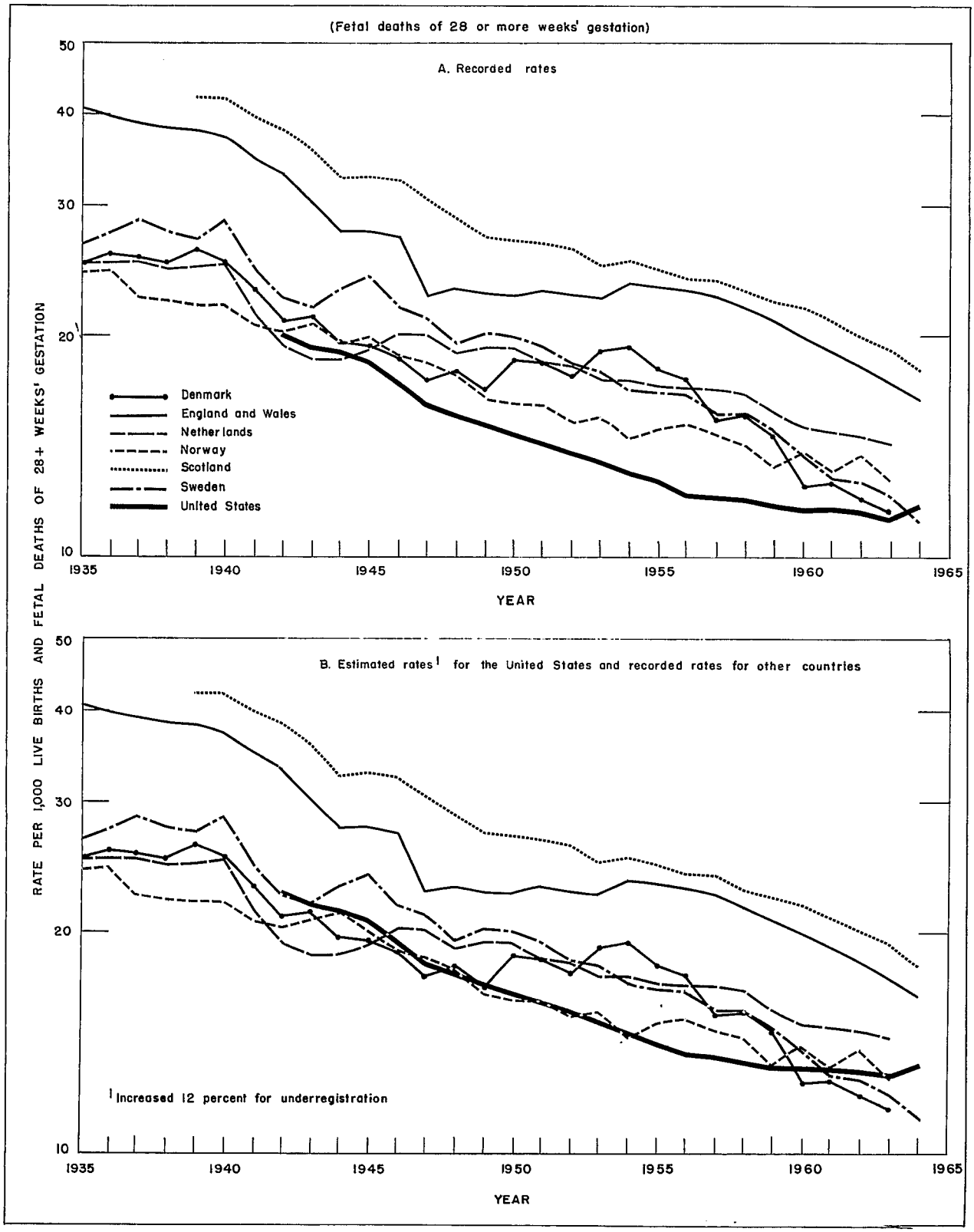


Figure 6. Fetal mortality rates: selected countries, 1935-64.

Furthermore, there is no documentation of the extent to which these preventive regimes are practiced in this or other countries, or their success or failure in improving the likelihood of live birth.

In the United States, tax advantages have also been mentioned as a possible source of faulty registration. The birth of a liveborn infant entitles the parents to an additional exemption on their income tax return in the year of birth even if the infant dies shortly after birth. If the fetus is stillborn, no such exemption applies. Thus, in instances when an infant may have either been a fetal death or survived only a few minutes, its registration as a live birth would deflate the fetal death statistics. While the plan would have advantages for the parents, it would be illegal. Furthermore, it is generally felt that physicians would not favor this practice because it would require the completion of two vital records (live birth and death) rather than one (fetal death). While there is no direct evidence to support the premise, in the Onondaga County study, no instance of faulty registration of a fetal death as a liveborn infant was found.[11]

According to available evidence and estimates from special studies, fetal mortality for the United States appears to be lower than that of the other countries. The many qualifications explored above reaffirm the need to educate medical and hospital personnel so that they will thoroughly understand the definitions and implement them to the best of their abilities.

Mortality Under 1 Day

Closely related to the problems associated with fetal mortality are those related to the period soon after birth. Early neonatal deaths (deaths in the first week of life) are not uniformly classified by the countries included in this report; Denmark, the Netherlands, and Sweden classify age at death by calendar days from date of birth, while England and Wales, Norway, Scotland, and the United States classify age by elapsed time from hour of birth. This difference has the greatest effect on death rates closest to the time of birth. For the purposes of this report, deaths in the period soon after birth are termed "early postnatal deaths" and include those on the calendar day of birth for Denmark, the Netherlands, and Sweden; and deaths within 24 hours of birth for England and Wales, Norway, Scotland, and the United States. The latter group includes deaths for a longer time span (24 full hours), while the former contains, on the average, only part of the first 24 hours of life for each live birth.

Mortality rates for the first 24 hours of life for the United States have been highest among this group of countries since 1935 (fig. 7A). When the comparison is limited to those countries which tabulated deaths in the first 24 hours of life (fig. 7B), mortality in the United States remains highest, although the difference is not so great. The rates for Scotland and the United States were proximal for a few years until 1954. Thereafter, the rates for the United States turned upward, while those for Scotland seem to have achieved a slightly lower level. The rates for England and Wales appeared to increase somewhat after 1950 but reverted to the midcentury level in 1963. The rates for Norway declined during the early 1950's, but suggest increases thereafter.

Using fetal and early postnatal mortality in combination, the earlier observations regarding the position of the United States can be reexamined. First, the problems associated with the definition of live birth are pertinent to early postnatal mortality as they were to fetal mortality. The statistical effect of various definitions would be relatively small on the denominator of live births, while the effect on fetal deaths or deaths in the first day (or first 24 hours of life) would be greater. However, if fetal deaths and early postnatal deaths are combined, the question of definition of live birth is minimized.

Second, with regard to the tabulation of early postnatal deaths, for the Netherlands van den Berg estimated that deaths occurring on the calendar day of birth should be increased by 20 percent to estimate the deaths within 24 hours of birth.[17] Using data from Indiana and North Carolina, Greenberg estimated that deaths within 24 hours of birth exceeded deaths which occur on the date of birth by about 28 percent.[18] Tabulations of actual deaths in the Netherlands (1958-59) and Norway (1949-51 and 1959-61) indicated the excess for these countries to be 37 to 40 percent, respectively (table 11). For present purposes if the deaths on the calendar day of birth for

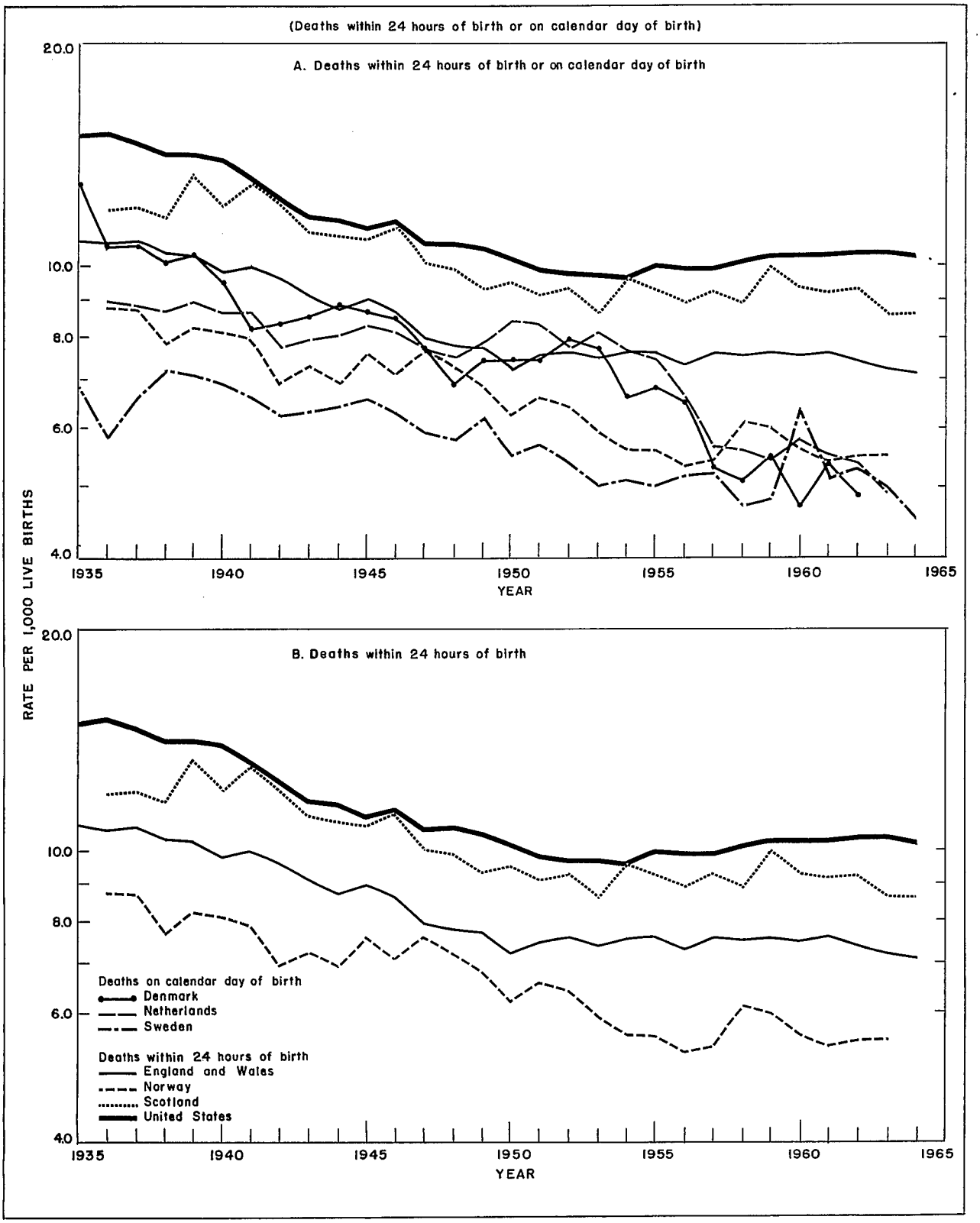


Figure 7. Early postnatal mortality rates: selected countries, 1935-64.

Denmark, the Netherlands, and Sweden are increased 40 percent, estimates of the deaths in the first 24 hours of life are made comparable to the data provided by the other countries (England and Wales, Norway, Scotland, and the United States). While this adjustment may seem high, the difference between the extremes (from 20 percent to 40 percent) of the four estimates is approximately 1.0 per 1,000 live births in the rates.

Allowance can be made for a third bias by increasing the count of fetal deaths for the United States by 12 percent for underregistration. Although it would be desirable to make adjustments for the other countries as well, estimates of the magnitude of their underregistration of fetal deaths are unavailable, and no adjustments have been made in their data for this fact. Because of the cross-checking between registered events and notifications, the adjustments should probably be smaller than that for the United States.

After these adjustments are made, the estimated combined fetal and early postnatal mortality rate for the United States (23.0 in 1962) was still considerably higher than those for the Scandinavian countries and the Netherlands, and was exceeded by those for England and Wales and for Scotland. The position of the United States relative to the other countries remained unchanged, but the range of the rates was reduced from 16.7-29.1 to 18.6-29.1 per 1,000 live births and fetal deaths:

	Registered	*Estimated*
Denmark	16.7	18.6
England and Wales	25.4	25.4
Netherlands	20.0	22.1
Norway	19.0	19.0
Scotland	29.1	29.1
Sweden	17.8	19.9
United States	21.7	23.0

These estimates present as comparable a set of statistics as can presently be devised for the period immediately surrounding birth. They avoid the discrepancies due to the definitions of live birth and fetal death. The rates have been adjusted for the estimated underregistration of fetal deaths in the United States, and for the variance in tabulation of the early postnatal deaths in Denmark, the Netherlands, and Sweden. They represent averages between fetal mortality where the United States had the lowest rates, and mortality for the first 24 hours of life where the United States had the highest rates. In this ranking, the estimated rate for the United States remains considerably higher than those for Denmark, Norway, and Sweden.

Mortality 1-6 Days

The third component of the perinatal mortality rate consists of the remainder of the first week of life. Again, it has a built-in bias due to the two methods of tabulation: deaths in terms of calendar days since birth in Denmark, the Netherlands, and Sweden; and in terms of elapsed time since birth in the other countries. The rates for Denmark, the Netherlands, and Sweden are overstatements compared with those for remaining countries (fig. 8A). Estimates of the overstatement are approximately 1.0 per 1,000 live births. If allowance is made for this difference, the mortality at this age for the United States is exceeded only by that of Denmark.

When the comparison is limited to three other countries which tabulate their deaths in the same manner as the United States, the relative position of the United States has changed since 1935 (fig. 8B). The relationship with Norway remains unchanged: throughout the three decades, the rates for Norway have been consistently lower than those of the United States. The change has been in the relationship of the rates for England and Wales, Scotland, and the United States. In the midthirties and throughout the war, the rates for the United States were lower than those for England and Wales and for Scotland. However, since 1955, the rates for England and Wales have fallen below those of the United States. In 1959, the rates for Scotland and the United States were the same. Since then, the rates for these two countries have fluctuated, merging once more in 1963 and 1964.

Components of Perinatal Mortality

Available evidence shows that the United States occupies fifth position among the study countries with regard to perinatal mortality. It appears to have some advantage in fetal mortality,

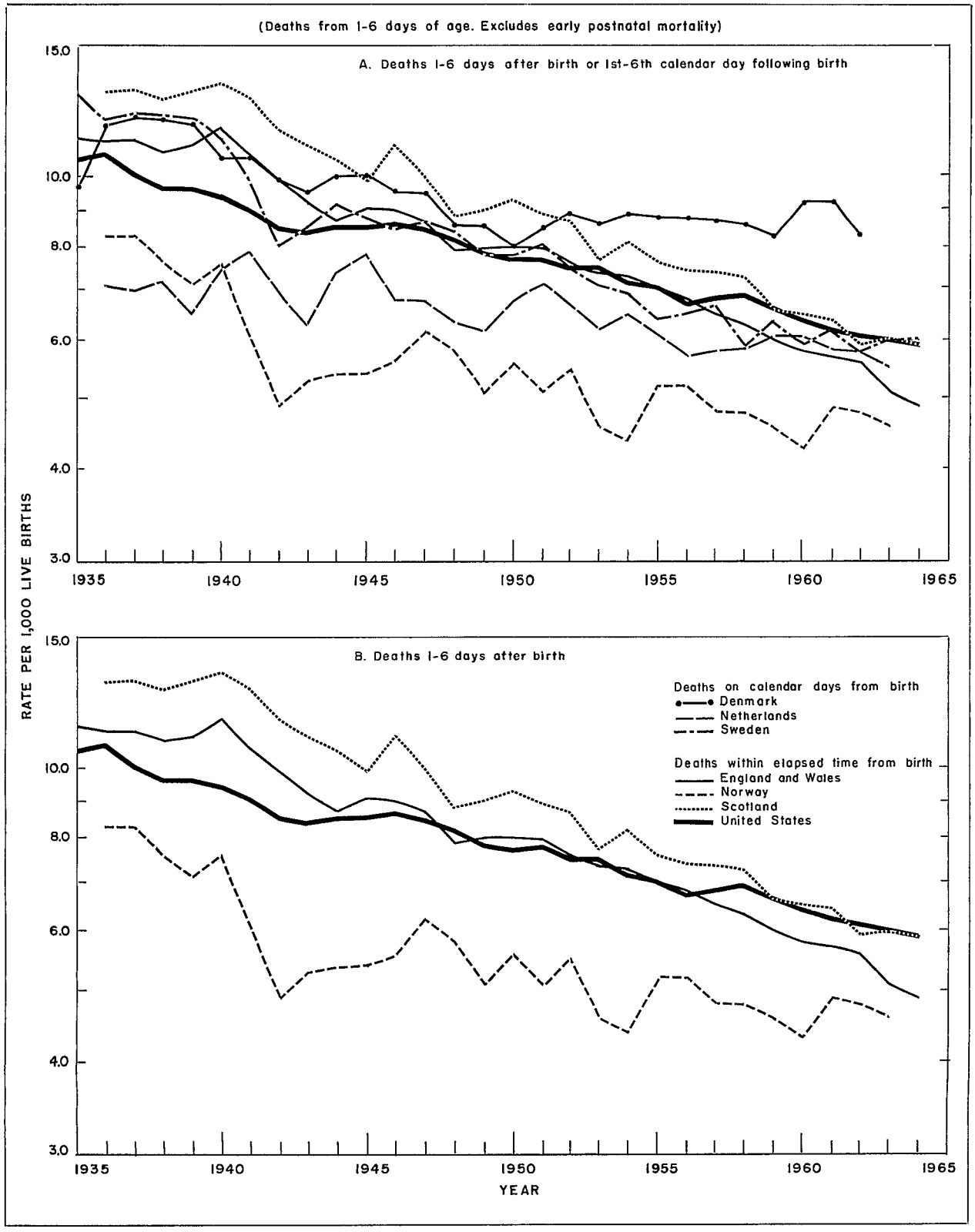


Figure 8. Early neonatal mortality rates: selected countries, 1935-64.

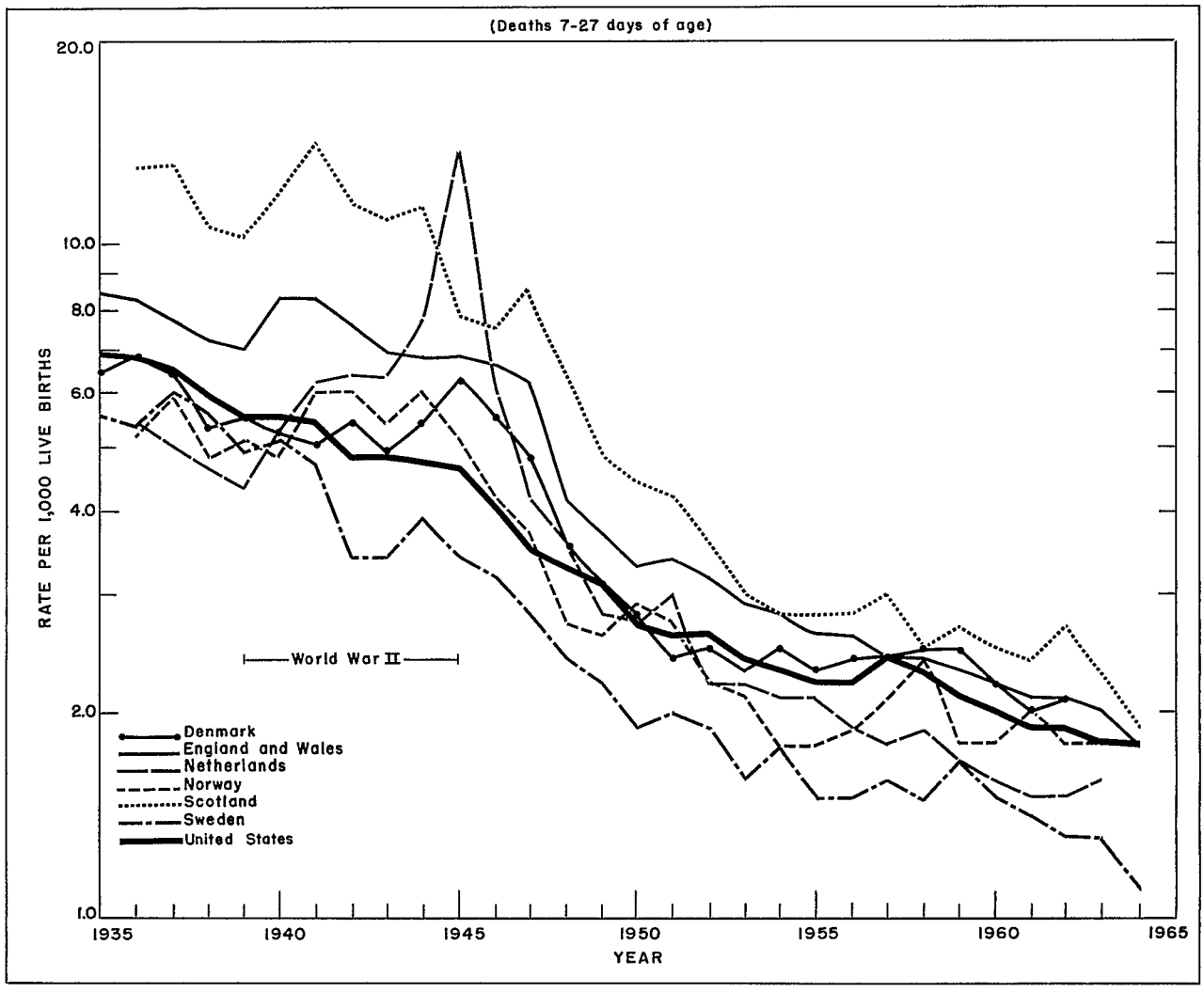


Figure 9. Late neonatal mortality rates: selected countries, 1935-64.

but this is offset by higher mortality during the first 24 hours of life and the remainder of the first week. Even the advantage in estimated fetal mortality may be somewhat illusory because the estimates of underregistration which were used are based on studies in areas with good registration. Underregistration of fetal deaths of 28 or more weeks of gestation may be higher than the estimate of 12 percent used here. In that case the differential between the United States and some of the Scandinavian countries would be eliminated, but the differential between this country and England and Wales or Scotland would not be eliminated.

MORTALITY 7-27 DAYS

Discharge from the hospital represents a significant change in the infant's life—there is a pronounced change in environment between the hospital and the home environment. The period from 7-27 days, for the most part, is spent at home by those infants who were born in hospitals as well as those who were born at home. They

are, however, still vulnerable to the effects of neonatal disorders: congenital malformations (particularly of the heart), pneumonia of newborn, postnatal asphyxia and atelectasis, and immaturity predominate among the recorded causes of death. In addition, in this age interval, accidents begin to emerge as a more frequent cause of death than in the first week of life.

Rates in the period 7-27 days are lower than those nearer birth, and the risk of death is also much lower. For example, in the United States (1959-61) the daily rate in the interval 7-27 days is about one-tenth the daily rate in the interval 1-6 days, which in turn is about one-tenth the rate in the interval under 24 hours:

Under 24 hours	1,029.9
1-6 days	106.5
7-27 days	9.6

Mortality in this age group has been somewhat erratic over the past three decades (fig. 9). During the depression of the 1930's, the rates were somewhat elevated. Thereafter, the countries which were severely bombed or were invaded in the war showed pronounced increases at some time between 1939 and 1945: Denmark, England and Wales, the Netherlands, and Norway. The unusually high mortality in the Netherlands was associated with severe food shortages just before and after the close of the war. Scotland which was closely affected by the events in England also showed increases. Only Sweden and the United States continued to have generally declining mortality in this age interval during the war.

Beginning with 1950, there appeared to be a definite change in trend for a number of countries. For all of them, the rate of decline since 1950 is not comparable with that of the preceding years, although the point of inflection occurs in different years. The change appears to have occurred around 1950 for Denmark, England and Wales, and the United States, and a few years later in Norway and Scotland. The change in trend for the Netherlands is, at present, inconclusive.

The relative position of the United States has changed during these three decades. In the 1930's, it occupied fourth or fifth position. The Scandinavian countries and the Netherlands seem to have had somewhat better records. During the 1940's, because of increased mortality in a number of countries, only Sweden had lower mortality than the United States for these infants. However, except for Denmark, since 1950 the countries have generally resumed the relative ranks they held in the thirties. Sweden has occupied the prime position since 1941.

POSTNEONATAL MORTALITY

In the postneonatal period, pneumonia and congenital malformations continue to be leading causes of death. Malformations of the heart are predominant among the malformations as they were in the interval 7-27 days. Accidents and diseases of the digestive system also rank high. Other important causes of neonatal mortality such as postnatal asphyxia and atelectasis and immaturity are less important.

There are many similarities between the trends in this and the preceding age interval (fig. 10). The effects of the depression and the ensuing war are similar. The pronounced peak in the Netherlands in 1945 is again evident. The trend for the United States made a decided change between 1945 and 1950. From a pattern of rapid decline, it shifted to an increase in 1948 and 1949, with relatively little decline thereafter. While the rate declined by 9.4 per 1,000 in the 10-year interval between 1935 and 1945, it declined only 1.4 per 1,000 between 1950 and 1960.

The United States has dropped from second best among this group of countries in the years 1941-51 to sixth place in the years 1958-64. The rates for other countries such as Denmark, the Netherlands, and Norway are declining at so rapid a pace that they have overtaken and bypassed the United States. The rates of decline for Denmark, the Netherlands, Norway, and Sweden are about equal although the relative positions of the trend lines differ. England and Wales was also proceeding at a similar pace until the midfifties when a decided change in trend took place. This change is reminiscent of that in the United States about 5 years earlier.

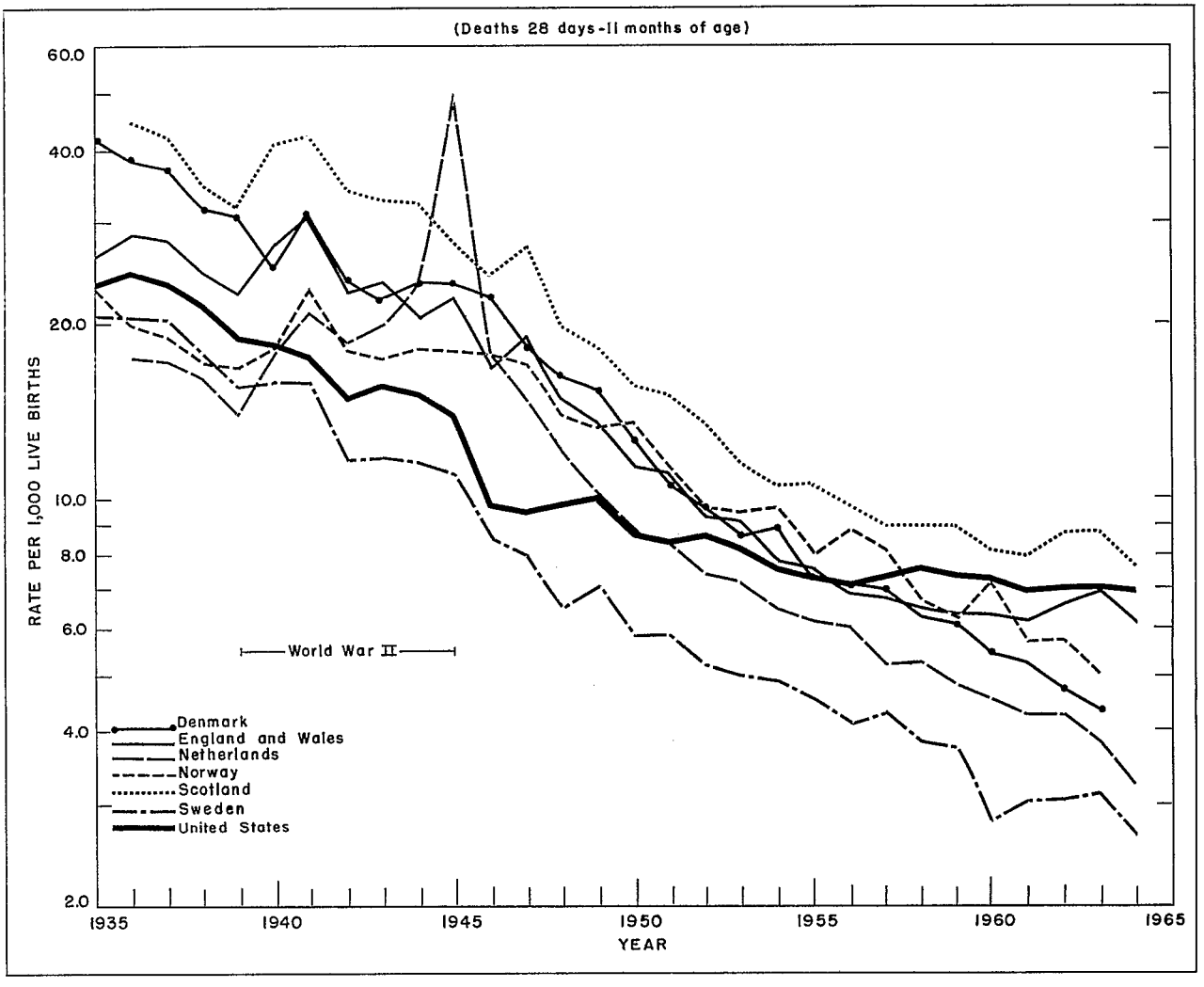


Figure 10. Postneonatal mortality rates: selected countries, 1935-64.

SUMMARY

Perinatal mortality (fetal deaths of 28 or more weeks' gestation and deaths under 7 days) declined during the past several decades in each of the countries included in this report. For each of them, the rate of decline since 1950 has been slower than for the earlier period. In recent years, all except Norway show evidence of declining more rapidly than the United States.

In the United States, during the decade 1949-51 to 1959-61, gains were made in reducing perinatal mortality despite the deceleration in the rate of decline (table 13). Perinatal mortality declined 13 percent and sizable reductions were observed in its components with one exception, namely, mortality under 24 hours of age. The salient point is that mortality for this age interval *increased* 2 percent while mortality for all of the other components *decreased* 17-29 percent.

Table 13. Infant and perinatal mortality rates, change in rates, and percent change, by age at death: United States, 1949-51 to 1959-61

Component	Rate		Change in rate (1949-51 to 1959-61)	Percent change (1949-51 to 1959-61)
	1949-51	1959-61		
Infant deaths (under 1 year)[1]	29.6	25.9	-3.7	-12.5
Perinatal deaths[2]	32.2	28.1	-4.1	-12.7
Fetal deaths[2]	14.6	11.6	-3.0	-20.5
Under 24 hours[1]	10.1	10.3	+0.2	+2.0
1-6 days[1]	7.7	6.4	-1.3	-16.9
7-27 days[1]	2.8	2.0	-0.8	-28.6
28 days-11 months[1]	9.0	7.2	-1.8	-20.0

[1]Rates per 1,000 live births.

[2]Rates per 1,000 live births and fetal deaths 28 weeks and over and a proportion of those with gestation not stated.

In the United States, most registered fetal and infant deaths occur in hospitals. This circumstance increases their research potential. In 1963, 95 percent of registered fetal deaths occurred in hospitals and other institutions. Furthermore, since 97 percent of live births occur in institutions, a high proportion of deaths in the first 24 hours of life must also occur in these settings. After the first week of life, death often occurs outside hospitals (40.6 percent in 1958). Nevertheless research is needed on this group as well because of the leveling off of the mortality trends for infants 7-27 days and 28 days-11 months of age.

IV. INFANT MORTALITY BY CAUSE

In addition to data on mortality by age, each of the contract investigators provided tabulations of infant deaths by cause of death. Standard tabulations for the west European countries were derived from basic data prepared by contractors or, in a few instances, data derived from official publications. The tabulations are presented using the World Health Organization International Statistical Classification of Diseases, Injuries, and Causes of Death (ICD). During the years 1950-64, the sixth and seventh revisions of this classification were in use in the United States and the changes between them were relatively minor. Furthermore, because the period since 1950 is the primary focus of attention, data by cause of death are limited to that period.

Certain limitations of the data are worthy of further comment. At the Center's Conference on the Perinatal and Infant Mortality Problem of the United States, it was pointed out that recorded causes of fetal and neonatal death are regarded with caution in the Netherlands.[18] Similar reservations are held in the United States, although larger proportions of registered fetal and early neonatal deaths occur in hospitals in this country. It is recognized that within countries as well as between countries, there are certain customs of reporting causes of death. Use of the term "respiratory distress syndrome" in the United States is one such example. Nosologists at the National Center for Health Statistics have noted increasing use of this term on death certificates, and statisticians face the ensuing problem of trying to determine whether this represents a true increase in the disease or a terminological vogue. Superimposed on trends of this kind within one country are international differences in usage of terms. To some extent, the effect of such practices can be minimized by grouping causes which may be reported differently, e.g., influenza and pneumonia, including pneumonia of newborn.

A further limitation of the data is related to statistical practices in the Netherlands. During the period covered by these trends, the practice in that country was to exclude from their live birth as well as infant death statistics all deaths among infants with gestations of less than 28 weeks which occurred before registration. In the previous section on mortality by age, this omission has been rectified, but in the data by cause, the deaths are deficient by that number. The effect of this deficiency is, of course, greater on neonatal deaths than on the infant deaths, while the effect on postneonatal deaths is probably negligible. In some instances, this omission may account for abnormally low rates for certain cause groups for the Netherlands, particularly those groups where the toll is highest soon after birth. For this reason, in comparisons with other countries the neonatal trends by cause for the Netherlands should be disregarded or regarded with caution.

A major gap in mortality data for the United States, and one which precludes international comparisons, is the unavailability of national statistics on fetal deaths by cause. This information is tabulated by a number of States and the results suggest that between 20 and 50 percent of fetal deaths with gestations of 20 or more weeks are certified as dying of ill-defined or unspecified causes. Much improvement is needed in certifying causes of fetal death before they will be generally useful. In any event, since the United States does not tabulate data by causes of fetal death, these deaths are omitted in the following comparison.

LEADING CAUSES OF DEATH 1959-61

Infant deaths in the United States are largely concentrated in five groups which account for almost three-fourths of all infant deaths (table 14). These five groups include postnatal asphyxia and atelectasis, immaturity, congenital malformations, influenza and pneumonia, and the residual category of diseases of early infancy. Yet, even among these categories, there are hidden associations which are not obvious from the statistics. The thread of prematurity and/or immaturity runs through a number of these causes.

The seven countries fall into two distinct groups with regard to influenza and pneumonia:

Table 14. Percentage distribution of infant, neonatal, and postneonatal deaths by cause of death: selected countries, 1959-61

Cause of death	Denmark	England and Wales	Netherlands	Norway	Scotland	Sweden	United States
Infant deaths	Percentage distribution						
All causes	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Infective and parasitic diseases (001-138)	1.3	1.1	1.0	1.8	1.2	0.7	1.3
Influenza and pneumonia, including pneumonia of newborn (480-493,763)	6.5	13.8	6.8	10.5	13.2	5.0	12.0
All other diseases of respiratory system (470-475,500-527)	1.8	2.7	0.8	1.4	1.7	1.0	2.4
Gastritis, duodenitis, enteritis, and colitis, including diarrhea of newborn (543,571,572,764)	2.0	2.0	0.9	2.0	3.0	1.2	2.7
All other diseases of digestive system (530-542,544-570,573-587)	1.2	2.0	1.7	2.0	1.5	2.1	1.5
Congenital malformations (750-759)	20.4	20.6	26.5	17.9	20.2	21.0	14.1
Birth injuries (760,761)	11.8	11.2	19.7	11.1	10.1	15.4	9.2
Postnatal asphyxia and atelectasis (762)	22.0	15.7	7.9	10.4	20.1	20.4	17.6
Hemolytic disease of newborn (erythroblastosis) (770)	2.0	2.1	2.6	1.5	1.9	1.5	1.9
Immaturity, unqualified (776)	11.9	16.8	11.6	19.5	13.4	17.7	17.5
All other diseases of early infancy (765-769,771-774)	12.1	5.6	8.8	7.3	4.4	8.6	10.6
Symptoms and ill-defined conditions (780-793,795)	1.7	0.2	3.9	7.5	1.3	0.1	2.2
Accidents (E800-E962)	1.7	2.7	2.1	2.1	5.0	1.2	3.4
All other causes (Residual)	3.5	3.7	5.8	5.1	3.0	4.0	3.5
Neonatal deaths							
All causes	[1]100.0	100.0	100.0	100.0	100.0	100.0	100.0
Infective and parasitic diseases (001-138)	0.4	0.1	0.1	0.0	0.0	0.2	0.3
Influenza and pneumonia, including pneumonia of newborn (480-493,763)	1.5	6.0	4.6	4.2	4.9	2.2	4.6
All other diseases of respiratory system (470-475,500-527)	---	0.4	0.1	0.1	0.1	0.1	0.4
Gastritis, duodenitis, enteritis, and colitis, including diarrhea of newborn (543,571,572,764)	0.4	0.4	0.2	0.3	0.8	0.3	0.6
All other diseases of digestive system (530-542,544-570,573-587)	0.8	1.4	1.3	1.4	1.0	1.5	1.3
Congenital malformations (750-759)	15.9	18.3	21.7	15.2	19.3	16.3	12.7
Birth injuries (760,761)	15.9	15.6	27.0	16.8	14.7	19.0	12.8
Postnatal asphyxia and atelectasis (762)	29.4	21.8	10.8	15.4	28.9	24.9	24.1
Hemolytic disease of newborn (erythroblastosis) (770)	2.6	2.9	3.5	2.1	2.7	1.8	2.7
Immaturity, unqualified (776)	---	23.4	15.9	29.1	19.4	21.8	24.1
All other diseases of early infancy (765-769,771-774)	---	7.4	9.6	9.8	5.9	10.1	13.3
Symptoms and ill-defined conditions (780-793,795)	0.4	0.1	2.5	4.6	0.2	-	1.3
Accidents (E800-E962)	0.2	0.8	0.4	0.2	1.0	0.2	0.7
All other causes (Residual)	---	1.3	2.1	0.9	1.2	1.8	1.3
Postneonatal deaths							
All causes	[1]100.0	100.0	100.0	100.0	100.0	100.0	100.0
Infective and parasitic diseases (001-138)	3.9	3.4	3.2	5.1	3.8	3.0	4.1
Influenza and pneumonia, including pneumonia of newborn (480-493,763)	21.0	33.3	12.3	22.5	31.5	16.7	31.2
All other diseases of respiratory system (470-475,500-527)	---	8.3	2.4	3.8	5.2	4.5	7.6
Gastritis, duodenitis, enteritis, and colitis, including diarrhea of newborn (543,571,572,764)	6.3	6.1	2.8	5.2	8.0	5.2	8.1
All other diseases of digestive system (530-542,544-570,573-587)	2.3	3.4	2.5	3.0	2.7	4.6	2.0
Congenital malformations (750-759)	33.3	26.6	38.9	23.3	22.1	40.5	17.5
Birth injuries (760,761)	0.2	0.0	0.7	0.3	0.0	0.5	0.1
Postnatal asphyxia and atelectasis (762)	1.0	0.5	0.3	0.8	0.4	1.6	0.9
Hemolytic disease of newborn (erythroblastosis) (770)	0.4	0.1	0.3	0.4	0.1	0.2	0.1
Immaturity, unqualified (776)	---	0.2	0.3	1.2	0.1	0.7	0.4
All other diseases of early infancy (765-769,771-774)	---	1.0	6.4	2.6	1.2	2.5	3.6
Symptoms and ill-defined conditions (780-793,795)	5.2	0.2	7.6	13.0	3.8	0.4	4.7
Accidents (E800-E962)	5.8	7.5	6.7	5.7	13.9	5.6	10.3
All other causes (Residual)	---	9.4	15.5	13.1	7.0	13.9	9.3

[1] Figures do not add to total because data for each cause group are not available for Denmark.

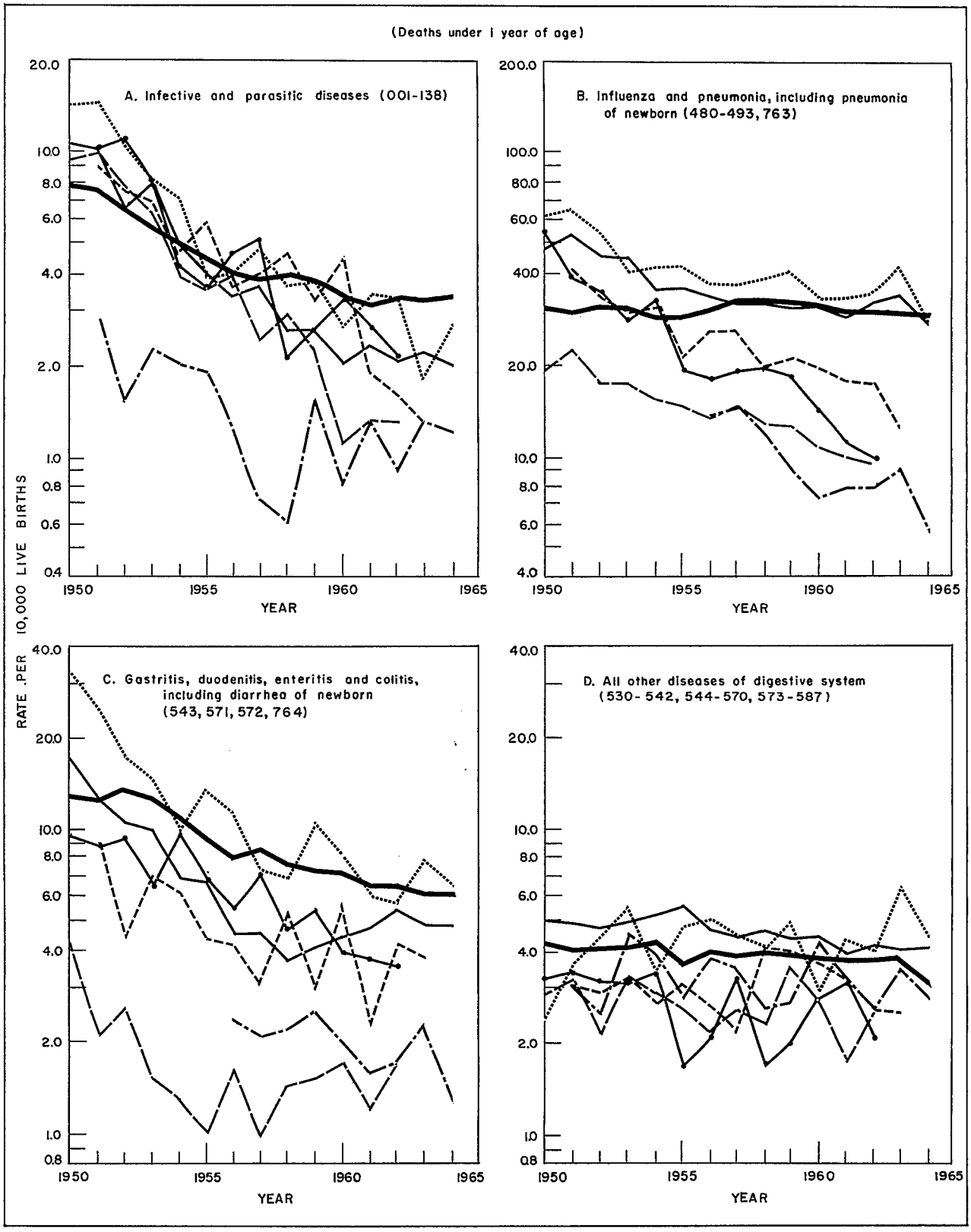


Figure 11. Infant mortality rates by cause: selected countries, 1950-64.

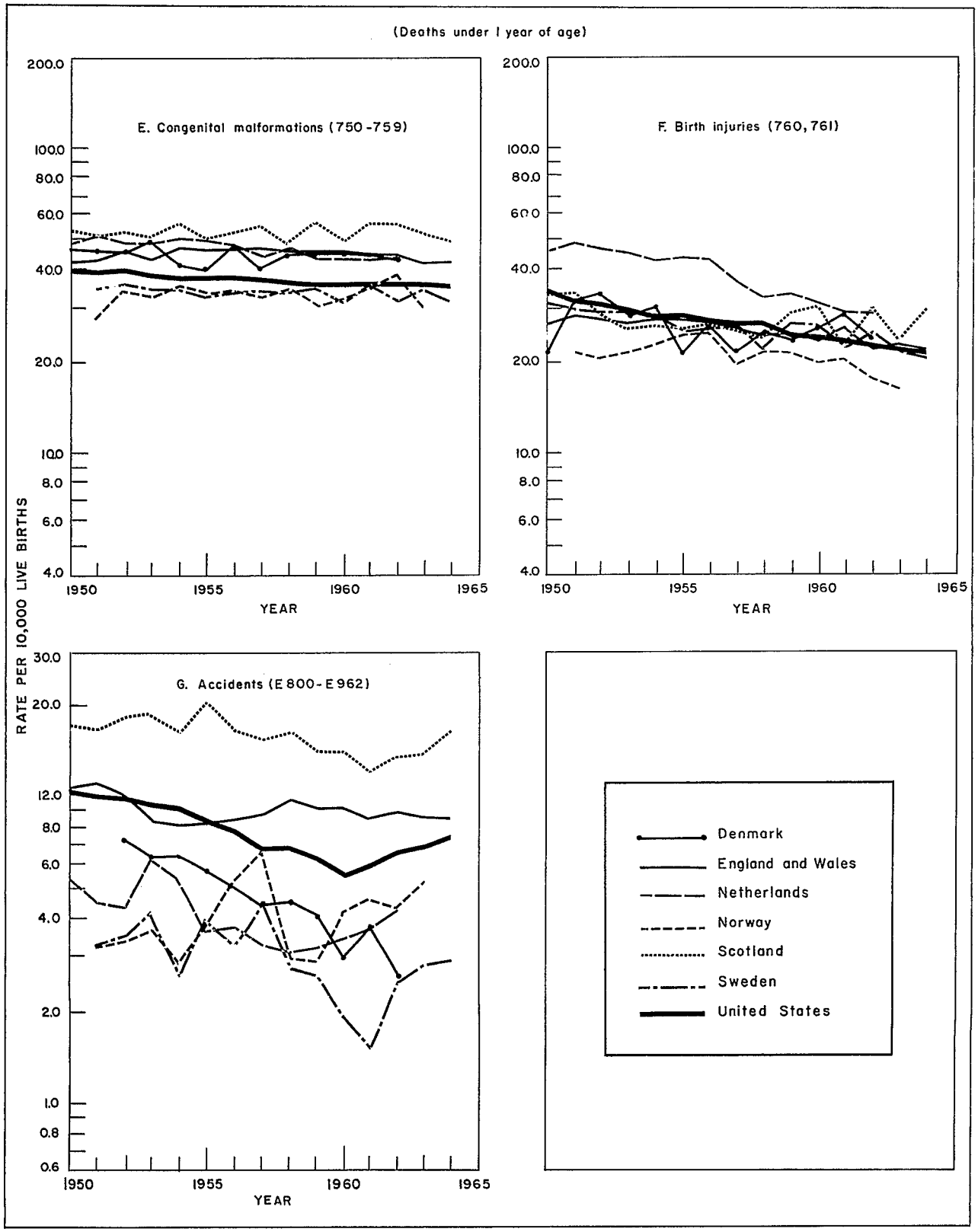


Figure 11. Infant mortality rates by cause: selected countries, 1950-64—Con.

between 5.0 and 6.8 percent of infant deaths in Denmark, the Netherlands, and Sweden are attributed to these causes while for England and Wales, Scotland, and the United States about twice the proportion of deaths are concentrated here (12.0-13.8 percent). These infectious respiratory diseases are apparently still a problem in the United States and the magnitude of their effect is not demonstrated in these data. In addition to the number of instances in which influenza or pneumonia is identified as the underlying cause of death, they appear frequently as contributory causes as well.[19] In contrast to the respiratory diseases, lower concentrations of infant deaths attributed to congenital malformations and birth injuries were recorded in the United States than in the Netherlands or Sweden.

In the neonatal period, deaths are even more concentrated by cause: five cause groups account for almost 90 percent of the deaths in the United States during this period. Among neonates, the influence of prematurity or immaturity affects many of the causes. The strong association of postnatal asphyxia and atelectasis, birth injuries, and congenital malformations with low birth weight has been demonstrated.[20] In early 1950, neonatal mortality from these causes among infants weighing 2,500 grams or less at birth was many times the mortality among heavier infants. Overall mortality among low birth weight infants was about 20 times the mortality among infants of heavier birth weight. In the neonatal period, the adverse effects of prematurity or immaturity are especially pronounced.

In the postneonatal period, the majority of deaths are more widely distributed among the various causes. Deaths attributed to influenza and pneumonia, congenital malformations, and accidents account for the majority of postneonatal deaths. The distributions show the United States to be among the countries with high concentrations of deaths due to diseases of the respiratory and digestive systems and to accidents. In this period as well as in the neonatal period, the statistics conceal a number of hidden factors. It has been suggested that deaths due to accidents include a number which are not truly accidental suffocation but which are due to a fulminating infection or to an allergic reaction.

INFANT MORTALITY BY CAUSE, 1950-64

Taken together, postnatal asphyxia, atelectasis, and immaturity contributed 35.1 percent to infant mortality in the United States. Numerically these are important causes of death but because of the nonspecificity of the diagnoses, little can be learned from them. Postnatal asphyxia and atelectasis are associated with prematurity, and the rates for the United States are high among this group of countries for these causes and for immaturity as well.

In the United States, deaths due to congenital malformations contributed 14.1 percent of the infant deaths in 1959-61. This is an important cause of death in the first year of life. The constancy and narrow range of the trends for each country are notable (fig. 11E). These trends may depict estimates of the irreducible minimum of infant mortality with the application of past knowledge. However, even this level of mortality may be amenable to further reduction in the future upon application of the results of present intensive research in genetics and drugs.

Influenza and pneumonia were also major contributors to infant mortality in this country; in 1959-61, 12.0 percent of infant deaths were attributed to these causes. The pneumonias constitute by far the major proportion of these diseases of the respiratory system—as much as 97 percent in the United States in 1963. Trend lines for the three Scandinavian countries and the Netherlands strongly suggest decreasing trends, while those for England and Wales, Scotland, and the United States do not (fig. 11B). The trend for the United States appears to have been almost horizontal since 1950. In England and Wales, mortality appears to have declined until about 1957, when it apparently leveled off. A similar change appears to have occurred in Scotland around 1953. Since 1957, the rates for England and Wales, Scotland, and the United States have been about double or triple those of Denmark, the Netherlands, and Sweden. Because of the high level of these rates, mortality from influenza and pneumonia greatly affects the overall mortality trends. Other diseases of the respiratory system contribute an additional 2.4 percent to infant mortality.

Other major contributors to infant mortality were birth injuries which accounted for 9.2 percent of infant deaths in this country in 1959-61. Trends for this group have been generally downward (fig. 11F). The rate of decline for the United States appears less rapid than those of the Netherlands or Scotland, but more so than the other countries.

The remaining causes are relatively less important numerically. In the first year of life, accidents caused 3.4 percent of deaths. Except for Scotland, the rates for this country have been higher than for any of the other countries since 1956 (fig. 11G). Since 1961, the rates for the United States have been relatively stable, while those for England and Wales and for Scotland have increased. This cause group includes deaths due to accidental mechanical suffocation in bed and cradle (sometimes called "crib deaths" or "cot deaths"). Some investigators believe these data to be inflated with deaths due to some cause other than accidental. While the magnitude of the "misdiagnosis" is unknown, at most it cannot be more than the total of deaths due to accidental mechanical suffocation.

Other deaths are distributed among a number of diagnostic categories. With regard to infective and parasitic diseases, the general trend for each of the countries between 1950 and 1963 is downward (fig. 11A). These causes contributed only 1.3 percent to infant mortality in the United States around 1960. At the same time, inflammatory gastrointestinal diseases contributed 2.7 percent to infant deaths. Although the trend for these gastrointestinal diseases is downward in this country, the rates are approximately three times those of the Netherlands and Sweden (fig. 11C). Mortality from other diseases of the digestive system is relatively less important than those mentioned above, contributing only 1.5 percent to infant mortality (fig. 11D).

NEONATAL MORTALITY BY CAUSE 1950-64

There is a marked difference between the proportionate distributions of deaths in the neonatal and postneonatal periods (table 14). For example, while influenza and pneumonia account for only 4.6 percent of neonatal deaths, they account for 31.2 percent of postneonatal deaths. Similarly, accidents, which cause less than 1 percent of neonatal deaths, are responsible for 10.3 percent of postneonatal deaths.

At the Center's Conference on the Perinatal and Infant Mortality Problem of the United States, there was considerable discussion of the reliability of the recorded causes of neonatal death. There are serious problems of diagnosis which are impossible to resolve in the absence of autopsy, and which may not be completely resolved even with autopsy. The recording of causes of early neonatal deaths, particularly, is reminiscent of that for causes of adult deaths of several decades ago when "high fever" was not uncommon as a recorded cause of death. Despite such crude beginnings, the identification of a number of health problems and, eventually, greater specificity in recorded causes of death ensued. Similar progressive development is needed with regard to causes of fetal and neonatal deaths.

The patterns of childbirth and neonatal care in the United States theoretically provide a climate for obtaining good cause-of-death information. Most births (96 percent in 1958) occur in institutions (general hospitals, maternity hospitals, and other hospitals and institutions). In the same year, the major portion of neonatal deaths (94 percent) also occurred in institutions (table 15). When the five cause groups with the highest proportions of neonatal deaths were combined, they accounted for 86.3 percent of deaths in that age period. Over 95 percent of the deaths in each of these five groups occurred in institutions—their combined rate was 96.5 percent. Thus, by far the major portion of neonatal deaths in this country occur in situations which are conducive to obtaining the best available diagnostic information.

Yet, causes of neonatal death are not recorded with great specificity in the United States—in 1958, almost one-fifth of recorded neonatal deaths were allocated to "Immaturity, unqualified" because of the lack of more specific information on death certificates. The high proportion of certificates with nonspecific causes may be indicative of incomplete recording of the cause-of-death information or of a genuine lack of knowledge among the medical profession regarding the causes of

Table 15. Percentage distribution and percent of deaths occurring in institutions in the neonatal and postneonatal periods, by cause of death: United States, 1958

Cause of death	Percentage distribution of deaths		Percent of deaths in institutions	
	Neonatal	Post-neonatal	Neonatal	Post-neonatal
All causes	100.0	100.0	94.0	52.9
Infective and parasitic diseases (001-138)	0.3	4.5	77.3	67.3
Influenza and pneumonia, including pneumonia of newborn (480-493, 763)	4.8	30.9	78.0	42.3
All other diseases of respiratory system (470-475, 500-527)	0.4	7.6	66.2	33.9
Gastritis, duodenitis, enteritis, and colitis, including diarrhea of newborn (543, 571, 572, 764)	0.7	8.3	80.8	72.2
All other diseases of digestive system (530-542, 544-570, 573-587)	1.2	2.1	97.1	84.9
Congenital malformations (750-759)	12.5	16.7	95.8	79.0
Birth injuries (760, 761)	13.6	0.1	97.0	64.5
Postnatal asphyxia and atelectasis (762)	24.6	1.0	97.5	59.9
Hemolytic disease of newborn (erythroblastosis) (770)	2.9	0.1	97.8	53.6
Immaturity, unqualified (776)	24.3	0.5	95.7	64.9
All other diseases of early infancy (765-769, 771-774)	11.5	3.7	95.9	59.7
Symptoms and ill-defined conditions (780-793, 795)	1.4	5.1	36.6	13.1
Accidents (E800-E962)	0.8	10.3	45.5	24.4
All other causes (Residual)	1.3	9.0	87.3	75.1

death. The answer to this problem can be obtained through further questioning of physicians, who certify causes of death, and nurses and medical librarians, who sometimes cooperate in entering the medical certification on death certificates for the doctor's review and signature.

When this point of accuracy of information is pursued one step further, one observes that the proportion of autopsies among neonatal deaths is not very high. ICD categories 760-776 (Certain diseases of early infancy) accounted for 82 percent of neonatal deaths in 1958. For the same year, about one-fourth of all certificates allocated to these same causes did not indicate autopsy status. Among the remaining certificates containing the information, there was an autopsy rate of only 44 percent. These shortcomings strongly suggest that the information on causes of death would be amenable to improvement with additional autopsies. Nevertheless, it would be unrealistic to expect diagnostic information on all neonatal deaths for pathologists point out that the true causes of some neonatal deaths are unknown despite the best pathological evaluation.

As was pointed out earlier, the international comparisons presented here are further com-

plicated by differences in use of terms over time and between countries. This is truly one of the unexplored areas in fetal, neonatal, and infant mortality statistics. The following comments on neonatal mortality are limited to a few trends which seem to show consistent interrelationships. Trends have been disregarded for the Netherlands, as the rates are probably too low because of the omission of deaths which occurred prior to registration.

The largest single group among neonatal deaths, postnatal asphyxia and atelectasis, included 24.1 percent of all neonatal deaths in the United States in 1959-61. Among the countries included in figure 12B, Denmark, Scotland, and the United States present the highest rates.

Second in order of magnitude among causes of neonatal mortality in the United States is the residual category "All other diseases peculiar to early infancy." These deaths accounted for 13.3 percent of neonatal deaths around 1960. The trend for the United States is diametrically opposite to those of Norway and Scotland (fig. 12D). In the United States, the increase is recognized to be associated with more frequent recording of terms such as "hyaline membrane disease" or "respiratory distress syndrome" on death certificates. Internationally, there may also be some difficulties between this group and postnatal asphyxia and atelectasis, based on choice of terms used by the certifiers. The classification of a given death depends on the terms used by the physician. If he enters the term "atelectasis" on the certificate, the death is included in "Postnatal asphyxia and atelectasis"; if he uses the term "respiratory distress syndrome," the death is included among the residual group "All other diseases of early infancy."

The rates for the United States are high for both postnatal asphyxia and atelectasis, and all other diseases of early infancy (table 16). Moreover, the association of these groups with prematurity has also been mentioned, and for the group "Immaturity, unqualified," as well, the rate for the United States is highest. Disregarding the Netherlands whose rate is artificially deflated, when these three cause groups are combined, the rate for the United States is considerably higher than that of Norway or Sweden and it remains the highest of this group of countries:

	Neonatal mortality per 100,000 live births
Denmark	989.2
England and Wales	819.0
Netherlands	426.4
Norway	658.3
Scotland	1,003.3
Sweden	747.4
United States	1,150.3

The causes in this combined category are composed largely of nonspecific causes and symptoms rather than etiologic causes: immaturity, postnatal asphyxia and atelectasis, and the category "All other diseases of early infancy" which is composed largely of respiratory distress syndrome. Together, these causes represent almost two-thirds of all neonatal deaths in the United States. The relative position of the United States would remain unchanged even if all deaths allocated to symptoms and ill-defined causes were added to these groups as well, i.e., this country would still maintain the highest neonatal mortality. Deaths from symptoms and ill-defined causes accounted for only 1.3 percent of neonatal deaths in the United States; smaller proportions in Denmark, England and Wales, Scotland, and Sweden; and higher proportions in the Netherlands (2.5 percent) and Norway (4.6 percent).

Congenital malformations and birth injuries are also major causes of neonatal mortality. In the United States, they contributed 12.7 and 12.8 percent, respectively—over one-fourth of all neonatal deaths. Despite their numeric importance, the general trend in neonatal mortality from these causes was downward for this country.

Influenza and pneumonia occupy a lesser role in the neonatal period (4.6 percent). This cause group consisted almost exclusively of pneumonia of newborn (99 percent). The rates of the Scandinavian countries range between 2 and 5 per 10,000 live births, substantially below that of the United States (fig. 12A). The rates for England and Wales, Scotland, and the United States are consistently

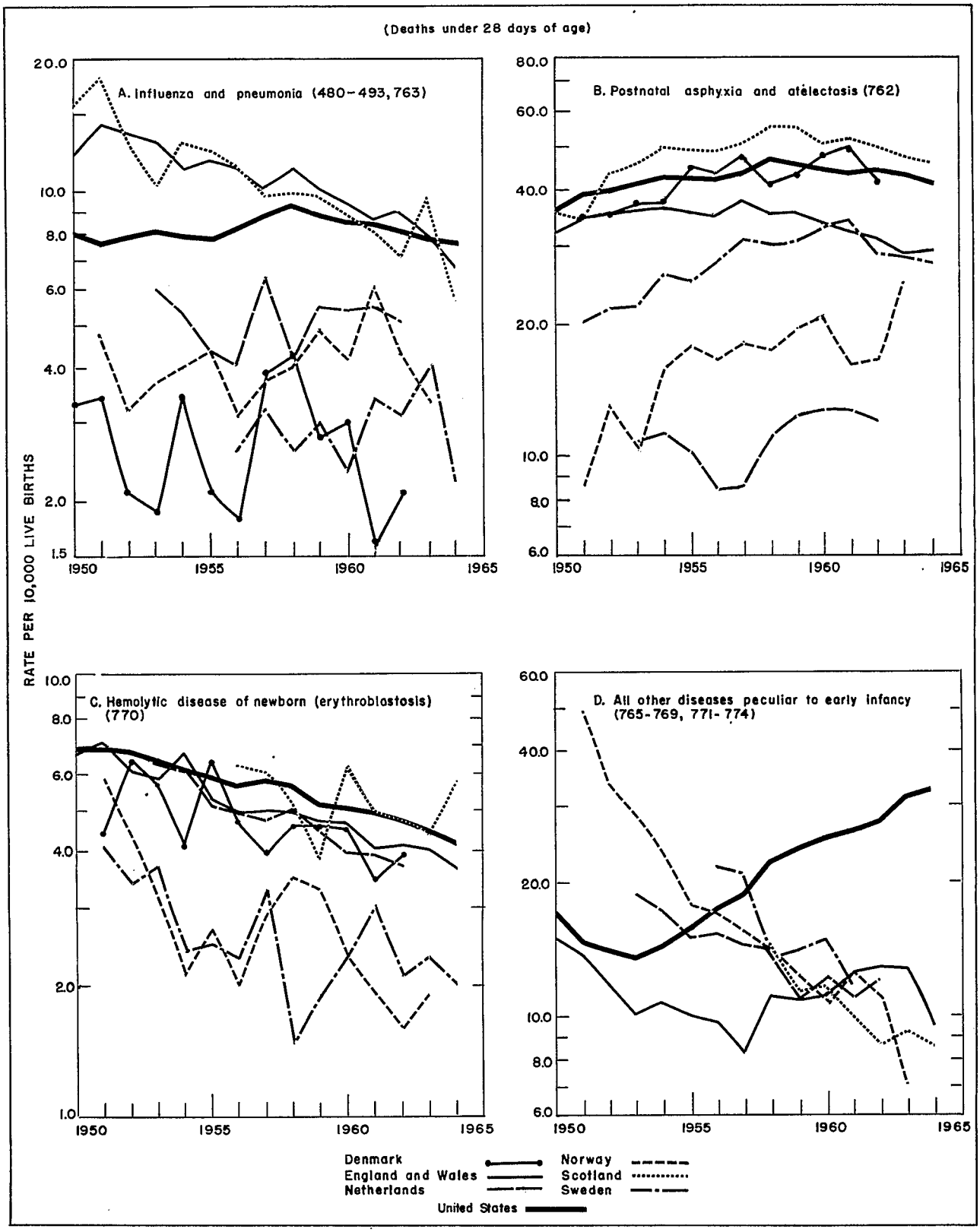


Figure 12. Neonatal mortality rates by cause: selected countries, 1950-64.

Table 16. Average annual infant, neonatal, and postneonatal mortality rates by cause of death: selected countries, 1959-61

Cause of death	Denmark	England and Wales	Netherlands	Norway	Scotland	Sweden	United States
Infant deaths	Rate per 100,000 live births						
All causes	2,191.7	2,181.0	1,622.8	1,846.5	2,686.0	1,633.6	2,590.5
Infective and parasitic diseases (001-138)	28.7	23.2	15.5	32.5	32.1	12.2	34.2
Influenza and pneumonia, including pneumonia of newborn (480-493, 763)	143.5	301.5	109.6	193.1	353.3	81.6	310.3
All other diseases of respiratory system (470-475, 500-527)	40.2	58.0	12.6	25.6	44.7	15.7	62.1
Gastritis, duodenitis, enteritis, and colitis, including diarrhea of newborn (543, 571, 572, 764)	42.8	44.7	14.8	36.8	81.2	20.2	69.2
All other diseases of digestive system (530-542, 544-570, 573-587)	26.5	42.6	27.0	36.3	41.1	33.7	37.8
Congenital malformations (750-759)	447.4	450.0	429.7	331.3	542.9	342.9	364.0
Birth injuries (760, 761)	259.2	243.9	320.3	205.4	271.5	252.4	239.2
Postnatal asphyxia and atelectasis (762)	483.1	342.5	128.0	191.5	539.3	332.6	456.9
Hemolytic disease of newborn (erythroblastosis) (770)	43.7	45.5	41.8	27.7	51.4	24.7	50.4
Immaturity, unqualified (776)	261.7	365.3	188.3	360.6	359.3	289.3	453.8
All other diseases of early infancy (765-769, 771-774)	265.8	121.8	142.1	135.0	118.7	140.9	275.3
Symptoms and ill-defined conditions (780-793, 795)	36.2	3.5	63.9	138.2	34.8	1.3	57.8
Accidents (E800-E962)	36.2	58.7	34.4	38.9	134.9	19.9	88.2
All other causes (Residual)	76.4	79.7	94.6	93.4	80.9	66.1	91.5
Neonatal deaths							
All causes	[1]1,624.7	1,557.3	1,172.9	1,214.3	1,850.4	1,317.7	1,871.4
Infective and parasitic diseases (001-138)	6.6	2.3	1.2	0.5	0.3	2.6	4.7
Influenza and pneumonia, including pneumonia of newborn (480-493, 763)	24.7	93.9	54.3	50.7	89.8	28.9	85.8
All other diseases of respiratory system (470-475, 500-527)	---	6.1	1.6	1.6	1.0	1.6	7.2
Gastritis, duodenitis, enteritis, and colitis, including diarrhea of newborn (543, 571, 572, 764)	7.1	6.8	2.3	3.7	14.6	3.9	10.9
All other diseases of digestive system (530-542, 544-570, 573-587)	13.7	21.6	15.6	17.1	18.2	19.3	23.7
Congenital malformations (750-759)	258.8	284.3	254.7	184.1	358.0	214.8	238.0
Birth injuries (760, 761)	257.9	243.6	317.3	203.8	271.1	250.8	238.8
Postnatal asphyxia and atelectasis (762)	477.4	339.2	126.5	186.7	535.6	327.5	450.1
Hemolytic disease of newborn (erythroblastosis) (770)	41.5	44.7	40.6	25.1	50.4	24.1	50.0
Immaturity, unqualified (776)	---	364.2	186.8	353.2	358.6	287.0	450.8
All other diseases of early infancy (765-769, 771-774)	---	115.6	113.2	118.4	109.0	132.9	249.4
Symptoms and ill-defined conditions (780-793, 795)	6.6	2.2	29.6	56.0	3.0	-	23.8
Accidents (E800-E962)	3.1	11.9	4.3	2.7	18.6	2.2	13.9
All other causes (Residual)	---	20.9	24.8	10.7	22.2	22.2	24.4
Postneonatal deaths							
All causes	[1]567.0	623.7	449.9	632.2	835.6	315.9	719.1
Infective and parasitic diseases (001-138)	22.1	20.9	14.3	32.0	31.8	9.6	29.5
Influenza and pneumonia, including pneumonia of newborn (480-493, 763)	118.8	207.6	55.3	142.4	263.5	52.7	224.5
All other diseases of respiratory system (470-475, 500-527)	---	51.9	11.0	24.0	43.8	14.1	54.9
Gastritis, duodenitis, enteritis, and colitis, including diarrhea of newborn (543, 571, 572, 764)	35.8	37.9	12.5	33.1	66.6	16.4	58.3
All other diseases of digestive system (530-542, 544-570, 573-587)	12.8	21.0	11.4	19.2	22.9	14.4	14.1
Congenital malformations (750-759)	188.6	165.6	175.0	147.2	184.9	128.1	126.0
Birth injuries (760, 761)	1.3	0.3	3.0	1.6	0.3	1.6	0.4
Postnatal asphyxia and atelectasis (762)	5.7	3.4	1.5	4.8	3.6	5.1	6.8
Hemolytic disease of newborn (erythroblastosis) (770)	2.2	0.8	1.2	2.7	1.0	0.6	0.4
Immaturity, unqualified (776)	---	1.2	1.5	7.5	0.6	2.2	3.0
All other diseases of early infancy (765-769, 771-774)	---	6.2	28.9	16.5	9.6	8.0	25.8
Symptoms and ill-defined conditions (780-793, 795)	29.6	1.4	34.3	82.2	31.8	1.3	34.0
Accidents (E800-E962)	33.1	46.8	30.2	36.3	116.3	17.7	74.3
All other causes (Residual)	---	58.7	69.8	82.7	58.7	44.0	67.1

[1] Figures do not add to total because data for each cause group are not available for Denmark.

higher and range from 7 to 10 per 10,000. Another lesser cause of neonatal mortality, hemolytic disease of newborn, accounted for only 2.7 percent of neonatal deaths in the United States during the same period. The trend is generally downward for all countries, but the United States has had among the highest rates since 1956 (fig. 12C). Continued improvement is expected in this category because of the state of knowledge concerning its cause and the availability of specific diagnostic and therapeutic techniques.

Deaths from accidents occupy a relatively low position among causes of neonatal death (0.7 percent in the United States in 1959-61). Almost half of the deaths in this class were due to inhalation and ingestion of food or some other object causing obstruction or suffocation, and accidental mechanical suffocation in bed and cradle (crib deaths). Although this last category may include a number of "mis-diagnosed" deaths, their proper allocation would probably not alter the ranking of the countries for other causes since these deaths contributed only about 0.3 percent to neonatal mortality.

POSTNEONATAL MORTALITY BY CAUSE, 1950-64

The shift in levels of mortality and the changes in the infant's exposure to external risks produce pronounced changes in the distribution of deaths in the postneonatal period. In the United States, the rate in the neonatal period (18.7 per 1,000 live births in 1959-61) was about 2½ times the postneonatal rate (7.2). When converted to a daily base, the risk in the neonatal period was over 30 times the risk in the postneonatal period. During the postneonatal period, environmental causes are more prominent than developmental or biologic causes.

There is also a realignment of the important causes of death in the postneonatal period (table 14). No longer do birth injuries, postnatal asphyxia and atelectasis, immaturity, and other diseases of early infancy occupy prominent positions. While these four groups constituted almost three-fourths of neonatal mortality, they account for only one-twentieth of postneonatal deaths. Congenital malformations increased slightly in relative importance (12.7 percent of neonatal and 17.5 percent of postneonatal deaths). Two groups emerged as relatively more important: influenza and pneumonia, which increased from 4.6 percent of neonatal to 31.2 percent of postneonatal deaths, and accidents which increased from 0.7 percent of neonatal to 10.3 percent of postneonatal deaths.

Influenza and pneumonia constitute the largest component of postneonatal mortality in the United States; around 1960, 31.2 percent were attributed to these causes and 96 percent of these were due to pneumonia. The trend for the United States has been almost horizontal since 1950 in contrast to the three Scandinavian countries and the Netherlands which strongly suggest downward trends (fig. 13B). Although the rates for England and Wales and for Scotland were declining until about 1956 or 1958, the rates for those countries as well appear to have leveled off. Because of the magnitude of the rates, the divergence in trends between these two groups of countries is particularly significant.

The residual group of diseases of the respiratory system contributes another 7.6 percent to postneonatal mortality in the United States. As with influenza and pneumonia, postneonatal mortality for these diseases appears to maintain a lower level in the Netherlands, Norway, and Sweden. In the United States, it seems to be increasing. In Great Britain (England and Wales, as well as Scotland), the rates have shown rather wide fluctuations in recent years (fig. 13C).

When the diseases of the respiratory system are taken together, they reinforce each other in demonstrating a basic difference in trends between the United States and Great Britain in comparison to the three Scandinavian countries and the Netherlands. This contrast suggests one possible target area for further research into the reasons for the change in trend in the United States.

Congenital malformations accounted for 17.5 percent of postneonatal mortality in the United States around 1960, ranking second to the respiratory diseases. The trend for this country has declined rather slowly but steadily since 1950, and the rates were generally more favorable than those of Denmark, England and Wales, and the Netherlands.

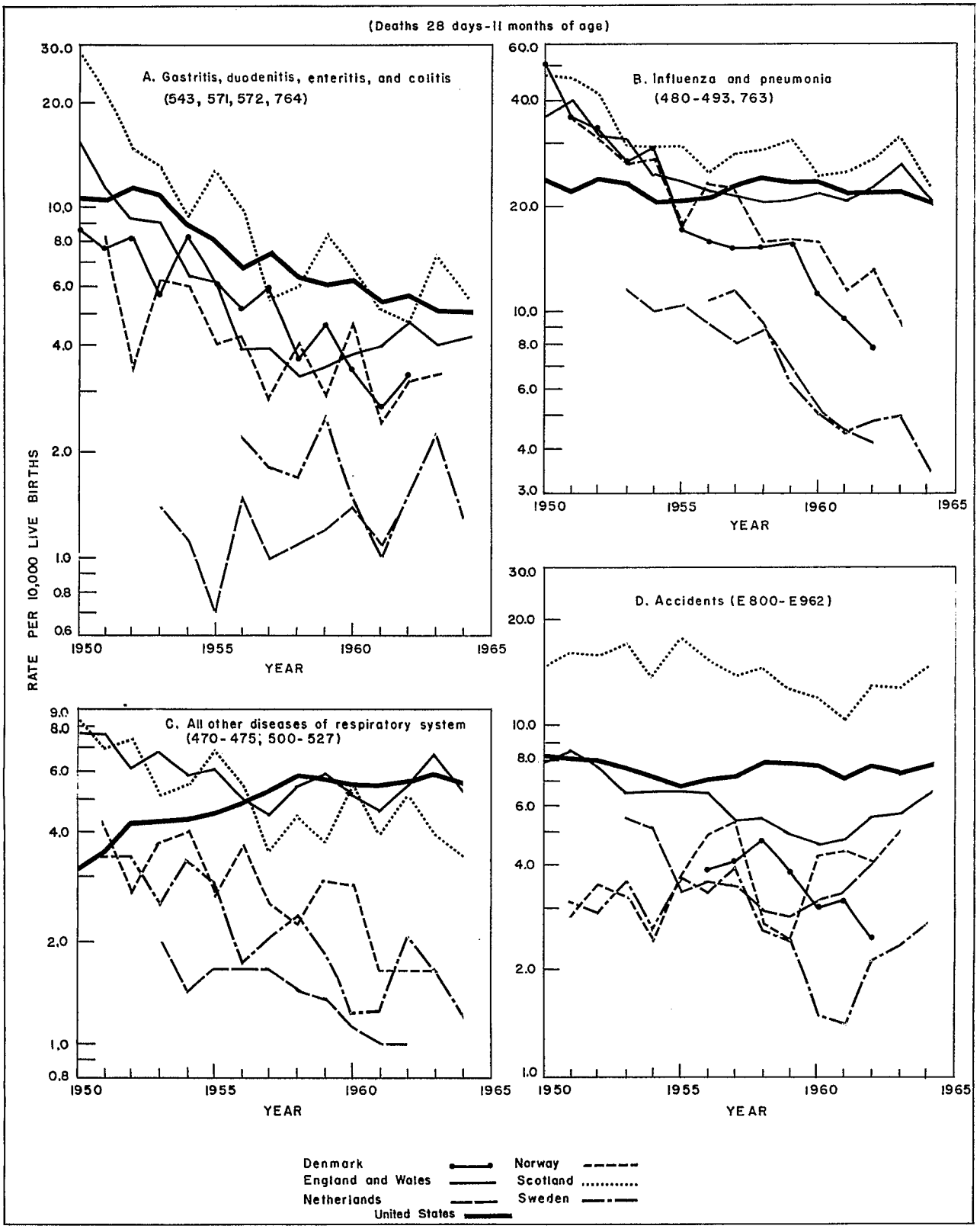


Figure 13. Postneonatal mortality rates by cause: selected countries, 1950-64.

Following the diseases of the respiratory system and congenital malformations, accidents constitute the next largest cause-of-death group in the postneonatal period (10.3 percent in 1959-61). Except for Scotland, rates for the United States have been consistently higher than those for any of the other countries for each year since 1952 (fig. 13D). Rates for the other countries are somewhat erratic with the trend for Denmark apparently on the decline; in 1962, the rate for Denmark was less than half of that of the United States. In this age group, almost one-fourth of the deaths resulted from accidental mechanical suffocation in bed and cradle. In recent years, two causes have been incriminated as possible etiologic causes: fulminating infection and allergic reaction, possibly to milk.

In the United States, the diseases of the digestive system rank next in order of importance. The inflammatory gastrointestinal diseases (gastritis, duodenitis, enteritis, and colitis) comprised 7.6 percent of postneonatal mortality in 1959-61. Although the trend has been downward throughout the period 1950-64, postneonatal mortality from these causes has been high and several times the rates for the Netherlands and Sweden (fig. 13A). Although the residual group of diseases of the digestive system is at a lower level (2.0 percent), postneonatal mortality from this group has failed to assume a generally downward trend since about 1956. The diseases of the digestive system contribute to the unfavorable postneonatal mortality in the United States.

With regard to other infective and parasitic diseases, the postneonatal rates for the United States declined consistently from 1950 to 1957, but thereafter increased in 1958 and again in 1962. The overall trend since 1957 is no longer continuing its former rate of decline.

DISCUSSION

Comparison of the trends by cause for the United States with those of the west European countries raises questions in need of answers. Prominent among them is the determination of reasons for the relatively high level of the rates in this country for causes which are associated with the environment and which should be preventable. For example, in the postneonatal period the United States ranks high for diseases of the respiratory and digestive systems and for accidents. Epidemiologic as well as medical research is needed to give direction to programs of prevention and therapy.

Secondly, the neonatal trends for postnatal asphyxia and atelectasis, and the cause group which includes hyaline membrane disease and respiratory distress syndrome mark the experience of the United States as differing from that of other countries. Together, these cause groups represent a considerable portion of neonatal mortality in the United States, and they appear to be increasing in contrast to experience elsewhere. Although there is doubtless some confounding among the cause groups due to international differences in terminology and coding, consolidation of a number of groups failed to eliminate the differences. The association of each of these causes with prematurity implicates that variable as one in need of further research.

One criterion of the level of certification is the proportion of deaths allocated to symptoms and ill-defined conditions. While the United States did not have a high proportion of deaths in this group in the neonatal period, it exceeded those of Denmark, England and Wales, Scotland, and Sweden. Medical certification in the United States may be said to be less specific than in those countries when measured by this criterion. Continued effort is needed to increase autopsies of fetal and neonatal deaths in a search for more specific information. Continued vigilance is needed to incorporate autopsy information into the vital statistics.

Research is needed to determine whether the level of medical certification can be improved for fetal deaths of 20 or more weeks of gestation as well as for neonatal deaths. Investigation of certification problems could be carried out simultaneously with ongoing medical research into causes of postnatal asphyxia and atelectasis, hyaline membrane disease, and respiratory distress syndrome.

While the fundamental etiologic agents cannot presently be identified in available vital statistics, certain broad conclusions leading to further study are possible. Whatever the reasons, changes in

the basic trends in the United States are evident for a number of underlying cause groups in the 1950's. In the health statistics field, further contribution to our knowledge could come from considering multiple causes of death certified on death certificates, by including more autopsy information in final statistics, and by generally improving the diagnostic information entered on death certificates. In the medical and epidemiologic fields, continued intensive research in early postnatal respiratory problems, diseases of the respiratory and digestive systems in the postneonatal period, and accidents are needed to determine etiology and point the way to improved preventive and therapeutic measures.

V. ASSOCIATED DEMOGRAPHIC FACTORS

The literature contains a vast number of investigations into factors associated with fetal or infant mortality. Among the earliest statistical information on infant mortality is that of Graunt.[21] The noted British vital statistician William Farr is credited with having "inaugurated the statistical discussion" of infant mortality two centuries later.[22] Since his time, infant mortality statistics have become part of the published data of almost all countries, and literally thousands of studies of fetal mortality and of infant mortality and its components have appeared in the literature.

Shortly after its founding in 1912, the U.S. Children's Bureau undertook a series of investigations into infant mortality. Because infant mortality was then higher in American cities than in rural areas, 10 cities were selected for study. The major results were combined and summarized by Woodbury.[23] These studies combined information from vital records and additional environmental and socioeconomic data obtained on home interview. DePorte used information for 1916-21 for States in the Birth Registration Area to analyze interracial variation in infant mortality.[24] Other studies of more limited geographic areas included those of Eastman in New York State,[25] Collins in Baltimore,[26] and Green in Cleveland.[27] Among the most extensive studies in the United States are those associated with Yerushalmy, some of which relate to data for New York State[28-33] and some of which relate to data for the United States.[33] These statistical studies analyze the relationship of neonatal and infant mortality to factors such as mother's age, father's age, parity, and previous reproductive loss. More recently, special reports of the National Office of Vital Statistics (NOVS) concentrated on birth weight and its relationship to neonatal mortality.[20, 34-36] In recent years, a number of British investigators have expanded their horizons to include socioeconomic variables, but recent national studies of infant mortality related to socioeconomic levels for the United States are unavailable. Available data for large population groups have been published for only a few States.[37,38] The most comprehensive recent report of infant mortality in the United States is that of Shapiro, Schlesinger, and Nesbitt which was prepared for the Center's Conference on the Perinatal and Infant Mortality Problem of the United States.[39]

For the purposes of the present report, the availability of statistical publications of the United Nations, most particularly of the World Health Organization, was particularly fortuitous. These international statistics, in addition to the reports of the contractors, afford a unique opportunity to examine correlates of infant mortality. The primary purpose is to determine from the data, if possible, whether certain factors are associated with the differences in perinatal and infant mortality experience between the United States and the other countries.

GEOGRAPHIC VARIATION

For several decades, geographic variations in infant mortality have been recognized in the United States. The highest rates (fetal, neonatal, and postneonatal) are found in the southeastern part of the country (fig. 14). There is considerable variation as well among the geographic subdivisions of the other countries involved in this report (table 17). Compared with geographic subdivisions of other countries, the rates for the States of the United States tend to be low in the fetal period and high in the infant and neonatal periods. The maximum State rates in the infant and neonatal periods

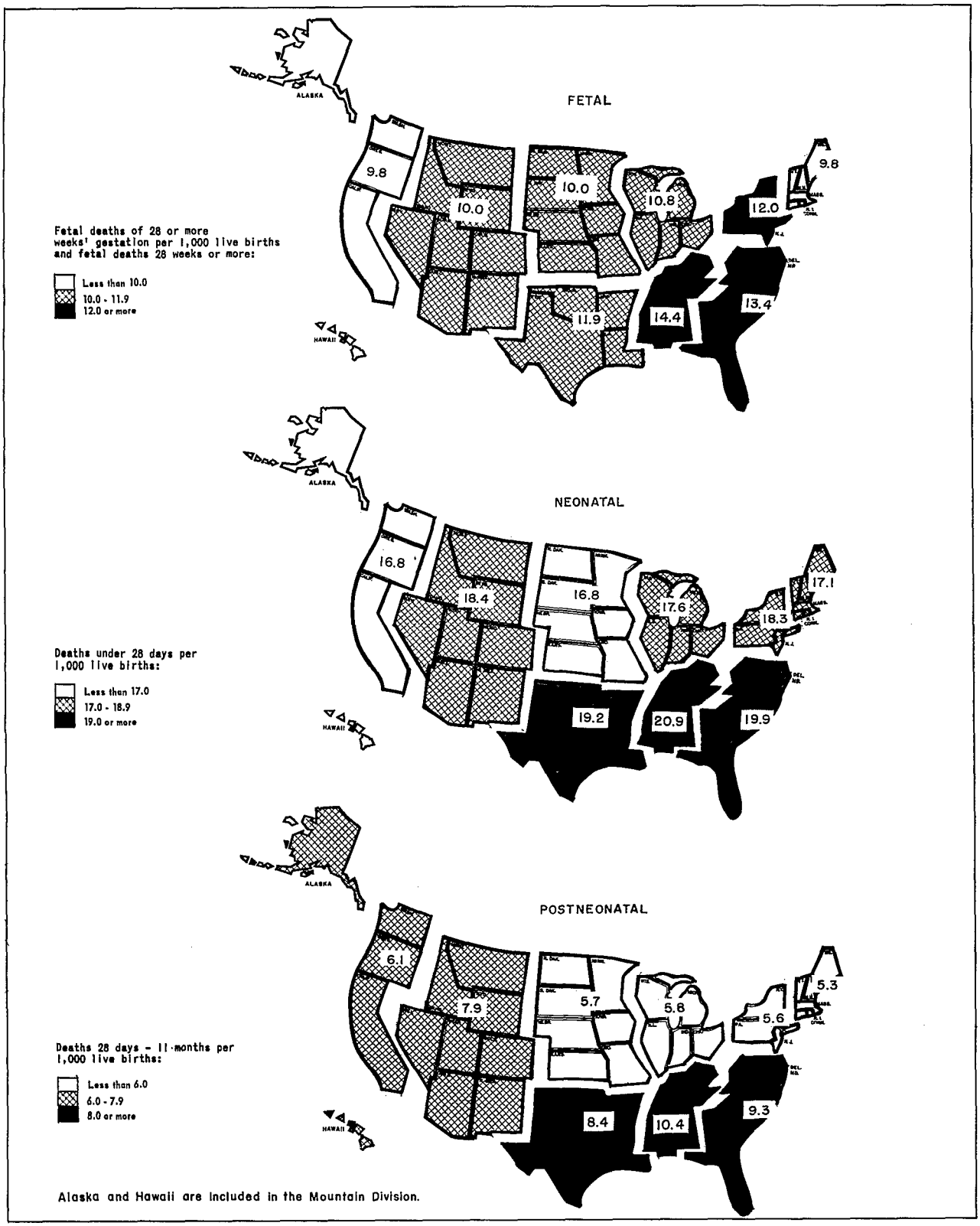


Figure 14. Average annual fetal, neonatal, and postneonatal mortality rates: geographic divisions of the United States, 1961-63.

Table 17. Average annual birth rates, and fetal death, perinatal, and infant mortality rates with ranges for geographic subdivisions: selected countries and years

Country and years	Births[1]	Fetal mortality[2]	Perinatal mortality[3]	Infant mortality[4]		
				Under 1 year	Under 28 days	28 days-11 months
	Rate					
Denmark, 1960-62	16.0	12.3	26.0	21.1	16.0	5.1
England and Wales, 1960-62	17.6	18.9	31.9	21.6	15.3	6.3
Standard regions (10)	16.5-18.5	16.0-22.6	27.6-37.3	18.1-25.6	13.2-17.7	4.9-8.1
Netherlands, 1960-62	20.9	14.8	24.6	15.8	11.5	4.3
Provinces (11)	18.6-23.9	13.4-18.7	22.4-29.7	14.3-18.6	10.5-13.4	3.5-5.8
Norway, 1956-60	17.9	14.3	24.5	19.9	12.4	7.5
Counties (20)	13.7-22.5	11.8-17.7	22.1-27.7	16.0-32.3	9.9-15.9	4.6-19.7
Scotland, 1960-62	19.7	20.8	36.7	26.3	18.0	8.3
Regions (4)	17.2-21.3	17.5-22.5	29.9-39.1	20.8-29.8	14.5-20.1	6.0-9.7
Sweden, 1959-61	13.9	13.7	25.2	16.3	13.2	3.2
Counties (25)	12.3-17.7	11.2-16.4	21.3-28.7	13.6-20.6	10.8-15.6	2.1-5.0
United States, 1961-63	22.5	11.5	27.8	25.3	18.3	7.0
Regions (9)	20.4-25.1	9.8-14.4	25.0-32.3	22.4-31.4	16.8-20.9	5.3-10.4
States (50)	20.1-31.7	7.6-18.1	21.5-38.1	19.5-39.7	14.2-25.8	4.5-15.2

[1]Live births per 1,000 population.

[2]Fetal deaths of 28 or more weeks' gestation per 1,000 live births and fetal deaths of 28 or more weeks' gestation.

[3]Infant deaths under 7 days and fetal deaths of 28 or more weeks' gestation per 1,000 live births and fetal deaths of 28 or more weeks' gestation.

[4]Rates per 1,000 live births.

(39.7 and 25.8, respectively) exceed the maximum for the geographic subdivisions of any of the other countries. In the postneonatal period, the maximum State rate (15.2) exceeds that of geographic subdivisions of every country except Norway.

Urban-rural differentials in perinatal and infant mortality in the United States have been modified since the turn of the century. These changes have been associated with greater availability and improved distribution of hospital and medical facilities, the rising standard of living, population migration, and so forth. In the early part of the century, infant mortality was particularly high in cities of the United States. A series of investigations by the Children's Bureau identified some of the associated conditions in a number of cities in the United States. By the time of the late 1920's and 1930's, the situation had reversed and children in most urban settings had lower mortality. At present, the situation in a number of major cities in the United States is once again reverting to the old pattern: neonatal mortality among 9 of the 10 largest cities in this country is higher than among those infants living outside these cities but in the same States.[40]

In the 1950 decade, there was a general deterioration of and considerable movement into and out from most major cities of the United States. This fact was made evident by the 1960 Census of Population which showed that the total populations of a number of the largest cities in the country had declined during the decade. This net loss was often composed of two mainstreams: an in-migration of economically deprived persons in search of better opportunities, and an out-migration of economically privileged to the suburbs. The many elements in the interrelationship of infant mortality among the migrating groups are difficult to unravel because of the lack of quantitative information specific for them. While census data are available for the population which moved, data are not available concerning its childbearing and mortality experiences. In many cities, the feeling is that some increase in perinatal and infant mortality has accompanied the population change.

Comparison with data for other countries is complicated by lack of standard definitions of "urban" and "rural." Even in the United States, the characteristics of urban areas in the 1920 or 1930 censuses do not compare with those of later censuses. A far more informative type of analysis is to study mortality in relation to identified characteristics of individuals rather than characteristics of geographic areas.

COLOR

Among the countries involved in this report, only the United States presents data specific for color (or race). In the other countries, the nonwhite populations are too small to represent groups of special interest. In the United States, 11.4 percent of the population and 15.4 percent of live births in 1960 were nonwhite. This nonwhite group consisted of approximately 90 percent Negroes and 10 percent other races. In many ways, this nonwhite population is economically deprived: their median income is less, their median year of education is lower, their level of unemployment is higher. In fact, at present, the white-nonwhite differentials are regarded as primarily socioeconomic in nature rather than racial per se.

Recorded mortality differentials in the fetal, neonatal, and postneonatal periods have been to the advantage of the white population since data have been available. For the past 20 years, the fetal death ratio of the nonwhite group has been almost double that of the white group. The following table gives the ratios of fetal deaths of 20 or more weeks' gestation per 1,000 live births for both white and nonwhite births and their ratios:

Year	Fetal death ratio		Ratio—nonwhite to white
	White	Nonwhite	
1945--------	21.4	42.0	1.96
1950--------	17.1	32.5	1.90
1955--------	15.2	28.4	1.87
1960--------	14.1	26.8	1.90
1963--------	13.7	26.7	1.95
1964--------	14.1	28.2	2.00

In the first 24 hours following birth, the rate for nonwhite infants reached their lowest point (12.7) in 1945 and 1951 (fig. 15). Since 1945, mortality trends among the white and nonwhite infants in this age group have proceeded differently. The trend for nonwhite infants has been upward with some fluctuation since 1945. The trend for white infants was downward until about 1954, although since then the trend has also been upward. The following table gives rates for white and nonwhite deaths under 24 hours of age per 1,000 live births as well as their ratios. Over almost 30 years, the differential between the two groups has increased:

Year	Rate		Ratio—nonwhite to white
	White	Nonwhite	
1935----------	14.8	16.2	1.09
1940----------	13.6	16.0	1.18
1945----------	11.0	12.7	1.15
1950----------	9.7	13.0	1.34
1955----------	9.3	13.9	1.49
1960----------	9.6	14.4	1.50
1964----------	9.3	15.0	1.61

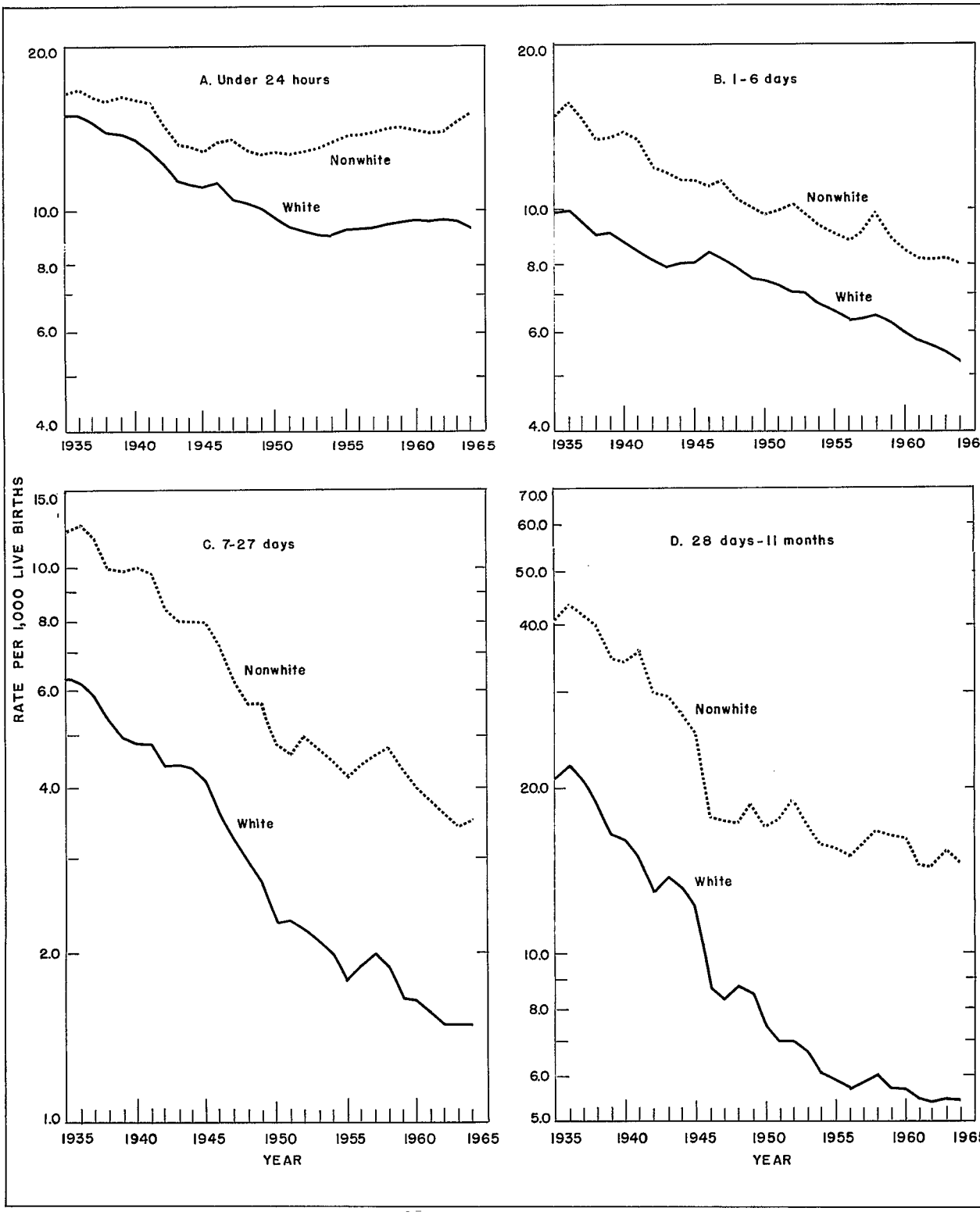


Figure 15. Infant mortality rates by color and age at death: United States, 1935-64.

While part of the increase in ratios in the earlier years may have been due to greater improvement in completeness of death registration among the nonwhite population, the increases in these ratios in the later years probably represent a widening gap in mortality experience.

In the age group 1-6 days, changes in trend are not readily discernible. There have been periodic increases at various times from which the trends did not recover. For example, the rates of decline for white infants in the periods 1935-43, 1946-56, and 1958-63 are approximately equal. However, each time there was an increase in mortality (1943-46 and 1956-58), the trend line did not recapture the level it would have achieved had the 1936-43 trend continued uninterruptedly. The same observation pertains to the nonwhite rate before and after the increase of 1956-58.

In the remainder of the neonatal period (7-27 days), the downward trends were interrupted for nonwhite infants around 1950, and for white infants around 1956. In recent years, although the rates seem to be generally declining, the trends are diverging.

In the postneonatal period, again, there were changes for both white and nonwhite infants. Trends for both groups proceeded in an overall downward direction until approximately 1945 for nonwhite infants and 1950 for white infants. The deceleration in the trend for nonwhite infants around the close of World War II was marked, while that for white infants was much less pronounced.

Despite these differences in mortality between white and nonwhite infants, the trend lines for the combined group are determined by the trends for the white infants since they represent about 85 percent of births. Part of the increased differential between white and nonwhite infants in this country is attributable to an earlier leveling off of the mortality among nonwhite infants, and for some age groups to a reversal in trends among nonwhite infants.

A detailed study of the complex interrelationships in white-nonwhite differentials is not pertinent here. The issue is whether the contribution of the higher nonwhite mortality is sufficient to change the position of the United States relative to the other countries. Or, put in another way, if the comparison were made between the west European countries and only the white births of the United States, would the comparative trends still exist?

The separate trends for white infants were plotted and examined in relation to the other countries, and the same changes in rates of decline in the 1950's were evident. The position of the United States relative to the other countries remained essentially unchanged. While higher mortality among nonwhite infants in the United States is not to be minimized, the position of the trends for the entire infant population in the United States relative to those of the west European countries cannot be attributed to the inclusion of nonwhite infants.

SEX

A higher proportion of live births are males, and mortality among them is higher than among females for all age groups in the infant period. There are variations in the sex ratios at birth within countries as well as between countries (table 18). From these data it may be seen that countries with higher sex ratios than the United States (e.g., the Netherlands and Sweden) have lower infant mortality rates. Furthermore, when the trends were examined separately for males and females the patterns which were noted earlier for both sexes combined were still evident. The differences in sex ratios do not explain the differences in infant mortality between the United States and the other countries included in this report.

MATERNAL AGE AND PARITY

Reproductive loss is associated with maternal age at time of delivery and the trends by maternal age vary with type of loss. In the United States, fetal mortality follows a "J" curve; that is, it is somewhat elevated among mothers under 20 years of age, is at an optimum low level between 20 and 29 years, and rises sharply thereafter. Fetal mortality among mothers 40 years or older is

Table 18. Sex ratio of live births: selected countries, 1950-64

[Male births per 1,000 female births]

Year	Denmark	England and Wales	Nether-lands	Norway	Scotland	Sweden	United States
1964	---	1,062	---	---	1,060	1,052	1,047
1963	---	1,056	---	1,063	1,053	1,069	1,053
1962	1,050	1,060	1,050	1,058	1,070	1,057	1,048
1961	1,051	1,062	1,050	1,070	1,056	1,061	1,050
1960	1,050	1,061	1,055	1,055	1,053	1,052	1,049
1959	1,057	1,063	1,051	1,068	1,062	1,073	1,049
1958	1,062	1,059	1,057	1,055	1,053	1,069	1,049
1957	1,066	1,060	1,058	1,053	1,057	1,049	1,051
1956	1,063	1,057	1,061	1,050	1,056	1,079	1,051
1955	1,070	1,060	1,053	1,065	1,056	1,060	1,051
1954	1,061	1,059	1,065	1,048	1,056	1,064	1,051
1953	1,072	1,059	1,064	1,054	1,063	1,066	1,053
1952	1,062	1,055	1,065	1,069	1,048	1,067	1,051
1951	1,072	1,060	1,065	1,076	1,063	1,064	1,052
1950	1,049	1,060	1,066	1,066	1,070	1,070	1,054

several times the mortality under 20. Neonatal and postneonatal mortality is more nearly "U" in shape with the rates in the older groups (40 years and over) perhaps only about 10 percent above that among mothers less than 20 years of age. However, as for fetal deaths, the optimum maternal ages are from 20 to 30 years.

Since maternal age is selectively associated with fetal and infant mortality, the age distribution of women giving birth affects the mortality rate. The distribution of live births by mother's age shows significant differences between the United States and the other countries under study: the age distribution of mothers for the United States is skewed to the younger ages (table 19). This country has a higher proportion of live births in the groups under 25 years than any of the other countries. In the age group under 20 years of age, when fetal, neonatal, and postneonatal mortality are somewhat elevated, the proportion of births in the United States is almost 50 percent higher than that of the next highest country, Denmark. Lower proportions in the United States are found in each age group beginning with age 25.

The relative effect of these differences in maternal age distributions on fetal mortality is demonstrated in table 20. Fetal death ratios by mother's age were adjusted to the live birth distribution by mother's age in the United States in 1950. The adjusted rates represent hypothetical ratios which would have prevailed in a standard population subjected to the maternal age-specific fetal mortality ratios of the several countries. For this table, it was necessary to use United States data for fetal deaths of 20 weeks or more since distributions and rates by maternal age for gestations of 28 weeks or more are not available.

The table shows relatively little change in ranking and level of ratios brought about by the process of age adjustment. The adjustment lowered the ratios for the west European countries bringing them closer to the United States. Although the adjusted ratios for the United States are not directly comparable to the others because of the difference in gestation (20 weeks or more rather than 28 weeks or more), the adjustment for mother's age made no difference in the ratios.

Table 19. Total live births and percentage distribution of live births, by age of mother: selected countries, 1950, 1957, and 1962

Country and years	Total live births	Age of mother								
		All ages	Under 20 years	20-24 years	25-29 years	30-34 years	35-39 years	40-44 years	45 years and over	Unknown
		Percentage distribution								
Denmark										
1950	79,558	100.0	7.3	28.0	30.4	19.4	11.2	3.5	0.2	-
1957	75,246	100.0	9.0	32.4	28.8	18.1	8.9	2.6	0.2	-
1962	77,808	100.0	11.3	34.6	28.7	15.8	7.3	2.1	0.1	-
England and Wales										
1950	697,097	100.0	4.4	27.3	32.8	19.7	11.9	3.5	0.2	0.3
1957	723,381	100.0	5.7	29.3	31.9	19.9	10.4	2.7	0.2	(1)
1962	838,736	100.0	8.0	31.1	30.6	18.4	9.1	2.7	0.2	-
Netherlands[2]										
1950	229,369	100.0	2.2	16.2	31.7	25.3	17.4	6.7	0.5	-
1957	233,608	100.0	2.6	18.2	33.1	25.5	14.8	5.4	0.4	-
1962	245,739	100.0	3.7	21.9	32.6	23.9	13.1	4.5	0.3	-
Norway[3]										
1950	62,410	100.0	2.8	19.7	29.7	25.6	15.5	5.9	0.6	0.1
1957	63,063	100.0	4.7	24.3	29.0	22.4	14.3	4.9	0.4	0.0
1963	62,254	100.0	8.4	30.5	26.7	19.0	11.1	4.1	0.3	0.0
Scotland[4]										
1950	92,530	100.0	4.3	26.7	31.5	20.5	12.9	3.7	0.2	0.2
1957	97,977	100.0	5.2	29.9	31.5	19.8	10.6	2.7	0.2	0.1
1962	104,334	100.0	6.7	31.3	30.9	18.6	9.4	2.7	0.2	0.1
Sweden										
1951	110,168	100.0	7.1	25.4	29.4	21.7	12.1	4.1	0.3	0.0
1957	107,168	100.0	8.4	26.8	29.2	20.5	11.4	3.4	0.3	0.0
1962	107,284	100.0	11.4	30.1	28.5	18.0	9.0	2.8	0.2	-
United States										
1950	3,554,149	100.0	11.9	31.8	28.8	16.8	8.3	2.1	0.1	0.2
1957[5]	4,254,784	100.0	13.1	32.0	26.8	17.2	8.6	2.1	0.1	0.1
1962[5]	4,167,362	100.0	14.6	34.7	25.1	15.3	8.0	2.2	0.1	(1)

[1]Births for which age of mother was not stated have been distributed according to known age proportions.

[2]Includes births occurring outside country if one or both parents are included in a Netherlands population register.

[3]Age of mother obtained by subtracting year of birth of mother from year of birth of child.

[4]Data tabulated by year of registration rather than occurrence.

[5]Based on a 50-percent systematic sample of births.

SOURCE: United Nations, Demographic Yearbook, 1959, 1963, and 1964, except for the United States. Data for United States taken from Vital Statistics of the United States, 1950, 1957, and 1962.

Table 20. Fetal death ratios adjusted for age of mother: selected countries, 1950 and 1957

Period of gestation and country	Unadjusted ratio[1]		Adjusted ratio[2]	
	1950	1957	1950	1957
28 weeks or more				
Denmark	18.8	15.5	17.9	15.1
England and Wales	23.1	23.0	21.8	22.3
Netherlands	19.7	17.2	16.5	15.2
Norway	16.4	14.9	14.1	13.9
Scotland	27.6	24.3	25.7	23.4
Sweden	[3]19.6	15.9	[3]17.9	15.0
United States	14.8	12.1	---	---
20 weeks or more				
United States	19.2	16.3	19.2	16.3

[1]Based on fetal deaths of specified gestations per 1,000 live births.

[2]Adjusted to distribution of live births by age of mother in the United States, 1950, using the direct method.

[3]Ratio is for 1951.

It seems unlikely that a similar adjustment limited to those of 28 weeks or more gestation would produce very different results.

Objective population data by mother's age are less readily available for the components of infant mortality than for fetal mortality. To obtain the desired information, composite records are needed of the two vital events for individual infants: for example, the data concerning cause and age at death from the death record must be related to maternal age, parity, birth weight, and so forth, from the birth record. For the United States such linked data are available for neonatal mortality for births during 3 months in 1950.[36] The preparation of a matched set of infant deaths and 1960 births in the United States is now in progress at the National Center for Health Statistics. Their completion will greatly assist the study of demographic factors and neonatal and infant mortality in this country. For England, Scotland, and Wales, the British Perinatal Study provided linked information for all births in one week (March 3-9, 1958); and all stillbirths and neonatal deaths throughout the months of March, April, and May, 1958.[5]

Similar trends in neonatal mortality associated with maternal age and birth order are reported in both studies. The United States data showed elevations for first births and high order births, and elevations among mothers under 20 years and over 30 years (table 21). Similar elevations are noted in the British data.

Table 21. Neonatal mortality rates by age of mother and total-birth order: United States, January 1-March 31, 1950

[Excludes data for Massachusetts]

Age of mother	Total-birth order					
	All orders	1	2	3	4	5 or more
	Rate per 1,000 live births					
All ages	20.0	19.1	17.8	19.7	21.1	26.9
15-19 years	23.8	21.2	28.1	35.3	45.2	68.8
20-24 years	19.0	16.6	18.2	22.0	24.9	35.8
25-29 years	17.6	17.3	14.3	17.7	19.6	25.5
30-34 years	20.0	24.1	16.1	16.9	18.8	25.5
35-39 years	23.6	28.7	20.3	19.8	21.5	26.1
40-44 years	27.2	30.9	25.3	26.4	23.6	28.0

SOURCE: National Center for Health Statistics, "Weight at Birth and Survival of the Newborn, by Age of Mother and Total-Birth Order, United States, Early 1950," by J. Loeb, Vital and Health Statistics, Series 21, No. 5, Public Health Service, Washington, D.C., July 1965, pp. 54-56. (reprint)

In considering the group of countries in this report, the question is whether the differences in rates by maternal age (or parity, etc.) could account for the overall differences noted between the countries. To explore this aspect, data for the Netherlands and the United States were compared since these two countries showed the greatest differences in maternal age and birth order distributions. Only about one-fifth of the difference in neonatal mortality could be accounted for by maternal age and birth order:

	Unadjusted	*Adjusted*
Netherlands, 1962-63--	12.4	12.9
United States, 1963----	18.2	17.6

It may be concluded, therefore, that differences in the maternal age and birth order distributions account for part but not all of the difference in neonatal mortality between these two countries.

LOW BIRTH WEIGHT

In recent decades, premature birth has emerged as the primary determinant in relation to fetal and neonatal mortality. For a number of years, it was the practice to equate the dividing line between mature and premature births to 2,500 grams.[41] However, the NOVS studies of births in the United States during 3 months in 1950 showed that the gestation-birth weight distributions of population subgroups vary. In more recent years, the preferred practice has been to avoid use of the term "premature" when referring to infants weighing under 2,501 grams, but to use the more accurate term "low birth weight."[42]

The variable of primary concern is, of course, the physical development and maturation of the infant. While it would be preferable to use the duration of gestation, the determination of this item for the country as a whole is quite inaccurate. Therefore, mortality studies in the United States have concentrated on birth weight rather

Table 22. Neonatal mortality rates, by birth weight, color, and sex: United States, January 1-March 31, 1950

[Based on deaths within the first 28 days after birth among children born Jan. 1 to Mar. 31, 1950. Rates per 1,000 live births. Births and deaths with birth weight not stated are distributed. Excludes data for Massachusetts]

Birth weight	Total			White			Nonwhite		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
All weights---	20.0	22.7	17.1	18.9	21.6	16.0	26.7	29.4	23.9
1,000 grams or less--------	871.7	894.2	848.0	883.3	905.0	861.0	821.4	849.9	789.0
1,001-1,500 grams----------	551.3	621.8	478.2	562.1	643.1	474.5	507.0	524.7	491.6
1,501-2,000 grams----------	211.0	265.0	160.5	214.6	271.9	160.4	195.7	235.1	161.1
2,001-2,500 grams----------	50.4	67.4	36.6	50.6	69.1	35.5	49.5	60.0	41.2
2,501-3,000 grams----------	12.6	16.6	9.5	12.0	15.9	9.1	15.4	19.9	11.8
3,001-3,500 grams----------	6.7	8.1	5.3	6.2	7.6	4.9	9.7	10.9	8.4
3,501-4,000 grams----------	5.6	6.4	4.6	4.9	5.6	4.1	10.5	12.2	8.4
4,001-4,500 grams----------	7.5	7.7	7.2	6.7	6.9	6.4	12.5	13.1	11.4
4,501 grams or more----------	14.2	13.7	15.1	12.0	10.8	14.7	20.2	23.1	16.0
2,500 grams or less--------	173.7	213.9	138.9	175.8	218.8	138.4	164.7	192.8	141.3
2,501 grams or more--------	7.8	9.1	6.4	7.1	8.3	5.8	11.9	13.9	9.7

SOURCE: National Center for Health Statistics, "Weight at Birth and Survival of the Newborn, United States, Early 1950," by S. Shapiro and J. Unger, Vital and Health Statistics, Series 21, No. 3, Public Health Service, Washington, D.C., July 1965, p. 15. (reprint)

than gestation, regarding this as an index of fetal maturity.

International studies involving birth weight are seriously hampered by the scarcity of birth weight information from the west European countries. Denmark has added the item of birth weight to its live birth and fetal death (stillbirth) records in recent years, but as yet no national data are available. The Netherlands, Norway, and Sweden do not have this item on their official records, but the Swedish Board of Health is planning to collect the information from hospital records. In England, Scotland, and Wales, birth weight has been included in stillbirth registration since October 1, 1960. It is not included on the live birth certificate, but the birth weight of premature infants is reported on notifications by physicians and midwives to the Ministry of Health.

For the United States itself, although distributions of births by birth weight are available annually, there are limited mortality data by birth weight. The most comprehensive and direct national data relating neonatal mortality to a

Table 23. Relationship of fetal, infant, and early childhood mortality to infant's weight at birth: New York State, exclusive of New York City, 1950-52

[Rates per 1,000 survivors among single white births]

Infant's birth weight	Total births[1]	Deaths							
		Fetal[2]		Under 28 days		28 days-11 months		1-4 years	
		Number	Rate	Number	Rate	Number	Rate	Number	Rate
Total	435,937	6,898	15.8	6,998	16.3	2,246	5.3	1,462	3.5
1,500 grams or less	6,144	2,303	374.8	2,809	731.3	52	50.4	5	5.1
1,501-2,000 grams	5,277	713	135.1	957	209.7	94	26.1	24	6.8
2,001-2,500 grams	19,681	962	48.9	843	45.0	225	12.6	104	5.9
2,501-3,000 grams	80,315	844	10.5	816	10.3	524	6.7	303	3.9
3,001-3,500 grams	170,947	1,149	6.7	899	5.3	792	4.7	539	3.2
3,501-4,000 grams	117,605	548	4.7	489	4.2	431	3.7	371	3.2
4,001 grams or more	35,968	379	10.5	185	5.2	128	3.6	116	3.3
2,500 grams or less	31,102	3,978	127.9	4,609	169.9	371	16.5	133	6.0
2,501 grams or more	404,835	2,920	7.2	2,389	5.9	1,875	4.7	1,329	3.3

[1]Excludes 103 births with birth weight and gestation not stated.

[2]20 or more weeks' gestation.

SOURCE: H. C. Chase, "Relationship of Certain Biologic and Socio-Economic Factors to Fetal, Infant, and Early Childhood Mortality, II, Father's Occupation, Infant's Birthweight and Mother's Age," New York State Department of Health, Albany, New York, 1962.

number of birth characteristics refer to events in 3 months of 1950. Additional data are available only from studies of smaller geographic areas.[43-45]

Mortality by Birth Weight

In the 1950 study of neonatal mortality in the United States, it is shown that mortality varied as much as 100-fold for various birth weight groups (table 22). Mortality in the group weighing 3,001-3,500 grams at birth is at its optimum (6.7 per 1,000), while in the group weighing 1,000 grams or less, it is 871.7. When all infants weighing less than 2,501 grams (sometimes termed "premature") are combined, their mortality (173.7) is over 20 times the mortality among infants weighing 2,501 grams or more (7.8). These relative variations far exceed those for other variables. They have been shown to exceed those of maternal or paternal age, birth order, race, socioeconomic level, or previous loss.[37, 38]

Similar results have been reported at other age levels as well. Among single white births in Upstate New York (the State exclusive of New York City) variations by birth weight were almost as great for fetal deaths of 20 weeks and over as for neonatal mortality (table 23). This study also showed that the handicap of low birth weight carries over to postneonatal mortality, but the magnitude of the differences is not nearly so great.

When the data of the Perinatal Study for England, Scotland, and Wales were extrapolated to an annual base, estimates of perinatal mortality showed similar variation: about 900 per 1,000 for infants weighing less than 1,000 grams at birth, and about 10 per 1,000 for those in the optimum survival group 3,501-4,000 grams. The perinatal mortality rate in the group weighing less than 1,000

Table 24. Percentage distribution of births by birth weight: Great Britain, 1958; England and Wales, 1963; and United States, 1960

Birth weight	Great Britain, 1958[1]	England and Wales, 1963[2]	United States, 1960[3]		
			Total	White	Nonwhite
	Percentage distribution				
All weights	100.0	100.0	100.0	100.0	100.0
2,000 grams or less	1.9	---	2.6	2.3	4.5
2,001-2,500 grams	4.3	---	5.1	4.5	8.2
2,501-3,000 grams	18.0	---	18.4	17.2	25.1
3,001-3,500 grams	35.9	---	37.8	38.0	36.9
3,501-4,000 grams	27.0	---	26.7	28.1	18.8
4,001 grams or more	9.3	---	9.0	9.6	5.8
Not stated	3.6	---	0.4	0.3	0.7
2,500 grams or less	6.2	7.4	7.7	6.8	12.7
2,501 grams or more	90.2	---	91.9	92.9	86.6
Not stated	3.6	---	0.4	0.3	0.7

[1]N. R. Butler and D. G. Bonham, Perinatal Mortality, E. & S. Livingstone, Ltd., Edinburgh and London, 1963. Based on single live births and stillbirths which occurred in the week of March 3-9, 1958.

[2]England and Wales Ministry of Health, personal communication. Based on notifications of live births and stillbirths by physicians and midwives to the Ministry of Health.

[3]Based on a 50-percent systematic sample of registered live births.

grams at birth was about 90 times the rate in the optimum period. Mortality may be said to vary widely with fetal development, and overall rates will therefore be affected by even small differences in the distribution of births by birth weight.

Incidence of Low Birth Weight Infants

For the United States, distributions of births by weight are published annually. Since 1953, such statistics have also become available for premature infants from the notifications to the British Ministry of Health, and another estimate is available from the Perinatal Study for England, Scotland, and Wales. Data shown in table 24 suggest that the proportion of low birth weight infants born alive in the United States exceeds that among live births and stillbirths in Great Britain. Unofficial estimates of the proportion of low birth weight infants in other countries tend to be even lower: Netherlands, 5.5 percent,[10] and Sweden, 5.04 percent.[46]

New Zealand, although not a European country, has an infant mortality rate (19.1 in 1964) which compares favorably with that of the United States (24.8). Beginning with 1965, statistics by birth weight have become available for that country.[47] For the entire population (including the Maoris) the proportion of low birth weight infants was as follows:

	Percent recorded less than 5 lbs., 9 oz.	*Percent estimated under 2,500 grams*
Total births	5.5	6.2
Live births	5.0	5.6
Stillbirths (28 weeks or more)	52.6	55.2

The experience of the Netherlands, Sweden, and New Zealand may be used to define a "low rate" country as one in which immature liveborn infants (those weighing 2,500 grams or less at birth) constitute 5 percent of its live births. Such a country would have a "low rate" of immaturity. Although the difference between this estimate of 5 percent versus an observed rate of 8.0 percent for the United States in 1962 may appear small, its possible statistical effect on neonatal mortality is considerable. By using standard neonatal mortality rates derived from the NOVS study of 1950, the effect of this difference in birth weight distributions may be estimated.

Country and year	Birth weight		
	Total	2,500 grams or less	2,501 grams or more
	Percentage distribution of live births		
"Low rate" country-	100.0	5.0	95.0
United States, 1962	100.0	8.0	92.0
	Standard neonatal mortality rate		
United States, Jan.-Mar., 1950	...	173.7	7.8
	Expected neonatal mortality rate		
"Low rate" country-	16.1	8.7	7.4
United States, 1962	21.1	13.9	7.2

Thus, an arithmetic increase of 3.0 percent in low birth weight infants could result in an increase of 5.0 per 1,000 in neonatal mortality. In 1962, the observed neonatal rates were:

Netherlands	12.8
Sweden	12.4
United States	18.3

The difference in neonatal mortality presented in the table above (5.0) would constitute 85-90 percent of the observed difference between the Netherlands or Sweden and the United States. Thus, theoretically, differences in birth weight distributions of this magnitude could account for 85-90 percent of the difference in neonatal mortality between the United States and these two countries.

This presentation is conjecture rather than evidence. In the first place, the estimate for "low rate" countries is based chiefly on unofficial estimates. As data by birth weight become available for other countries (e.g., Denmark, New Zealand, and Sweden), further exploration of international differences in infant mortality with regard to birth weight will become possible. Secondly, the estimated neonatal mortality rates shown in the preceding table are the weight-specific rates derived from the 1950 NOVS study. Later data would have been preferred but are presently unavailable.

Turning from international comparisons to the United States alone, examination of data shows small but consistent increases in the proportion of low birth weight infants among live births in recent years. These have occurred in each weight group up to 3,500 grams (table 25). With regard to the group under 2,501 grams, this proportionate increase cannot be explained by decreasing proportions of unknowns. While the proportion of live births with weight unspecified has remained fairly constant, the proportion of low birth weight infants has increased almost each year.

	Percent 2,500 grams or less	*Percent 2,501 grams or more*	*Percent not stated*
1959	7.7	91.8	0.5
1960	7.7	91.9	0.4
1961	7.8	91.9	0.3
1962	8.0	91.7	0.3
1963	8.1	91.4	0.5
1964	8.2	91.6	0.2

Similar data may be derived from notifications submitted to the Ministry of Health for Great Britain. These data do not suggest increases in the proportion of low birth weight infants similar to the experience in the United States.

	Percent 2,500 grams or less
1953-57	6.8
1958	6.9
1959	6.7
1960	6.7
1961	6.7
1962	6.7
1963	6.6

Table 25. Percentage distribution of live births by birth weight: United States, 1959-64

Birth weight	Year					
	1964	1963	1962	1961	1960	1959
	Percentage distribution					
Total	100.0	100.0	100.0	100.0	100.0	100.0
1,000 grams or less	0.6	0.6	0.6	0.5	0.5	0.5
1,001-1,500 grams	0.7	0.7	0.6	0.6	0.6	0.6
1,501-2,000 grams	1.5	1.5	1.5	1.4	1.4	1.4
2,001-2,500 grams	5.4	5.4	5.3	5.2	5.1	5.1
2,501-3,000 grams	19.3	19.3	19.1	18.8	18.4	18.5
3,001-3,500 grams	38.2	38.1	38.0	38.0	37.9	37.9
3,501-4,000 grams	25.8	25.7	26.0	26.4	26.7	26.6
4,001-4,500 grams	7.0	6.9	7.1	7.3	7.4	7.4
4,501-5,000 grams	1.3	1.2	1.3	1.3	1.4	1.3
5,001 grams or more	0.2	0.1	0.2	0.2	0.2	0.2
Not stated	0.2	0.5	0.3	0.3	0.4	0.5
2,500 grams or less	8.2	8.1	8.0	7.8	7.7	7.7
2,501 grams or more	91.6	91.4	91.7	91.9	91.9	91.8
Not stated	0.2	0.5	0.3	0.3	0.4	0.5

SOURCE: U.S. Department of Health, Education, and Welfare, Public Health Service; annual report, Vital Statistics of the United States.

The problem of fetal development at birth (gestation as well as birth weight) and its relationship to mortality is in need of further clarification. If the differences in distribution by birth weight are real, they may account for a considerable part of the differential in mortality between the United States and some of the other countries. At the present level of mortality in the United States, an arithmetic increase of 1 percent in infants weighing less than 2,501 grams causes a relative increase of 10 percent in first-week mortality. To more fully understand the relationship between fetal and infant mortality to birth weight would require objective information related to birth weight for other countries and for mortality data correlated with birth weight for all of these countries including the United States.

Recent investigations have pointed to the necessity for the simultaneous analysis of data by gestation as well as birth weight.[48] This prospect highlights the need for vast improvement in the quality of gestation information for the United States. Except for a few areas which request the "first day, last normal menses," gestation information is inaccurately reported on live birth and fetal death certificates in multiples of 4 weeks. Furthermore in some States high proportions of records with unknown periods of gestation are registered.

Other Related Factors

For live births in the United States in 1950, the incidence of low birth weight was shown to be related to a number of other variables (table 26). The greatest relative differential is for infants with gestations less than 37 weeks and those born in plural deliveries. Next highest are infants born

Table 26. Incidence of low birth weight among subgroups of live births: United States, January 1-March 31, 1950

[Excludes data for Massachusetts]

Item	Percent 2,500 grams or less	Index	Item	Percent 2,500 grams or less	Index
Total	7.4	100	Gestation[2]		
Type of county[1]			Under 28 weeks	94.4	1,276
Urban	7.8	105	28-31 weeks	87.8	1,186
Rural	6.7	91	32-35 weeks	62.9	850
Metropolitan	7.7	104	36 weeks	12.3	166
Nonmetropolitan	6.9	93	37 weeks and over	4.2	57
Size of place (hospital births only)[1]			Total-birth order[3]		
Urban			First	7.7	104
250,000 or more	8.3	112	Second	6.9	93
50,000 to 250,000	7.7	104	Third	7.2	97
10,000 to 50,000	7.4	100	Fourth	7.5	101
2,500 to 10,000	7.3	99	Fifth and over	7.7	104
Rural	6.9	93	Age of mother[3]		
Sex[1]			15-19 years	9.0	122
Male	6.7	91	20-24 years	7.3	99
Female	8.1	109	25-29 years	6.7	91
Color[1]			30-34 years	7.2	97
White	7.0	95	35-39 years	7.7	104
Nonwhite	9.7	131	40-44 years	7.7	104
Plurality[1]			Outcome of previous deliveries[3,4]		
Single birth	6.4	86	No previous fetal death	6.2	84
Plural birth	53.0	716	Previous fetal death	10.0	135
			Attendant[1]		
			Physician, in hospital	7.5	101
			Physician, not in hospital	6.9	93
			Midwife, other, not specified	6.4	86

SOURCES:

[1]National Center for Health Statistics, "Weight at Birth and Survival of the Newborn, by Geographic Divisions and Urban and Rural Areas, United States, Early 1950," by J. Unger, Vital and Health Statistics, Series 21, No. 4, Public Health Service, Washington, D.C., July 1965. (reprint)

[2]National Center for Health Statistics, "Weight at Birth and Survival of the Newborn, United States, Early 1950," by S. Shapiro and J. Unger, Vital and Health Statistics, Series 21, No. 3, Public Health Service, Washington, D.C., July 1965. (reprint)

[3]National Center for Health Statistics, "Weight at Birth and Survival of the Newborn, by Age of Mother and Total-Birth Order, United States, Early 1950," by J. Loeb, Vital and Health Statistics, Series 21, No. 5, Public Health Service, Washington, D.C., July 1965. (reprint)

[4]Based on multiparous mothers of single live births.

Table 27. Incidence of low birth weight among subgroups of single white births: New York State, exclusive of New York City, 1950-52

Characteristic	Percent 2,500 grams or less	Index
Total	7.1	100
Father's occupation group		
Nonagricultural		
Professional	6.1	86
Managerial	6.5	92
Sales workers	6.9	97
Clerical workers	6.7	94
Craftsmen	7.1	100
Operatives	7.5	106
Service workers	7.6	107
Nonfarm laborers	8.1	114
Agricultural		
Farmers	6.0	85
Farm laborers	6.8	130
Not classified	11.5	162
Age of mother		
Under 20 years	8.9	125
20-24 years	6.9	97
25-29 years	6.5	88
30-34 years	7.1	100
35-39 years	8.3	117
40 years and over	9.6	135
Gestation		
Under 37 weeks	59.2	834
37-40 weeks	3.7	52
41 weeks and over	1.6	23

SOURCE: H. C. Chase, "The Relationship of Certain Biologic and Socio-Economic Factors to Fetal, Infant, and Early Childhood Mortality, Part II, Father's Occupation, Infant's Birthweight and Mother's Age," New York State Health Department, Albany, New York, 1962.

to mothers who had previously experienced fetal deaths, nonwhite infants, and infants born to mothers 15-19 years of age.

Turning to the Upstate New York data, once again the greatest relative differential in the incidence of low birth weight infants is for those with gestation under 37 weeks (table 27). This group is followed by those with father's occupation not specified (probably mostly illegitimate births), those born to mothers 40 years and older, and infants of agricultural laborers. With regard to social class, these findings are similar to those of the British Perinatal Study. That study showed a "steady increase in the incidence of curtailed pregnancy (28-37 weeks) as family social class falls." The highest incidence of curtailed pregnancy in that study was found among unmarried mothers.

The United States and New York State studies are based on births in January-March 1950 and in 1950-52, respectively. Completion of the U.S. study relating to 1960 live births which is currently in process at the National Center for Health Statistics will provide data a decade later than the 1950 studies. It will be possible to analyze changes which have occurred between 1950 and 1960, the decade in which infant mortality appears to have changed its course.

PREVIOUS LOSS

In addition to the factors already mentioned, a history of reproductive loss in previous pregnancies is correlated with outcome in ensuing pregnancies. Among women whose current pregnancy terminates in a loss (fetal or neonatal death), the previous loss rate is higher than among women presently delivering infants who survive the neonatal period. Furthermore, the type of loss is selective. Women whose current pregnancy ends in fetal death have higher previous fetal loss rates than women whose current pregnancy results in neonatal death; these women in turn have rates which are higher than for women whose current newborn infants survive the neonatal period. There is similar correlation between neonatal loss in the current delivery and death among prior liveborn infants.[28, 38] These relationships persist in all socioeconomic levels and are not attributable to that characteristic alone.

Other studies have shown the relationship to be even more complex. According to Butler, infant loss (stillbirth or neonatal death) is also more likely among mothers who previously had premature live births.[5] From a health insurance plan population, Shapiro has shown that women whose last immediate pregnancy terminated in a fetal death or low birth weight infant had higher rates of loss in succeeding pregnancies.[49] In this study, "loss" was used to characterize any pregnancy which resulted in a fetal death, a neonatal death, an infant of low birth weight, or one born with congenital anomalies. Furthermore, women whose preceding pregnancy had ended in premature birth had higher risks of premature birth in their ensuing pregnancies.

Except for special studies outlined above, there are no nationwide data for the United States on this subject, or on the contribution of such high-risk groups to the international differences. There has emerged the concept of a group of women who, for unknown reasons at the present time, have a higher risk of unfortunate outcomes in successive pregnancies. This may be related to genetic or constitutional characteristics of this group of individuals or to other factors which affect individuals in such a way as to generate repeated occurrences of reproductive failure. This phenomenon has found acceptance in medical circles in the United States. Under the auspices of the Children's Bureau, there are currently underway 51 projects in 34 States and the District of Columbia whose purpose is to identify high-risk groups of pregnant women and to afford them hospital care which they might not otherwise be in a position to obtain. It is too early to report any results from these projects. Under the National Health Service in Great Britain, national policy has been established for hospital care for delivery based on the concept of high-risk groups. Births to mothers in certain age groups, to mothers of high parities, and to mothers with adverse prenatal histories are eligible for hospital care under the National Health Service. These are considered priority groups in need of hospital care at time of delivery.

SOCIOECONOMIC DIFFERENCES

Since 1911, British statistics have repeatedly shown an inverse relationship between parental social class (determined from the father's occupation) and fetal and infant mortality. The British Perinatal Study provides similar data,[5] and other studies have been extended to include variables such as maternal stature and social class of the maternal father.[50]

With the initiation of the National Health Service in Great Britain, a common base of antepartum, partum, and postpartum care became available to the entire childbearing population. Although there were significant declines in infant mortality in each of the social classes in the first half of this century, the relative differences between the classes have not decreased. In fact, the British Perinatal Study suggests that the gap between the classes may have widened even at a time when medical care was readily available to the entire population.[5]

Comparable data for the entire United States are unavailable. However, studies for Upstate New York in 1950-52 (table 28) and California in 1959 [37, 38] have provided data by father's occupation group. These studies reaffirm an inverse relationship between mortality and the level of the father's occupation group similar to the British experience.

In the United States, medical care for deliveries is arranged on a private basis with a

Table 28. Percentage distribution of live births, and fetal, neonatal, and postneonatal mortality rates, by father's occupation: New York State, exclusive of New York City, 1950-52

[Based on single white births]

Father's occupation at time of infant's birth	Percentage distribution of live births	Mortality rates		
		Fetal[1]	Neonatal[2]	Postneonatal[3]
Total	100.0	15.9	16.3	5.3
Nonagricultural				
Professional	14.1	12.8	14.1	3.7
Managerial	9.4	13.3	15.2	3.5
Sales workers	5.8	14.3	15.0	4.6
Clerical workers	6.1	14.9	14.3	3.9
Craftsmen	24.3	15.5	16.0	5.0
Operatives	20.0	17.8	17.4	6.0
Service workers	3.4	17.8	18.3	5.6
Nonfarm laborers	8.5	18.0	18.8	9.6
Agricultural				
Farmers	4.8	17.7	15.9	6.4
Farm laborers	0.7	18.1	20.4	8.3
Not classified	2.9	22.7	22.8	6.8

[1] 20 weeks or more gestation per 1,000 live births and fetal deaths.

[2] Under 28 days per 1,000 live births.

[3] 28 days-11 months per 1,000 survivors to 28 days among births.

SOURCE: H. C. Chase, "The Relationship of Certain Biologic and Socio-Economic Factors to Fetal, Infant, and Early Childhood Mortality, I, Father's Occupation, Parental Age, and Infant's Birth Rank," U.S. Department of Health, Education, and Welfare, Children's Bureau, 1964.

general practitioner or obstetrician. It is usually only in cases of restricted finances that patients attend prenatal clinics run by health departments or hospital outpatient departments. Among lower socioeconomic groups, medical care is often relegated to a position outside the range of the family's financial resources. In some groups (e.g., lowest part of the nonwhite segment of large city populations), as many as 30 to 40 percent may have had no prenatal care at the time of delivery.

Until further data become available for the United States as a whole, it is impossible to pursue the quantitative magnitude of the socioeconomic differences with one exception—the nonwhite population. This separate social group consistently has infant mortality rates which are about twice those of its white counterpart. This contrast is greater than that by father's occupation groups among white infants alone.

ILLEGITIMACY

The attitude of society toward illegitimacy has become more tolerant in the past several decades, more so in some countries than in others. These attitudes affect the quality and, in fact, the availability of statistical information.

International comparisons of mortality and illegitimacy are, at present, virtually impossible because of lack of standard definitions and comparable data. In the United States, a birth is termed "legitimate" if the parents are married at time of the infant's birth. For some of the other countries, legitimacy is determined by the marital status at time of conception. These and other differences make international comparisons virtually impossible.

However, for individual countries, it is possible to compare trends in mortality among illegitimate and legitimate infants, regardless of their definitions. In Denmark, for example, perinatal mortality in 1962 was 24.1 per 1,000 for legitimate births and 34.1 for illegitimate births.

According to the British Perinatal Mortality Survey, perinatal "mortality in illegitimate babies over 2,500 grams is considerably above average, and indeed is 20 percent higher than that of social class 5" (the lowest ranking social class).[5] Furthermore, women with no husbands have a prematurity rate of 10.8 percent which was 30 percent higher than that of the lowest social class. The total illegitimacy rate among single births was 4 percent.

Table 29. Percent illegitimate[1] live births: selected countries, 1950-64

Year	Denmark	England and Wales	Netherlands[2]	Norway	Scotland[3]	Sweden	United States[4]		
							Total	White	Nonwhite
	Percent								
1964	---	7.2	---	---	5.4	13.1	6.8	3.4	24.5
1963	---	6.9	1.6	3.9	5.2	12.6	6.3	3.1	23.6
1962	8.3	6.6	1.5	3.8	4.8	12.4	5.9	2.8	23.0
1961	8.0	6.0	1.4	3.7	4.6	11.7	5.6	2.5	22.3
1960	7.8	5.4	1.4	3.7	4.4	11.3	5.3	2.3	21.6
1959	7.3	5.1	1.4	3.6	4.2	10.4	5.2	2.2	21.8
1958	7.2	4.9	1.2	3.6	4.1	10.2	5.0	2.1	21.2
1957	6.9	4.8	1.2	3.5	4.1	10.1	4.7	2.0	20.7
1956	6.8	4.8	1.2	3.5	4.3	10.2	4.6	1.9	20.4
1955	6.6	4.7	1.2	3.4	4.3	9.9	4.5	1.9	20.2
1954	6.7	4.7	1.3	3.5	4.5	9.8	4.4	1.8	19.9
1953	6.9	4.7	1.3	3.6	4.7	9.8	4.1	1.7	19.1
1952	6.8	4.8	1.4	3.7	4.8	9.9	3.9	1.6	18.3
1951	7.0	4.8	1.4	4.0	5.1	10.1	3.9	1.6	18.3
1950	7.4	5.1	1.5	4.1	5.2	9.8	4.0	1.7	18.0

[1] "'Illegitimacy' refers to legal illegitimacy recorded on the birth record, that is, it is a characteristic of a child 'born out of legal wedlock, as determined by laws of each country." See U.N. Demographic Yearbook, 1959, pp. 39-40.

[2] Includes births occurring outside country if one or both parents are included in Netherlands population register.

[3] Data tabulated by year of registration rather than occurrence.

[4] Refers only to births occurring within the United States, Alaska beginning 1959, and Hawaii, 1960. Data on illegitimacy are estimated from a varying number of States with this information. Based on a 50-percent sample except for 1950 and 1955. Figures by color exclude residents of New Jersey for 1962 and 1963.

In the United States, a number of States prohibit any entry concerning legitimacy on their vital records. Therefore, for this country, information is available for only a limited number of States. Estimates of the incidence of illegitimate births increased during the period 1950-64 (table 29). One of the outstanding contrasts in the data is the marked difference in the incidence of illegitimacy between the white and nonwhite groups of the population. If the differentials in mortality which have been observed in Denmark and in England and Wales exist in the United States as well, the effect on the rates for nonwhite infants would be significant.

DISCUSSION

Excess fetal and infant mortality are associated with a number of demographic variables, and the relationships have been documented in a number of studies. For some of the characteristics, international comparisons are virtually impossible because of the lack of common definitions, e.g., urban-rural, illegitimacy. In the United States, the population is steadily gravitating toward urban centers, and in a number of these infant mortality is higher than in the surrounding areas. However, it is difficult to compare a city like New York or Los Angeles, each with a population of more than 6 million in 1960, with cities like Copenhagen, Amsterdam, or Edinburgh. A second characteristic, illegitimacy, is not uniformly defined in the various countries and the statistics are not directly comparable for that reason. Estimates based on a limited number of States in the United States suggest that the rate of illegitimate births is increasing, and mortality among illegitimate infants is known to be higher than among legitimate births. For these characteristics, statistically comparable international data are nonexistent.

Inverse relationships between mortality and socioeconomic levels are generally accepted. However, there are no national data for the United States except for the division between white and nonwhite infants. Despite their higher mortality, the increasing proportions of nonwhite infants are not sufficiently large to account for the deceleration in trend in the United States. Furthermore, the relationship between this country and other countries is not changed materially when that comparison is limited to white infants in the United States.

Studies of fetal and neonatal mortality related to previous loss are consistent in pointing to a group of high-risk women having repetitive losses. However, it is not completely clear whether these losses are associated with biologic or socioeconomic factors; both have been implicated.

The neonatal mortality among low birth weight infants is over 20 times as high as that of infants weighing more than 2,500 grams at birth. Although fully documented evidence of the international distributions is lacking, there are suggestions that the incidence of low birth weight infants may be significantly higher in the United States than in the Netherlands or Sweden. At present, this may be considered a hypothesis for further exploration. The effect of the difference, if found to be true, may account for a considerable portion of the difference in neonatal mortality between the United States and these countries of low infant mortality.

The incidence of low birth weight infants is higher among low socioeconomic groups, among young mothers under 20 years of age, in highly populated urban areas, and particularly among infants with curtailed gestations. This higher incidence of low birth weight infants may account for part of the associated elevated mortality in these groups. Because of lack of factual evidence, these issues cannot be resolved at present.

For only a few demographic characteristics can definite statements be made. With regard to color, in the United States similar changes in trend were observed for nonwhite as well as white infants. With regard to sex of the infant, the differences in sex ratios between the countries included in this report cannot account for the variations which were found in mortality. With regard to mother's age and parity, the variations in births related to these factors may account for part but not all of the difference between the Netherlands and the United States, the two countries which are most divergent with regard to these characteristics.

Examination of all of these demographic characteristics does not identify any single characteristic which completely explains the varia-

tions in mortality. Data permitting, these various characteristics can also be considered for their combined effect on mortality. Pending such studies, the results cannot be estimated by adding the separate effects because of the intercorrelation. For example, high parity births, older mothers and fathers, low socioeconomic levels, and low birth weight infants are positively correlated. Effects of two or more characteristics can be obtained by cross-tabulation of a number of variables, a procedure which demands a large volume of data for study.

Since postneonatal mortality has progressively become a smaller part of infant mortality, fetal and neonatal mortality have assumed relatively greater importance. As a consequence, those factors which are associated with higher fetal and neonatal mortality also assume greater importance.

Prominent among the correlates of elevated fetal and neonatal mortality are multiple birth, older mothers, low birth weight, and short gestations. Although the relative mortality among multiple births is markedly higher, their incidence is relatively low (2.1 percent in the United States in 1958).

The relationship with regard to mother's age is somewhat different. Fetal and neonatal mortality are somewhat higher among mothers 30 years or older than for all ages combined. Although about 25 percent of births in 1963 were to mothers in these ages, the excess mortality is not as marked as for multiple births, and the combined effect of incidence and elevated mortality is not great.

The pattern with regard to low birth weight and gestation is different also. The relative mortality among small or premature infants is markedly higher than among infants weighing more than 2,500 grams, or those with gestations of 37 weeks or more. Furthermore, these low birth weight infants comprise almost 8 percent of live births, and the combined effect of the incidence and mortality experience is greater for prematurity and/or immaturity than for mother's age or multiple birth.

Pursuit of international studies of prematurity would require widespread effort. Most European countries do not request birth weight information on birth records. Further progress in this area may be expected in accord with the 1961 recommendation[42] of the WHO Expert Committee on Maternal and Child Health:

> *The Expert Committee, therefore, recommends that birth registration should be as complete as possible and that, as soon as is practicable, birth weight be added to the official birth certificate used in each country.*

At least two of the countries included in the report (Denmark and Sweden) are collecting and will be tabulating data by birth weight.

In addition to obtaining birth weight, there is need for reliable information on gestation as well. An examination of the recorded weeks of gestation for fetal deaths in the United States implied gross misreporting in comparison with gestations which are computed from the first day of the last normal menses.[51] Changes in this item for U.S. certificates require revision of the vital records of a large number of States. Among the other countries, revision of official records would also be required, but would be somewhat simplified because a common record is used throughout each country.

Improved information on birth weight and gestation would permit studies of the incidence of low birth weight or curtailed gestation. However, the crucial element would be the establishment of combined death and birth records. This can be accomplished in the vital statistics office after registration, as in the United States, or through the design of a combined neonatal death and birth record as proposed by the Medical Statistics Committee on Australia.[52]

In the United States, emphasis is needed on improved recording of gestation information and on analyses of mortality in relation to indexes of prematurity and immaturity. More intensive investigation of these variables seems to be the most promising lead to unraveling the reasons for changes in mortality trends.

SUMMARY

The association of fetal and infant mortality with selected demographic factors has been well established. Higher mortality is associated with very young and old mothers, first and high order births, prematurity, mother's previous repro-

ductive loss, low socioeconomic levels, and illegitimacy. Associations with father's age after cross-tabulation with mother's age have been supported by several studies in the United States [33, 38] but unsupported by similar studies of fetal mortality in New Zealand.[53]

Although variations in mortality exist in relation to these variables, the point at issue is whether these differentials could account for international differences in mortality. As each of the variables was examined and discussed in turn at the Center's conference, the results were found to be inconclusive. A comparison of available data with regard to geographic variation, color, sex, maternal age and parity, low birth weight, previous loss, socioeconomic levels, and illegitimacy failed to demonstrate any single factor as clearly responsible for the deceleration in trend in the United States. Prematurity and/or immaturity evolved as a hypothesis for future investigation.

VI. MEDICAL CARE AND OBSTETRIC PRACTICE

Good prenatal medical care is commonly accepted as one of the cornerstones of infant and maternal health. Although the countries included in this comparison have generally been characterized as having "advanced" medical education and medical care, differences exist among them in medical care associated with pregnancy, delivery, and infancy. Some of the chief differences have been suggested by Rutstein.[54] The number of prenatal visits, place of delivery, attendant at birth, and period of confinement vary considerably. Some of these characteristics can be documented from available data. For more precise information, such as that on anesthetics, surgical intervention, and resuscitation of the newborn infant, international data are unavailable.

MEDICAL CARE

One of the outstanding differences in maternity care between the United States and the west European countries is the use of nurse-midwives. In the west European countries, a great deal of prenatal care is supervised by nurse-midwives, and sizable proportions of births are delivered by them. Midwifery is regarded as a "specialized branch of the nursing profession" in England.[55] In England and Wales, a nurse-midwife is a registered nurse with an additional year of training in hospitals and home midwifery. She is required to call for medical aid for any abnormality during pregnancy, labor, or the puerperium. Her license is withdrawn if she fails to practice for 6 months, and it can be reinstated only after a period of retraining. A 3-year period of training is required in Denmark and the Netherlands. In the latter country, once midwives have been licensed, they are permitted to practice quite independently of physicians. As in England, midwives are required to refer complicated cases to physicians and are restricted as to the care they may render—in effect, caring for women with uncomplicated pregnancies and attending normal deliveries.

In the United States, the term "midwives" has had a different connotation. In the past, midwives consisted of two groups: one, a group of largely untrained women who immigrated with the large influx of migrants in the early part of this century; and the second, another group, also with limited training, who lived predominantly in the rural areas of the country. The immigrant midwives have largely disappeared due to their aging, but a group of practicing midwives is still to be found among the nonwhite rural population. In 1963, for example, 0.3 percent of white live births and 9.1 percent of nonwhite live births in the United States were attended by midwives.

In recent years there has been increasing interest in programs for training nurse-midwives. In 1963, there were only 495 known nurse-midwives in the United States and only 15 percent of a sample of these were practicing or teaching nurse-midwifery.[56] Because of their limited numbers, nurse-midwives have little effect on the overall mortality experience in the United States.

Prenatal Care

In the United States, the recommended practice has been for a woman to seek medical attention as soon as she suspects she is pregnant. Thereafter, a regular program of periodic visits to a physician or obstetrician, followed by delivery in a hospital with the advantages of medical attention close at hand, is advised. This pattern of maternity care has been advocated for several decades and is generally accepted as desirable by a majority of women.

Prenatal care is usually a matter of private arrangement between the patient and the physician, and when prenatal care is sought, it is generally provided under the supervision of a physician. For those unable to pay for care by a private physician, prenatal clinics are available. These clinics, which emphasize preventive care, are conducted under the auspices of local governments (cities or States), voluntary agencies, or hospitals. In some of these clinics, small fees are charged but services are predominantly free. Such clinics are often crowded.

Inpatient maternity care in hospitals at time of delivery is generally covered in part by some form of hospital insurance which is purchased by the family, sometimes with partial payment by the employer. However, insurance benefits for maternity care are not adequate to meet the entire costs in most instances and must be supplemented with personal or other funds to make up the difference. The benefits are often limited to a flat fee of $75 or some such stipulated amount. For women without hospital insurance or those who are unable to pay for hospital delivery, such services are obtainable from public hospitals but these facilities are usually overcrowded.

In the west European countries, prenatal care for the insured population is provided through their social insurance systems. In Denmark and the Netherlands, for example, the insured are entitled to a specified number of prenatal visits according to a predetermined schedule for normal pregnancies. Additional free visits are permitted for pregnancies with complications. As an example, in Denmark pregnant women are allowed nine free consultations during pregnancy: three with a physician and six with a midwife.[57] The scheduling is as follows:

Physician—first visit, as early as possible
second visit, 25th week of pregnancy
third visit, 34th-36th week

Midwife—six visits in the 20th, 30th, 33d, 37th, 38th, and 39th weeks

In England and Wales, the schedule of prenatal visits is monthly until 28 weeks, then every 14 days until 36 weeks, and thereafter weekly until delivery.[58] The selection of a physician or midwife who will provide prenatal care is left to mutual agreement between physician and patient at the first prenatal visit.

In addition, in each of the west European countries certain maternity leave, food and milk, and cash benefits as well as family allowances are included in the social insurance systems (see appendix). In the Netherlands, health insurance is compulsory for the lowest income groups, but optional for higher income groups. In Great Britain, all persons are covered by the National Health Insurance and hospitals are under government control. Medical care is supported by national taxation, weekly contributions by taxpayers, local taxes, and limited charges. Physicians are paid on a per capita basis for each patient enrolled.

Data relating to prenatal care from a special study in Great Britain together with those for a few areas of the United States are shown in table 30. Although the grouping of weeks of gestation is not uniform, the data indicate the wide variability which is to be found in the timing of the first prenatal visit even in parts of the United States. For example, the proportion seeking "early" prenatal care (first 3 months of pregnancy) varied from less than 50 percent in Washington, D.C., to about 65 percent in Kansas and about 70 percent in Iowa. These percentages are affected by the nature of the population, but suggest that although the majority of women seek prenatal care early in pregnancy, a sizable proportion do not. In this country, prenatal care is generally understood to mean a visit to a physician or to a clinic in contrast to some of the west European countries where prenatal care includes care by a nurse-midwife. In the Netherlands, "half of pregnant women place themselves under supervision of doctor or midwife before 18 weeks of gestation, the first visit usually being earlier when attending a doctor."[10] The association between prenatal care and the overall neonatal or infant mortality experience has been studied in the United States, but the conclusions are controversial.[59, 60] Nevertheless, there is general agreement in the United States as in the other countries of the value of early prenatal care as a screening device for identifying pregnant women who should be under closer medical supervision or who should be booked for hospital delivery.

Although it seems that a majority of women in the United States seek prenatal care in the first trimester of pregnancy, also of interest are those women who wait until late in pregnancy for their first visit or those who have no prenatal care by the time they are delivered. Following are the proportions who either seek care

Table 30. Number and percentage distribution of births, by duration of pregnancy at first prenatal visit: Great Britain and selected areas of the United States

Area and duration of pregnancy at first prenatal visit	Births	
	Number	Percentage distribution
GREAT BRITAIN (March 3-9, 1958)[1]		
Total—single live births and stillbirths	16,994	100.0
1-7 weeks	662	3.9
8-15 weeks	7,634	44.9
16-23 weeks	5,460	32.1
24-31 weeks	2,146	12.6
32-35 weeks	392	2.3
36 weeks or more	152	0.9
No prenatal care	100	0.6
Not stated	448	2.6
UNITED STATES		
California (1959)[2]—live births		
Third trimester or no prenatal care	---	10.2
Iowa (1963)[3]		
Total—live births	56,183	100.0
1-3 months	40,641	72.3
4-6 months	12,636	22.5
7 months or more	2,450	4.4
No prenatal care	116	0.2
Not stated	340	0.6
Kansas (1960-61)[4]		
Total—live births	97,547	100.0
First trimester	62,965	64.5
Second trimester	25,512	26.2
Third trimester	6,250	6.4
At delivery	1,548	1.6
Not stated	1,272	1.3
Washington, D.C. (1963)[5]		
Total—live births	33,095	100.0
Under 14 weeks	14,013	42.3
14-27 weeks	8,703	26.3
28-35 weeks	3,080	9.3
36-39 weeks	620	1.9
40 weeks or more	109	0.3
No prenatal care	3,463	10.5
Not stated	3,107	9.4

SOURCES:

[1]N. R. Butler and D. G. Bonham, Perinatal Mortality, E. & S. Livingstone, Ltd., Edinburgh and London, 1963.

[2]State of California Department of Public Health, Perinatal Mortality and Survival, 1949-59.

[3]Iowa State Department of Health, Division of Vital Statistics; Iowa Annual Report, 1963.

[4]Kansas State Department of Health, Divisions of Vital Statistics and Maternal and Child Health; Kansas Perinatal Casualty Report, 1960-61.

[5]District of Columbia Department of Public Health, Vital Statistics Summary, 1963.

in about the last trimester or those who have received no such care at time of delivery:

	Percent
England and Wales[5] (24 weeks or more, or no prenatal care)	16.4
United States	
California[37] (third trimester, or no prenatal care)	10.2
Iowa[61] (7 months or more, or no prenatal care)	4.6
Kansas[62] (third trimester, or at delivery)	8.0
Washington, D.C.[63] (28 weeks or more, or no prenatal care)	22.0

Data from the States of California, Iowa, and Kansas suggest smaller proportions of women postpone their first prenatal visit until "late" in pregnancy than is the case in England and Wales. The rate for Washington, D.C., is less representative of the United States as a whole, since about 70 percent (1963) of its live births are nonwhite.

Place of Delivery

There are marked differences between the United States and some of the other countries with regard to the proportion of births which occur in hospitals, at home, or elsewhere. Hospitals are by far the predominant place of delivery in the United States, and virtually all registered live births as well as fetal deaths occur in hospitals. With Norway and Sweden, the United States stands near the top of this group of nations in the percent of deliveries occurring in hospitals or maternity units. The proportions of births occurring in specified locations are as follows:

Denmark - 1962

Private clinics	10 percent
General hospitals	21 percent
Obstetric departments	23 percent
Home	46 percent

England and Wales - 1958

Hospitals	49 percent
Maternity units	11 percent
Home	35 percent
Other and unknown	6 percent

Netherlands - 1960-62

Hospitals or maternity homes	
All births	29 percent
Live births	28 percent
Stillbirths	60 percent

Norway - 1962

Hospitals or maternity wards	96 percent

Scotland - 1963

Hospitals	79 percent

Sweden - 1960

Hospitals, *live* births	99 percent

United States - 1963

Hospitals	
Live births	97 percent
Registered fetal deaths (20 or more weeks of gestation)	94 percent

In the Netherlands, the home is the predominant place of delivery. In part, this lower proportion may be the result of health benefits provided by the sickness funds, since the family is not reimbursed for a normal delivery which occurs in a hospital. Yet, despite the large proportion of home deliveries, the Netherlands enjoys a favorable infant mortality rate.

Duration of Hospital Stay

There are several cooperative statistical systems in the United States collecting data from a number of hospitals and producing statistical information for the use of their members and other interested individuals. These include the Obstetrical Statistical Cooperative, the Perinatal Study of the Foundation for Medical Research, and the Professional Activity Study of the Commission on Professional and Hospital Activities. In addition, the Collaborative Perinatal Research Project of the National Institute of Neurological Diseases and Blindness is able to supply similar data. Each of these studies compiles statistics relating to childbirth in a hospital setting; none purports to use a scientific sample of the population. While such selected samples are generally not useful in establishing national rates, they are useful in estimating experience with regard

to certain medical practices associated with deliveries, which, in this country, are highly concentrated in institutions.

The Collaborative Project of the National Institute of Neurological Diseases and Blindness is based on data from 14 leading medical centers distributed across the United States. By 1965, 50,000 women had been enrolled in the study.[64]

The Obstetrical Statistical Cooperative consists of a group of 18 hospitals, also distributed across the United States. These hospitals are either associated or affiliated with a medical school and therefore may have an incidence of complications which is higher than the rate in all hospitals, or in the general population. In one year, 1962, the Cooperative's data were based on 59,884 deliveries. The patients are described as "a mixture of private and service patients of the more 'difficult kind.' "[65]

The Perinatal Study of the Foundation for Medical Research is based on data from about 150 hospitals distributed over 43 States, the District of Columbia, and Puerto Rico. The group varies from large urban teaching institutions to small community hospitals, and includes 17 medical school hospitals. Each hospital has 500 or more deliveries per year. Four years' experience (1961-64) included 659,001 deliveries.[66]

The Professional Activities Study of the Commission on Professional and Hospital Activities (PAS) collects coded information from member hospitals and provides them with statistical data for their own use. In 1963, the 267 hospitals constituting the PAS group were located in over 30 States, with over half in the North Central States. They were predominantly nonprofit institutions. The majority of the hospitals fell in the 100-499-bed category; total discharges were 2½ million that year.[67]

The average period of hospital stay for confinement is affected by the proportion of deliveries occurring in hospitals, the supply of hospital beds, and the availability of financial resources for women needing such care. For example, in the United States, the period of hospital confinement for delivery was 8-10 days in the 1930's. Under the pressure of a rapidly increasing birth rate and little hospital construction during World War II, the average length of hospital stay gradually grew shorter. Despite an extensive hospital construction program in the 1950's, the hospital stay for maternity care continued to decline. This was probably related to increased early ambulation of maternity patients as well as other patients. Based on July 1963-June 1964 data from the Center's National Health Survey, the average hospital stay in the United States was as follows:[68]

All deliveries	4.2 days
Cesarean sections	8.6 days
All other deliveries	4.0 days

Survey data for July 1960-June 1961 show that the average stay increased with family income:[69]

Age 17-24 years	
Income under $4,000	3.7 days
Income $4,000 and over	3.9 days
Age 25-44 years	
Income under $4,000	3.4 days
Income $4,000 and over	4.3 days

By regions, the average stay varied from 3.2 to 4.6 days:[69]

Northeast	4.6 days
North Central	4.2 days
South	3.5 days
West	3.2 days

In a study of 21 hospitals which were part of the group subscribing to the Commission on Professional Activities Study in January-March 1964, the average stay among 12,377 normal delivery patients varied by hospital from an average of 3.0 to 5.3 days.[70] The following distribution by length of stay was found:

3 days or less	39 percent
4-6 days	52 percent
7 days or more	9 percent

There was wide variation among hospitals in the percent of delivery patients who stayed 3 days or less: the proportions ranged from a high of 83 percent to a low of 9 percent, with an overall rate of 39 percent.

Data from the Perinatal Study of the Foundation for Medical Research based on 659,001 ma-

ternity patients in 1961-64 showed a similar pattern:[66]

3 days or less	31.3 percent
4-6 days	59.6 percent
7 days or more	9.0 percent

Maternity patients, even more so than other patients, are caught in the crosscurrents of rising hospital costs and rigid insurance benefit limitations. Uniform benefits of $75 per normal delivery, which exist in many health insurance policies, will often cover no more than 3 days of inpatient care. Additional costs must be borne by the patient, who may press for early release from the hospital for this reason.

What is the effect of early discharge from the hospital? At the Center's Conference on the Perinatal and Infant Mortality Problem of the United States, it was pointed out that the "trend in this country, regardless of the availability of hospital beds has been to keep the period of confinement to a much lower period of time and we have thought this was a distinct advantage to mother, to baby, and to hospital to shorten the stay, although not to unreasonable periods."[17] The reversal in trend of early neonatal mortality raises a question concerning the neonate's welfare. How much of the increase may be associated with discharges very soon after delivery? Hospital stays as short as 18 hours were indicated to occur frequently in some large institutions. Are these very early discharges associated with such severe financial and home problems that sending the neonate home soon after birth may be harmful?

For the west European countries, the average period of confinement for mothers whose infants are delivered in hospitals is generally longer than for the United States:

England and Wales	10 days
Netherlands	10-12 days
Scotland	9 days
United States	4 days

In the European countries listed above, because of national policy and patterns of maternity care, hospital deliveries consist of higher proportions of complicated deliveries and high-risk groups than in the United States. For example, national policy in Great Britain stipulates that mothers who experienced complications in previous pregnancies constitute one among several high-risk groups which are eligible for hospital benefits under the National Health Service. In the Netherlands, under the provisions of sick funds, families are not reimbursed for hospital care for normal deliveries. Hospital deliveries in that country consist of complicated pregnancies, cases of difficult labor or other obstetrical problems, and normal deliveries among those willing to pay their own hospital costs. Under these circumstances, the period of confinement would be expected to be longer in these countries than in the United States where normal deliveries far outnumber complicated deliveries in hospitals.

Attendant

Since over 97 percent of live births and 94 percent of registered fetal deaths are delivered in hospitals in the United States, it may be assumed that a physician was in attendance at the majority of these. The term "physician" as used here is intended to include obstetrician, general practitioner, or resident. In view of the relatively few nurse-midwives in this country, they cannot have a significant impact on the large number of deliveries.

In England and Wales, the woman generally consults a general practitioner when she suspects she is pregnant. It is then decided whether she will have her baby at a hospital, a General Practitioner Unit, or at home, and whether her prenatal and delivery care will be under a physician or midwife.[55] General Practitioner Units are small maternity units, usually having fewer than 25 beds and staffed by midwives, to which one or more physicians send their patients for delivery. Data from the British Perinatal Study show that a midwife was the senior person present at the actual delivery of about 70 percent of births whether the births occurred in hospitals, in General Practitioner Units, or at home.[5]

In the Netherlands, although only 30 percent of live births are delivered in hospitals, about 60 percent of all births are attended by physicians (general practitioners or obstetricians). It is obvious from these proportions that a significant portion of home deliveries are attended by physicians. For normal pregnancies or deliveries,

insurance benefits are available for the service of a midwife, or for a physician if no midwife is practicing in the area. However, for complicated pregnancies or difficult deliveries, physicians' services are approved.

In Norway, although 96 percent of births occur in hospitals and maternity wards, as a rule they are attended by midwives. However, in hospitals, physicians are available for difficult or complicated deliveries.

The relationship of factors of hospital delivery, period of hospital confinement, and attendant at birth to fetal mortality and mortality during the first weeks of life is not entirely clear. Some countries with lower mortality than the United States have higher proportions of births occurring outside hospitals, and these births are attended by persons other than physicians. Although the periods of confinement are longer than in the United States, it cannot be immediately concluded that this factor is responsible for the lower rates because deliveries in hospitals in these other countries consist of higher concentrations of difficult cases.

Postnatal Care

In the Netherlands, in addition to nurse-midwives, there is another group of young women called "Maternity Home Helpers" who play a part in postnatal care. These young women receive 15 months of training in the care of the mother and/or her child, cooking, washing, and other household duties. Their training also includes care of older children and basic elements of obstetrics and newborn pathology.[10] These helpers serve for 10 hours a day for 10 days. One-half of the home deliveries, or about 35 percent of all births, have Maternity Home Helpers. With regard to infants, about 74 percent attend infant welfare centers. The first visit is generally between 3 and 8 weeks of age and an average of 10-11 visits are made in the first year. These are comparable to the "well baby clinics" of the United States in that they offer examinations of healthy infants, including vaccinations, and nutritional advice to the mother, but no treatment.

In England and Wales, the British Central Midwives' Board considers the lying-in period to be at least 10 days. In cases of home delivery, the midwife is responsible for providing care for that period. For women who are delivered in hospitals and who return home before the 10th day, home care by a midwife is provided up to 10 days after delivery. In 1960, 22 percent of babies went home on the seventh day or earlier, and these early discharges are increasing.[71] Home help for household services is available for a fee.

In Denmark, nine free examinations of children are provided.[57] These are at 5 weeks, 5, 10, and 15 months, and annually for the following 5 years. At these visits, immunizations are scheduled. These include protection against smallpox, diphtheria, tetanus, poliomyelitis, and pertussis. In addition to these services, public health nurses make home visits 10 times during the first year, but only one-third of Denmark is covered by such service.

In the United States, although almost all births occur in hospitals, the average hospital stay is relatively short—about 4 days. When the new mother returns home, her care is largely an individual matter. For a fairly large proportion, although the exact magnitude is unknown, the assistance of some family member or friend is obtained for a short period immediately following discharge from the hospital. In some areas, a public health nurse tries to visit the home to determine whether special care is needed, to provide health information, and to demonstrate techniques of infant care. However, because of increased demands on their time, such visits are generally on a selective basis, e.g., primiparae, complicated deliveries, congenitally malformed infants, prematurely born infants. These are State or local programs and, consequently, practice across the United States is not uniform. Postnatal care of the infant is provided by a family physician, a pediatrician, or a government or hospital clinic.

OBSTETRIC PRACTICE

The statement is sometimes made that obstetric care in the European countries is more "conservative" than in the United States. Is there any statistical evidence to support such a statement? The basic problems in considering this question are comparability of information and

uniformity of definitions from one country to another. Only a few characteristics can be assumed to have standard meanings for the several countries. Among these are cesarean section, use of forceps, episiotomy, and the administration of anesthetics, each of which is an overt act associated with delivery.

Cesarean Section

In the British Perinatal Study, 2.7 percent of single deliveries were by cesarean section.[5] In the Netherlands, an estimated 1.25 percent of all deliveries in 1958 were by cesarean section.[10] Several estimates are available for States of the United States, and groups of hospitals. Based on birth records for single live births in Upstate New York for 1964, 4.4 percent were by cesarean section.[72] Similar data for Kansas in 1962 yielded a rate of 3.3 percent for single live births as well as all live births; the rate increased to 3.4 percent when fetal deaths were included.[73]

Following are data from several of the cooperative statistical studies.

	Number of deliveries	*Percent cesarean section*
Collaborative Project, 1959-Nov. 1964[74]	≠16,954	4.2
Professional Activity Study, 1962[75]	142,437	4.3
Perinatal Study, 1961-64[66]	659,001	4.6
Obstetrical Statistical Cooperative, 1962[76]	59,884	5.7
White	42,840	5.8
Nonwhite	17,044	5.2

≠Single deliveries only.

All of these estimates exceed those for England and Wales and the Netherlands.

The data for England and Wales are based on single births occurring during one week (March 3-9, 1958). The three statistical cooperatives and NINDB's Collaborative Project are based exclusively on hospital populations and lack information relating to deliveries outside hospitals, an omission which probably is not serious in connection with cesarean sections. The data for Kansas and Upstate New York are based on vital records. From special studies conducted in New York, it was found that the reporting of cesarean sections on birth records is about 95 percent complete. Thus the estimated rate of cesarean sections in Upstate New York would increase from 4.4 to 4.6 percent for single live births. Based on these data, it seems that cesarean sections are conducted more frequently in the United States. In order for the British rate of 2.7 percent for single deliveries to reach 4.0 percent (a compromise among the three United States estimates), the number of cesarean sections among plural deliveries in Britain would have to exceed the number of plural births.

Breech extractions were reported for 2.2 percent of single births in England and Wales,[5] 1.4 percent of deliveries in 152 hospitals in the United States in 1961,[75] and 2.1 percent of single deliveries in 39 U.S. hospitals in 1964.[77] To some extent, lower rates of breech extractions in the United States may be offset by higher rates of cesarean sections. For, with higher proportions of hospital deliveries and closer availability of obstetric care in hospitals, operative procedures would probably be used more readily in the United States.

Forceps

According to a report from England and Wales, "In general, forceps are not used in this country except in the presence of a specific indication for assisted delivery."[58] The British Perinatal Study indicated that forceps were used in 4.7 percent of deliveries, but failed to further subdivide the type of forceps used.[5]

Based on a Professional Activity Study of 142,437 deliveries in 1961 at 152 hospitals in the United States,[75] the proportions were:

	Percent of deliveries	*Range among hospitals*
Low forceps	33.7	19.8-37.3
Midforceps	0.9	0.3-1.0
High forceps	0.03	0.02-0.06

The use of low forceps appears much more common in the United States. A larger PAS series of 325,812 delivery patients discharged in 1963 yielded a rate of 35.4 percent for deliveries with low forceps.[78]

Among the other cooperative statistical systems, the overall rates of forceps deliveries were of similar magnitude:

	Percent
Collaborative Project, 1959-Apr. 1962[74]	≠37.2
Perinatal Study, 1961-64[66]	36.2
Obstetrical Statistical Cooperative, 1962[76]	34.2
White	37.9
Nonwhite	24.8

≠Single deliveries only.

The reporting of this item on vital records is not sufficiently complete to be useful.

Episiotomy

The British Perinatal Study reported that episiotomy was performed in about 16.0 percent of deliveries (41.2 percent of hospital deliveries, 11.3 percent of home deliveries). In Great Britain, a midwife is permitted to perform an episiotomy, but its repair requires the services of a physician.

For the United States, the rates apparently are considerably higher. A study of 325,812 delivery patients discharged in 1963 from hospitals contributing information to the Commission on Professional and Hospital Activities showed that 67.4 percent of them had reported episiotomies, and this item is not felt to be completely reported.[79] More specifically:

	Number	*Percent*
Episiotomy without low forceps	113,944	35.0
Delivery by low forceps with episiotomy	105,571	32.4
Delivery by low forceps without episiotomy	9,668	3.0

The Obstetrical Statistical Cooperative yielded reported rates of 65.0 percent: 71.3 percent for white patients and 49.4 percent for nonwhite patients.[76]

Analgesia and Anesthetics

Analgesics and volatile anesthetics are rather widely used in Great Britain and the United States, but less in the Netherlands. In the PAS study of 211 hospitals in the United States, 82.7 percent of patients discharged from maternity services used some form of anesthetic. The most common form was inhalation anesthetic which was used in more than half of all deliveries requiring anesthesia.[80] According to the Collaborative Project, 82.9 percent of 17,244 single birth records which were processed between January 1959 and November 1964 reported the use of some form of anesthetic—gaseous, intravenous, or conduction.[74]

In the British Perinatal Study, 78.6 percent used some form of volatile anesthetic, and 24.6 percent used at least one of a specified list of analgesics.[5] The presentation of the British data precludes elimination of any overlap between the groups receiving anesthetics and analgesics. However, the most striking difference is the selfadministration of inhalation analgesia (primarily nitrous oxide and air) reported in the Perinatal Study. Under existing practice, this is permitted in home deliveries with midwives in attendance.

In the Netherlands, "analgesia is hardly practiced and not preferred by mothers."[10]

DISCUSSION

Judgmental decisions of the value of these various obstetric techniques require studied investigation of comparable information. It is clear that differences in obstetric practice do exist, but it is not always clear that practice reflects the best scientific thinking. In part, practice may reflect tradition such as a preference for delivery at home in the Netherlands, or use of anesthetics in Great Britain or the United States. In part, practice may reflect a compromise with existing situations such as the gradual reduction in the length of hospital stay for maternity pa-

tients in the United States. Or, practice may reflect an inertia which accompanies the initiation of new ideas in any nation. Assuming the necessary financial and personnel resources, the relative merits of various patterns of medical and obstetric care are amenable to investigation on an international scale.

The relative effect of socioeconomic and medical factors is also amenable to further investigation. While reported studies from a number of countries leave no doubt that differentials in infant mortality exist in relation to socioeconomic differentials, it is also true that for individual infants identified developmental or obstetric conditions increase the risk of death to an even greater degree: the twin pregnancy, the low birth weight baby, the malformed fetus present hazards which exceed those associated with socioeconomic differentials.

In the past two decades, attempts to reduce the socioeconomic differentials have been approached in an organized fashion in some countries. In the west European countries, social insurance was felt to answer many of the health problems associated with socioeconomic differentials. Nevertheless, in England and Wales, it has been recognized that after almost two decades of universal medical care, the socioeconomic differentials in infant mortality have not been eliminated.

In addition to socioeconomic factors, medical care, and obstetric practices, another hypothesis which has been proposed to explain some of the differences in infant mortality between the United States and the west European countries relates to heredity. It has been hypothesized that the populations of west European countries are largely homogeneous populations and, except for the periods of war and invasion, have not been affected to any great extent by immigration. The population of the United States, on the other hand, is described as a heterogeneous, multiracial, multiethnic population. While this is generally true, there remain a few clusters of descendants of homogeneous immigrant populations in the United States. The northern States of the Great Plains have concentrations of Scandinavian immigrants. Counties with high proportions of individuals of Scandinavian origin in Minnesota and North Dakota show more favorable birth weight distributions than counties with low proportions of individuals of Scandinavian origin.[18] The relationship is associative, having been derived from census and vital statistics data. It is, therefore, impossible to take other factors into account. Nevertheless, in other forms of animal life, selective breeding is used to generate desired characteristics in the offspring.[17] Among breeds of cattle, gestation length is said to be inherited. Is it possible that through many generations of low immigration to some west European countries, certain genetic characteristics have become concentrated? Could length of gestation or birth weight represent such inherited characteristics? It has been demonstrated from U.S. data that recurrent losses are concentrated in a small group of women, [30, 38] but not enough research has been completed to decide whether these are the result of inherited characteristics or other factors. Before such questions can be approached, it will be necessary to determine whether or not there are significant differences in the gestation or birth weight of infants in the countries concerned. Although birth weight and gestation are but two of the variables of interest, they are prime determinants of infant survival. Their effect extends beyond the neonatal period into the whole first year of life.

Answers to these questions will not be found through comparison of disconnected studies with varying study designs. Although a few comparisons may be possible fortuitously, they lack the assurance which is to be derived from a well-designed study planned to give answers to specific questions.

VII. POSSIBLE AREAS OF INVESTIGATION

The future course of infant mortality in the United States, as in the west European countries, remains to be unfolded. Commendable as advances during the first half of the 20th century were, they are part of the past. More realistic guides to future trends should be based on more recent experience. By 1950, the adverse effects of World War II were subsiding, and the 13-year period of observation (1950-62) provides a suitable base for fitting trend lines. Events such as war, epidemics, and major therapeutic or preventive advances cannot be predicted and are omitted from consideration here.

If the rates of decline which were experienced during the period 1950-62 continue, 10 years hence the infant mortality rates for the countries considered in this report would be:

Denmark	13.0
England and Wales	14.0
Netherlands	9.4
Norway	11.1
Scotland	16.5
Sweden	10.7
United States	22.0
White	18.5
Nonwhite	38.6

By 1975, the rate for the United States would exceed those of all of the other countries—in fact, the rate for the white infants alone would exceed those of all of the other countries (fig. 16). Furthermore, the rate for the white infants would be about double that of the Netherlands and would not yet have declined to the 1960 level of the rates for the Netherlands, Norway, or Sweden.

Independent estimates of the future course of infant mortality in the Netherlands indicate that by 1970 the rate may approach 11-13 per 1,000, and by 1975 it may drop below 10 per 1,000.[10] The authors conclude that cutting the infant mortality in half between 1950 and 1970 is "not optimistic or pessimistic, but realistic." For the United States, Shapiro and others believe a rate of 20.0 is a realistic goal.[39]

Although the arithmetic differences between the projected rates may not appear large, the number of infant deaths in the United States represented by these differences is imposing. The difference between the actual number of infant deaths in the United States and those expected to occur if this country experienced the current mortality rate of the Netherlands or Sweden represents about 40,000 infants annually.

PROMINENT CAUSE GROUPS

Remedies, however, are even more elusive than the facts. The assumption of a constant rate of decline implies that the net effect of gains and losses in the next 10 years will be such that the net rate of decrease will be the same as in the period 1950-62. To accelerate this rate of decline in the overall infant mortality rates, major breakthroughs will be needed in medical research. For example, while postnatal asphyxia and atelectasis are significant contributors to infant mortality, progress in the identification of causative mechanisms has been slow. For this group, actual agents have not yet been identified. The association with prematurity has been observed but the terms used to describe causes of death are often symptoms rather than causes. There may be a number of causative agents involved and consequently future progress in this area may continue to be slow.

A second large segment of infant deaths is ascribed to immaturity for lack of additional diagnostic information. For these, additional information about conditions associated with an immature fetus or premature birth would be important to a better understanding of the problem. Improved medical certification or verification of the absence of additional diagnostic information, and study of family situations (e.g., nutrition, family size expectations) may shed further light on the subject.

A third major segment of infant mortality is associated with congenital malformations. Already, a number of diverse agents have been implicated: infectious diseases, drugs, and radiation. Others are yet to be identified. The problem of gene mutation and the prevention of undesirable

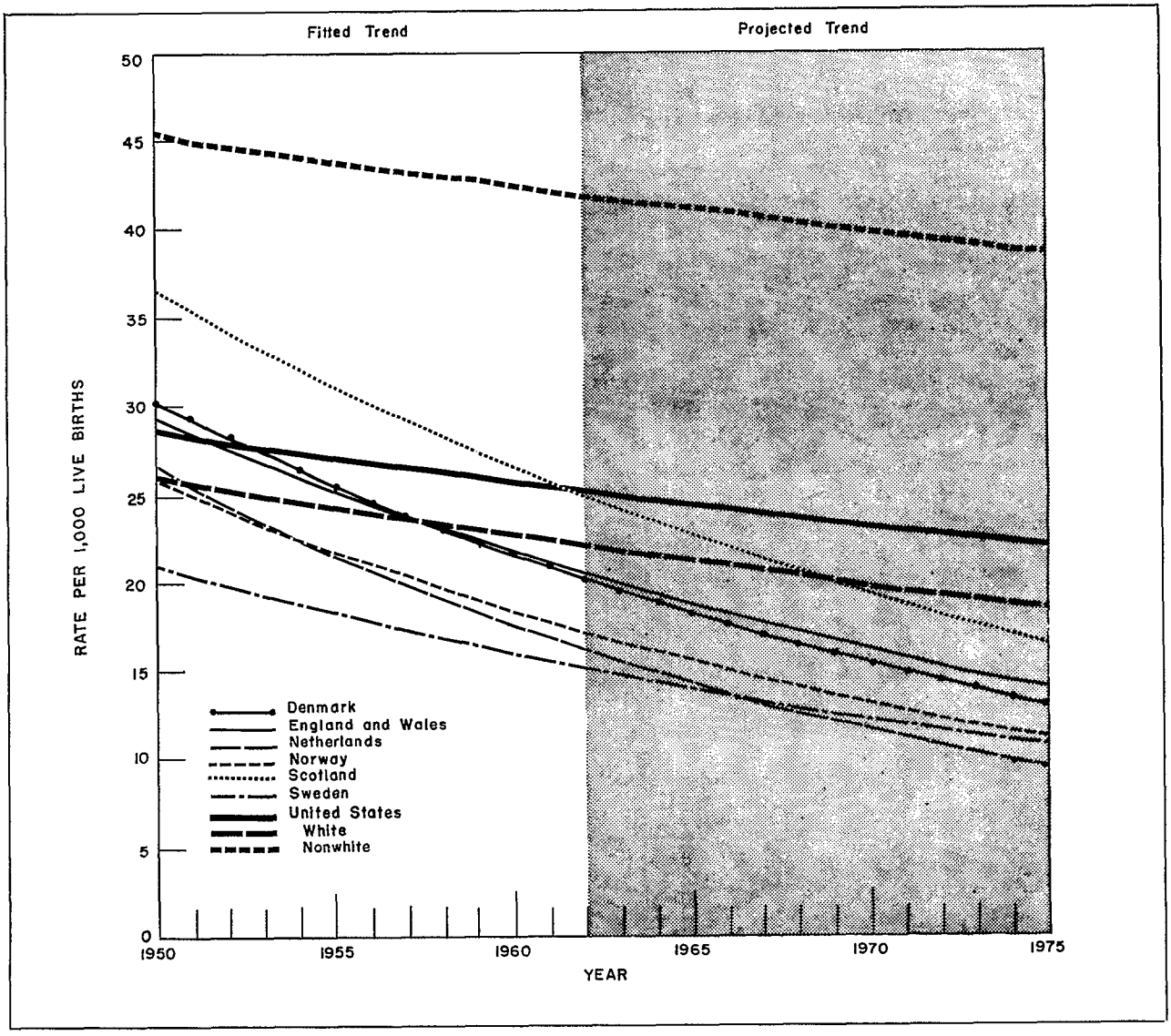


Figure 16. Fitted and projected infant mortality trends: selected countries, 1950-75.

mutations need clarification. The multicausal nature of congenital malformations precludes rapid advances.

With regard to environmental causes (including infectious diseases) more than one approach must be considered. The lack of therapeutics for certain viruses and the development of microbial strains resistant to antibiotics pose clinical problems and may require new drugs for clinical use. Other environmental causes such as water, food, housing, and crowded conditions require different approaches: alleviation of poverty, health education, public housing—all major undertakings already in process of development. Only time will reveal the benefits to infants which may accrue from special programs of the Federal Government such as the Maternity and Infant Care Programs and other less direct programs such as those of the Office of Economic Opportunity. Among accidents, continued clinical and epidemiologic investigation of crib deaths may produce etiologic leads.

LOW BIRTH WEIGHT AND PREMATURITY

In addition to pathology, low birth weight and premature birth are prominent hazards facing the fetus and newborn infant. Although, in this report, no single factor was demonstrated to account for the entire difference between the United States and countries of low infant mortality such as the Netherlands or Sweden, the hypothesis that the estimated differences in birth weight distributions could account for most of the differences in neonatal mortality was tenable. This hypothesis is in need of verification or refutation.

With the amount of raw data on birth weight already available on vital records in the United States, this variable is a candidate for prompt investigation. Two aspects, the incidence of low birth weight and the relationship of mortality to birth weight, are amenable to early study through record linkage. Studies related to gestation are presently less promising because of the gross misreporting of gestation on vital records. Considerable improvement may be expected in time if the item "weeks of gestation" on the vital records is replaced by "first day, last normal menses." Continued surveillance of the incidence of low birth weight and premature deliveries will be needed to establish whether or not they are increasing in this country.

In comparison with the other countries, the incidence of low birth weight infants in the United States seems high. Some of these countries (e.g., Denmark and Sweden) are currently gathering birth weight information, but relatively little published information is available. It would be helpful to have data for countries like Norway and Sweden where large proportions of infants are born in hospitals or maternity units. The quality of information which could be obtained in other countries like the Netherlands is less promising because of the large number of home deliveries and questionable reliability of the raw data. Information on both the incidence of low birth weight infants and mortality associated with birth weight in countries with low infant mortality would help clarify the question of whether higher proportions of poor-risk fetuses are born alive in the United States because the risk of prenatal death has been reduced.

MEDICAL AND OBSTETRIC CARE

Possible studies of the Nation's status with regard to medical and obstetric care are more remote in time. The development of medical demography in the United States to obtain basic population characteristics such as those of the perinatal study in Great Britain would bring into focus certain characteristics which are presently estimated from biased groups or surmised. On an international basis, it would help to evaluate the benefits to be derived from prenatal care, home or hospital delivery, specific obstetric procedures, or short or prolonged hospital stay. At the Center's Conference on the Perinatal and Infant Mortality Problem of the United States, numerous other questions were raised concerning the effects of analgesia, drugs, induced labor, and resuscitation practices on the condition of the neonate.[17] The lack of such information for the United States was emphasized.

REGISTRATION

While the registration of live births is relatively complete in the United States, the registration of fetal deaths is not. It is generally accepted in medical circles that when all periods of gestation are included, fetal deaths outnumber infant deaths. If all fetal deaths of 20 or more weeks of gestation were registered, they alone would probably almost equal infant deaths. Promotion of complete registration of fetal deaths in accordance with legal requirements could be undertaken without establishing any new record systems. Although the registration of infant deaths is felt to be more complete than the registration of fetal deaths, there have been no tests of their registration completeness comparable to those for live births.

In addition, certain items on live birth and fetal and infant death records are deficient. A concerted effort to improve the information on these records with regard to three items (i.e., birth weight, gestation, and causes of death) would greatly improve the utility of vital records in the next decade.

International comparisons of definitions, registration methods, and diagnostic terms would greatly assist the interpretation of statistics presented in this report. Documentation of the practices used by physicians in applying the definitions of live birth and fetal death in the process of registration would be valuable in assessing the relationship between fetal and first-day mortality. As infant mortality declines, these technical aspects surrounding birth assume increasing importance. However, even without such studies, available data for the United States point to certain subclasses of infants, such as those of low birth weight, which experience excess mortality. More intensive study of these groups is needed to stimulate inquiry, to identify problems, and to promote knowledge.

CONCLUSION

Despite the vast numbers of studies which have been conducted, it is disquieting to realize how little is known concerning the reasons for the change in trend in infant mortality in this country since 1950. Equally perplexing are the reasons for similar changes occurring in the west European countries, although some are at significantly lower levels. Some investigators believe that the basic reason for decelerating rates of change may be identical in all of these countries. Despite this, the infant deaths represented by the differentials between this country and the other countries of lower mortality should be preventable in the United States as well.

VIII. SUMMARY AND CONCLUSION

Infant mortality in the United States is lower than it has ever been: 24.8 per 1,000 live births in 1964. Although this is a major accomplishment, the rates appear to have leveled off since about 1950; the rate of decline since 1950 has been slower than during the first half of the century. As a result, a number of other countries which had rates higher than the United States in the early part of the 20th century today have rates which are lower. Although the infant mortality trend of the United States has been declining in comparison with the other countries included in this study, it has been gradually losing ground. According to the Statistical Office of the United Nations, in 1964 its infant mortality rate was the highest among the seven countries included in this report.

The failure of this country to keep pace with the rate of decline of others prompted this study of the experience of seven countries: Denmark, England and Wales, the Netherlands, Norway, Scotland, Sweden, and the United States. In climate, age composition of the population, level of industrialization, medical education, personal and environmental health, they constitute a fairly homogeneous group. Comparison of the experience of the United States with such a group of countries increases the opportunities for sharper comparisons.

In analyzing the problem of infant mortality, the basic measures are drawn from vital statistics. Each of the selected countries included in this report has a well-established vital registration system, antedating the national coverage of birth and death statistics for the United States. Although there are variations in definitions, registration practices, and statistical procedures, as far as could be determined these differences are not large enough to alter the general relationship between infant mortality in the United States and the countries concerned.

A number of highlights emerged from the study. In spite of the decelerating decline in the United States, gains were achieved in fetal and infant mortality in the United States after 1950. However, these were not uniformly distributed over all age groups. For example, fetal mortality and mortality at 1-6 days of age decreased 21 and 17 percent, respectively, between 1949-51 and 1959-61. In contrast, mortality in the intervening interval, the first 24 hours after birth, increased 2 percent. Thus, while declines were occurring in the period before birth, and the last 6 days of the first week of life, there was an increased risk of death in the period immediately following birth. Since over 97 percent of live births occur in hospitals or other institutions, a high proportion of these deaths in the first 24 hours of life may be assumed to have been born in hospitals or other institutions. Thus, the focus of attention is drawn toward this vulnerable age period (the first 24 hours of life), and toward these locations (hospitals and other institutions). Since these observations are based on data for the United States alone, they are not affected by international differences.

When the trends by age are compared with those of other countries, it appears that the United States generally has the lowest rates in the fetal period and highest rates in the period just after birth. These observations may be somewhat clouded by variations in the application of definitions of fetal death and live birth, but when fetal mortality and mortality in the first 24 hours of life are combined, the mortality rate for the United States continues to be relatively high. Thus, in comparison with other countries, attention is again focused on the period immediately surrounding birth.

In considering causes of death, significance can be attached only to broad groups. Each of these countries classifies deaths according to the International Statistical Classification of Diseases, Injuries, and Causes of Death. Nevertheless, it is recognized that patterns of medical certification, coding, and tabulation can affect the resulting statistics. A number of cause groups contribute to the changing relationship between the United States and the other six countries. The increasing trends in neonatal mortality for postnatal asphyxia and atelectasis and the cause group which includes hyaline membrane disease and respiratory dis-

tress syndrome appear to be diametrically opposite when the United States is compared with other countries. These groups should be considered together since there is variation in the way the condition is certified on death certificates: some physicians prefer the term "postnatal asphyxia," while others prefer the term "respiratory distress syndrome." Mortality allocated to immaturity without further qualification is also high for the United States and is related to the cause previously mentioned. In the postneonatal period (1-11 months of age), mortality is lower than that observed in the neonatal period and environmental causes generally predominate. In the postneonatal period, mortality from respiratory and digestive diseases is also notably high in this country in comparison with the other countries.

A number of demographic factors were examined to assess their possible statistical effects on the infant mortality rates. It appears that factors such as age of mother and the infant's birth order have relatively little effect in explaining the difference between the United States and countries of low mortality, such as the Netherlands or Sweden. Of the factors considered, only birth weight is felt to have sufficient effect on the rate to suggest it as a possible hypothesis for future investigation. The effects caused by apparent differences in the incidence of low birth weight infants are of such a magnitude that it is possible that they could account for a considerable proportion of the difference between the United States and countries of low infant mortality. Available data suggest that the United States has a higher proportion of low birth weight infants and that these proportions have been slowly increasing. This observation is consistent with the increasing death rates within 24 hours of birth and increasing rates for causes known to be associated with immaturity or prematurity, e.g., postnatal asphyxia and atelectasis, hyaline membrane disease, and respiratory distress syndrome.

The relationships of infant mortality to medical care and obstetric factors are less clear-cut. The general philosophy concerning maternal and child care is similar in many respects in all of these countries: early and continued prenatal care, referral of complicated pregnancies to medically competent physicians or to hospitals, hospital delivery for all complicated pregnancies and high-risk groups, and postnatal supervision of mother and infant. However, there is a contrast between the United States and the west European countries in the financing and administration of medical care. Because of their social insurance systems, medical care in these west European countries has been spread to their lower socioeconomic groups which could not otherwise afford it. In the United States, the major proportion of medical care associated with childbirth is privately financed.

In spite of the widespread availability of medical care, proportionally fewer births are delivered in hospitals or other institutions in some of these west European countries than in the United States. Yet at least one of them, the Netherlands, is experiencing low infant mortality rates, despite the low rate of hospital deliveries. Similarly, relatively more infants are delivered by physicians in the United States. By this criterion, the United States has an advantage, but this variable is not inversely related to the level of the infant mortality rates. As for hospital stay, the average stay is shorter among mothers hospitalized for delivery in the United States, but this observation is difficult to interpret because these patients include many with uncomplicated deliveries who may not need extended hospital stays. Although there are also suggestions of differences in obstetric practices between the United States and some of these west European countries, the unavailability of adequate data precludes any conclusions but emphasizes the need for quantitative information relating to these factors.

In times of dynamic change, for the United States to maintain its present level of perinatal and infant mortality is to lose ground in comparison with other countries of similar economic and medical development. In the light of present knowledge, perinatal and infant mortality cannot be eliminated completely, but the attainable levels seem to be somewhat lower than those presently achieved in the United States. There is a need to determine whether the levels achieved elsewhere are realistic for this country and whether the resources which are needed to achieve these goals are available. Although the infant mortality in this country is the lowest it has ever been, the estimated excess loss of 40,000 infants annually suggests there may be room for improvement.

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DENMARK

Dates of Basic Laws and Types of Programs	Coverage	Source of Funds	Qualifying Conditions
SICKNESS AND MATERNITY First law: 1892. Current law: 1960. Semi-voluntary social insurance system (cash and medical benefits) (1 crown equals 14.5 U.S. cents)	Medical benefits: All residents may voluntarily become active member of local sickness fund (children under 16 covered by parent's membership). Residents not active members must become passive members of fund and pay 24 crowns a year, but receive no benefits. Cash benefits: All employees who are active members of fund compulsorily covered for cash benefits. Other active members under age 45 may insure for such benefits voluntarily. Special system for railroad employees.	Insured person: About 100 crowns a year, on average (varies according to fund and cash benefit rate for which insured); covers about 70% of cost. Employer: 3 ore per employee-hour. Government: Subsidies to sickness funds by national and local governments. Include 5 crowns a year per active member; 25% of cost of medical treatment, dental care, home nursing and cash benefits; over 90% of cost in public hospital; 75% of extra cost of chronic care; and full cost of vital medicines such as insulin, cash maternity benefits, transport, and contributions of needy members.	Cash sickness and maternity benefits: Active membership in sickness fund (passive member may become active member and qualify for benefits after 6 months); and 40 hours of employment in last 4 weeks (non-employee 3 months of insurance for such benefits). Medical benefits: Active membership in sickness fund (passive member may become active member and qualify for benefits after 6 months).
FAMILY ALLOWANCES First and current law: 1952. Universal public system	Residents with 1 or more children.	Insured person: None. Employer: None. Government: Whole cost.	Family allowances: Child must be under age 16.

NETHERLANDS

SICKNESS AND MATERNITY First law: 1913. Current laws: 1929 (cash benefits) and 1941 (medical benefits). Social insurance system (separate but interlocking programs of cash and medical benefits) (1 guilder equals 27.6 U.S. cents)	Employees earning not more than 10,900 guilders a year. Must enroll in approved sickness fund. Voluntary coverage for medical benefits available to other persons and pensioners, if annual income below specified levels. Special systems for miners, railroad employees, public employees, seamen, and certain other groups.	Insured person: 3.4% of earnings. Pensioners, 5.5 or 11 guilders a month, according to marital status. Employer: From about 3% to 9% of payroll, according to risk in industry. Government: None, except subsidy for voluntary low-income contributors.	Sickness and maternity benefits: Membership in approved sickness fund (i.e., in covered employment or voluntary member); no minimum contribution period.
FAMILY ALLOWANCES First laws: 1939 (employees) and 1951 (self-employed). Current laws: 1962 Dual employment-related and general systems	Employees, self-employed persons of limited income, and social insurance beneficiaries, with 1 or more children; and all other residents with 3 or more children.	Insured person: Employee, none. Self-employed and non-employed, 2% of net income. Employer: 5.3% of payroll. Government: Whole cost of allowances for 1st and 2nd child of self-employed persons, and for pensioners. Maximum earnings for contribution purposes: 10,900 guilders a year	Family allowances: Child must be under age 16 (27 if student or invalid). Self-employed must earn less than 4,000 guilders a year to receive allowances for 1st and 2nd child. Non-employed receive allowances only from 3rd child.

DENMARK

Cash Benefits for Insured Workers (except permanent disability)	Permanent Disability and Medical Benefits for Insured Workers	Survivor Benefits and Medical Benefits for Dependents	Administrative Organization
Sickness benefit: 16 crowns a day, plus 5 crowns for 1 dependent (non-employees, 5-21 crowns a day, according to rate insured against). Maximum, 80% of earnings. Payable after 1-week waiting period (non-employees, 2 weeks), for up to 26 weeks in any 12 months or 78 weeks in any 3 years. Maternity benefits: 16 crowns a day, plus 5 crowns for 1 dependent (non-employees, 5-21 crowns a day, according to rate insured against). Payable for up to 14 weeks, including 8 weeks before confinement (non-employees, payable for 2 weeks after confinement).	Medical benefits: Service benefits, ordinarily provided by doctors and hospitals under contract with and paid directly by sickness funds. General practitioner care, specialist care, hospitalization in public hospital, 75% of cost of vital medicines, maternity care by midwife or doctor, home nursing, limited dental care, and transport. Fund members whose income above that of skilled worker pay part of cost of doctors' fees. Duration: No limit.	Medical benefits for dependents: Wife or other adult dependent not eligible for medical benefits as dependent, but must insure in own right. Children under 16 usually covered by insurance of parent, and receive same medical benefits.	Ministry of Social Affairs, general supervision. Directorate of Sickness Funds, in Ministry, direct supervision of program, including approval of rules of funds and granting of subsidies. Sickness funds, usually one for each locality, administer contributions and benefits. Funds must be officially approved, and are managed by elected officials; grouped into county and national federations.
Family allowance: 400 crowns a year for 1st child, 450 crowns each for 2nd to 4th child, and 500 crowns for 5th and each other eligible child.			Ministry of Finance, national administration of program; allowances usually credited against income taxes due from recipients. Local communal governments pay difference annually in cash to recipients, if allowance exceeds tax liability, and are then reimbursed by national government.

NETHERLANDS

Sickness benefit: 80% of earnings. Payable after 3-day waiting period for up to 52 weeks. Maternity benefit: 100% of earnings, payable for 6 weeks before and 6 weeks after confinement. Maternity grant: Lump sum of 55 guilders.	Medical benefits: Service benefits provided by doctors, hospitals, and druggists under contract with and paid directly by sickness funds. General and specialist care, hospitalization, laboratory services, medicines, limited dental care, obstetric care, appliances, and transportation. Patient shares cost of sanatorium care, artificial limbs, and transportation. Maximum duration: No limit, except 70 days for hospitalization.	Medical benefits for dependents: Same as for insured person. Maternity grant: Lump sum of 55 guilders payable to wife of insured man.	Ministry of Social Affairs and Public Health, general supervision. Industrial association for each industry, administration of cash benefits within industry; approved joint employer-employee bodies with compulsory nationwide membership and bipartite governing boards. District and local offices of associations receive and pay claims. Approved sickness funds, administration of medical benefits; supervision by tripartite Sickness Funds Council. About 115 funds now operating.
Family allowance: 19.50 guilders a month for 1st child, rising to 32.50 guilders a month for 6th and each additional child.			Ministry of Social Affairs and Public Health, general supervision. Industrial associations, administration of allowances within each industry; larger employers pay allowances to own employees and settle surplus or deficit of contributions due with association. Social Insurance Bank, administration of allowances for non-employees and pensioners, with assistance of regional Labor Councils.

NORWAY

Dates of Basic Laws and Types of Programs	Coverage	Source of Funds	Qualifying Conditions
SICKNESS AND MATERNITY First law: 1909. Current law: 1956. Social insurance system (cash and medical benefits) (1 crown equals 14 U.S. cents)	Medical benefits: All residents (dependent spouse earning below 1,000 crowns a year and children under 18 covered by insurance of family head). Cash benefits: All employees covered compulsorily; nonemployees may be covered voluntarily. Special systems for seamen, fishermen, and public employees.	Insured person: From 2.20 to 10 crowns a week, according to annual-income class. Self-employed pay additional premium if covered voluntarily for cash benefits. Pensioners exempt from contributions, unless non-pension income above 1,000 crowns a year. Employer: 75% of contributions of employees. Government: National government, 20% of contributions of insured persons; local governments, 25% of same.	Cash sickness and maternity benefits: 14 days of insurance (nonemployees, 6 weeks). Medical benefits: Currently insured.
FAMILY ALLOWANCES First and current law: 1946. Universal public system	Residents with 2 or more children.	Insured person: None. Employer: None. Government: Whole cost.	Family allowances: Family must normally contain 2 or more children under age 16. If both parents aliens, child or 1 parent must have 6 months of residence in country.

SWEDEN

SICKNESS AND MATERNITY First laws: 1891 (cash benefits) and 1931 (medical benefits). Current law: 1962. Social insurance system (cash and medical benefits). (1 crown equals 19.3 U.S. cents)	Cash benefits: Gainfully occupied persons earning 1,800 crowns a year or more, and most housewives. Medical benefits: All residents (children under 16 covered by parents' insurance).	Insured person: In Stockholm 75 crowns a year for medical benefits; and 70-269 crowns a year for cash benefits, according to income. Elsewhere, about 1/5 less, on average. No contribution if income under 2,400 crowns a year or if pensioner. (Covers about 1/2 of cost.) Employer: 1.5% of payroll, excluding wages above 22,000 crowns a year. (Covers about 1/4 of cost.) Government: 50% of cost of basic cash benefits, refunds of doctors' fees, and maternity grants; most hospital costs; part of medicine costs; contributions of low-income persons; and other subsidies. (Covers about 1/4 of cost.)	Sickness and medical benefits and maternity grant: No minimum qualifying period. Cash maternity benefit: Insured for 9 months prior to confinement at earnings rate of 2,600 crowns a year or more.
FAMILY ALLOWANCES First and current law: 1947. Universal public system	All residents, with 1 or more children.	Insured person: None. Employer: None. Government: Whole cost.	Family allowances: Child must be under age 16 (19 if student).

NORWAY

Cash Benefits for Insured Workers (except permanent disability)	Permanent Disability and Medical Benefits for Insured Workers	Survivor Benefits and Medical Benefits for Dependents	Administrative Organization
Sickness benefit: 3-19 crowns a day, according to annual-income class, plus 2 crowns a day for dependent spouse and each child under 18. Payable after 3-day waiting period for up to 104 weeks (unlimited for tuberculosis, cancer, arthritis, and poliomyelitis, if under treatment). Maternity benefit: 3-19 crowns a day, according to annual-income class, plus 2 crowns a day for dependent husband and each child under 18. Payable for 6 weeks before and 6 weeks after confinement.	Medical benefits: Cash refunds of part or all of medical expenses, or less commonly service benefits furnished by providers under contract with funds. 66-75% of cost of doctors' fees, dental care, and transport; free care in public hospital, maternity clinic, and sanatorium; and listed vital medicines and laboratory services. Duration: No limit while in receipt of remedial treatment.	Medical benefits for dependents: Same as for insured. Wife of insured employee also receives maternity grant of 200 crowns, unless treatment provided in maternity clinic.	Ministry of Social Affairs, general supervision. National Insurance Institution, national administration of program, supervision of local funds, equalization of costs by distribution of Government contribution, and approval of contracts with doctors. Local insurance funds, administration of contributions and benefits locally.
Family allowance: 400 crowns a year for 2nd child under age 16, 500 crowns for 3rd, 600 crowns for 4th, etc. (rate rises 100 crowns for each additional child under age 16). Allowance payable for 1st child also if orphan, invalid, or parents divorced.			Ministry of Social Affairs, general supervision. National Insurance Institution, national administration of program and supervision of local funds. Local insurance funds, administration of allowances locally.

SWEDEN

Sickness benefit: 5 crowns a day (all covered persons), plus supplement of 1-23 crowns a day according to 13 income classes (for persons earning at least 2,600 crowns a year). Child's supplements: 1 crown a day for 1-2 children under 16, 2 crowns for 3-4, and 3 crowns for 5 or more. Payable after 3-day waiting period, for duration of illness. Maternity benefit: 1-23 crowns a day, according to 13 income-classes, payable for up to 180 days. Maternity grant: Lump sum of 900 crowns.	Medical benefits: Cash refunds of part of medical expenses, and some service benefits. Refund of 75% of doctors' and outpatient fees, according to schedule, and of travel costs; free hospitalization in ward of public hospital; free medicines for some chronic diseases, and other medicines at half price; cost of confinement, including care in maternity ward; limited dental care, including free care for school children; and specified appliances. Duration: No limit, except 180 days for hospitalization if age 67.	Medical benefits for dependents: Same as for family head. Maternity grant: Lump sum of 900 crowns.	Ministry of Social Affairs, general supervision. National Social Insurance Board, administration of program through regional and local social insurance bodies. Contributions of insured persons paid with income tax.
Family allowance: 500 crowns a year for each eligible child, or 600 crowns if student age 16-18.			National Social Welfare Board, national administration of program. Local social welfare offices and child-welfare boards, administration of allowances locally.

UNITED KINGDOM

Dates of Basic Laws and Types of Programs	Coverage	Source of Funds	Qualifying Conditions
SICKNESS AND MATERNITY First law: 1911. Current laws: 1946 (national insurance and national health service laws). Dual social insurance (cash benefits) and national health service (medical care) systems (£1 equals U.S. $2.80; 1s. equals 14 cents; 1d. equals about 1 cent)	Cash sickness and maternity benefits: Employed and self-employed persons (coverage optional for married women, and for self-employed persons whose income below £208 a year). Maternity grants: All mothers. Medical care: All residents.	Insured person: For cash benefits, employee, 8s3½d (men) or 7s2½d (women) a week, plus 4¼% of weekly wages between £9-18 (contracted-out men, 10s8½d; women, 8s8½d). Self-employed, 13s4d (men) or 11s (women). Non-employed, 10s2d (men) or 7s10d (women). For national health service, 2s8½d a week (male employee), 2s0½d (female employee), 2s10d (other men), or 2s2d (other women). Employer: For cash benefits, 8s3½d (men) or 7s2½d (women) a week, plus 4¼% of weekly wages between £9-18 (contracted-out men, 10s8½d; women, 8s8½d). For national health service, 7½d per employee a week. Government: For cash benefits, amount equal to ¼ of above flat contributions (1/3 for self and non-employed); lump-sum subsidy; and full cost of national assistance. For national health service, about 80% of total cost. Above flat and government contributions also finance cash old age, invalidity, death and unemployment benefits.	Cash sickness benefit: 26 weeks of paid contributions as employee or self-employed, and 50 weeks paid or credited in last year (reduced benefit if 26-49 weeks). Cash maternity benefit: 26 weeks of paid contributions in last year as employee or self-employed, and 50 weeks paid or credited (reduced benefit if 26-49 weeks). Maternity grants: 26 weeks of paid contributions by woman or husband, and 26 weeks paid or credited in last year. Medical care: Residence in country (no other conditions).
FAMILY ALLOWANCES First and current law: 1945. Universal public system	Residents, with 2 or more children.	Insured person: None. Employer: None. Government: Whole cost.	Family allowances: Child must be under age 15 (16 if invalid, 19 if student). 26 weeks of residence in last 12 months (aliens must have, in addition, 156 weeks of residence in last 4 years).

UNITED STATES OF AMERICA

SICKNESS AND MATERNITY Four State laws only: Rhode Island, 1942; California, 1946; New Jersey, 1948; and New York, 1949. Limited social insurance system (cash sickness benefits mainly)	Employees in industry and commerce in California, New Jersey, New York, and Rhode Island. Exclusions: Agricultural employees (except California); domestic employees; employees of nonprofit institutions; and employees of firms with 3 or less workers (New Jersey). Three States (excluding Rhode Island) permit employer to substitute equivalent private plan or self-insurance for State coverage. Special national systems for railroad employees (cash benefits) and Federal employees (medical expenses); and Federal-State system for aged persons of limited means (medical expenses).	Insured person: 1% of earnings (California and Rhode Island), or 0.5% (New Jersey and New York). Employer: None (California and Rhode Island); 0.1-0.75% of payroll, according to risk (New Jersey); and any benefit costs above 0.5% of earnings (New York). Government: None. Maximum earnings for contribution and benefit purposes: $3,000 a year (New Jersey and New York); $3,600 (Rhode Island); and $5,600 (California).	Sickness benefit: $300 of insured earnings in last year (California); 17 weeks of employment in last year (New Jersey); employment during last 4 weeks (New York); and 20 weeks of employment in last year (Rhode Island). Medical and maternity benefits: Same as above, where provided (provided only on limited scale).
FAMILY ALLOWANCES None			

UNITED KINGDOM

Cash Benefits for Insured Workers (except permanent disability)	Permanent Disability and Medical Benefits for Insured Workers	Survivor Benefits and Medical Benefits for Dependents	Administrative Organization
Sickness benefit: £3 7s.6d. a week, plus £2 1s6d. for 1 adult dependent, £1 for 1st child, and 12s. for each other child. Payable after 3-day waiting period (no waiting period if 12 days lost within 13 weeks), for up to 52 weeks; duration unlimited after 156 weeks of contribution. Maternity benefits: £3 7s.6d. a week, plus £2 1s.6d. for 1 adult dependent, £1 for 1st child, and 12s. for each other child; payable for 11 weeks before and 7 weeks after confinement. Also, lump-sum maternity grant of £16, plus an additional £6 if confinement in home or at own expense.	Medical benefits: Medical services provided by doctors and druggists under contract with and paid directly by national health service, and by public hospitals. General practitioner care, specialist services, hospitalization, maternity care, dental care, medicines, appliances, and home nursing. Patients pay 1s. for each prescription item, £1 for each dental treatment (except children and expectant or new mothers), 10s. for each spectacle lens, and about 50% of cost of dentures. Duration: No limit.	Medical benefits for dependents: Same as for family head. Wife also receives same lump-sum maternity grants as working woman.	Ministry of Pensions and National Insurance, administration of contributions and cash benefits through its regional and local offices. Ministry of Health, general administration of medical services through national health service. Medical services administered locally by Executive Council for each local health authority area (general medical, dental, and pharmaceutical services); about 15 Regional Hospital Boards; and local health authorities (home nursing, midwifery, etc.).
Family allowances: 8s. a week for 2nd child, and 10s. for 3rd and each other child.			Ministry of Pensions and National Insurance, administration of program through its regional and local offices.

UNITED STATES OF AMERICA

Sickness benefit: 50% of weekly earnings (New York), 55% (Rhode Island), or 61-67% (New Jersey); or 4-7% of quarterly earnings a week (California). Supplement of $3 a week per child for up to 4 children payable in Rhode Island only. Payable after 7-day waiting period (none in California when hospitalized), for up to 26 weeks. Maternity benefit: In Rhode Island, 55% of earnings payable for up to 14 weeks. In New Jersey, 61-67% of earnings payable for up to 8 weeks. Other States, none.	Medical benefits: In California, cash refund of $12 a day toward hospital expenses for up to 20 days. In New York, medical benefits may be provided under a private plan in lieu of cash sickness benefits up to prescribed maximum. Other States: No medical benefits provided. (Medical services provided to aged persons unable to pay for own care in about 30 States under Federal-State program.)	Medical benefits for dependents: None provided.	Departments of State Governments administering unemployment insurance, administration of program in 3 States (California Department of Employment, New Jersey Department of Labor and Industry, and Rhode Island Department of Employment Security). Workmen's Compensation Board, administration of program in New York.

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