TABLE 2—Mean Number of Discharges Per Physician Per Year and Per cent Distribution (of Discharges) by Income Level and Specialty of the Physician.

Specialty	Mean Number of Discharges per year Per Physician	Income Level			
		Less than $7,000	$ 7,000-10,499	$10,500 $13,999	$14,000 and over
		Percentage of Discharges			
Total	150	8	39	45	7
Primary Care	133	6	41	44	8
Internal Medicine	145	11	39	39	11
General & Family Practice	129	5	42	47	5
Pediatrics	133	12	42	34	10
Other Specialties	168	8	38	46	07
Unspecified and Unknown	202	7	43	44	6

spect to socio-economic level, the diseases entities most commonly managed, and the quantitative aspects of hospitalization. Although this study is limited to hospitalized patients, it indicates that different primary care physicians may serve distinctly different populations. The practice characteristics of primary care physicians should be examined further on a larger scale in order to help develop a meaningful definition of primary care; more precisely define our needs in the area; and provide guidelines for a national health policy.

REFERENCES

1. Hurtado, A., Greenlick, M., Saward, E. The organization of home care and extended care-facility services in a prepaid comprehensive group practice plan. Med Care 7:30–40, 1969
2. Muller, C. Income and receipt of medical care. Am J. Public Health 55:510–521, 1965.

Race-Specific Differences In Bacterial Meningitis Deaths In the United States, 1962–1968

ROGER A. FELDMAN, MD, ROBERT E. KOEHLER, MD AND DAVID W. FRASER, MD

Introduction

With the development of vaccines against the major causes of bacterial meningitis,[1–3] it seems important to define the population segments at highest risk of these diseases so that vaccination programs may be appropriately focused. One method of determining the risk of bacterial meningitis is to measure death rates due to this illness. However, with the exception of case reporting of meningococcal disease, the only information on a national level concerning bacterial meningitis comes from death certificates. The National Center for Health Statistics (NCHS), which codes a variety of epidemiologic data from death certificates, publishes annually, in its volume on mortality statistics, only total deaths and death rates by color and sex, for meningitis (ICDA No. 320), and for the following four subcategories into which this list title has been divided: *H. influenzae* (ICDA 320.0); Pneumococcus (ICDA 320.1); due to other specified organism (ICDA 320.8); and with no organism specified as cause (ICDA 320.9). NCHS also publishes annually only total deaths and death rates, by color and sex for meningococcal meningitis (ICDA No. 036.0); and total deaths and death rates, by color and sex for meningococcemia without mention of meningitis (ICDA No. 036.1).

The authors have reviewed information on certificates

From the Bureau of Epidemiology, Center for Disease Control, PHS/DHEW, Atlanta, GA. Address reprint requests to Dr. David W. Fraser, Chief, Special Pathogens Branch, Bacterial Diseases Division, Center for Disease Control, Atlanta, GA 30333. This paper, submitted to the Journal February 24, 1975, was revised and accepted for publication November 7, 1975.

for deaths attributed to the above listed six causes, for the United States for 1962–68. Hereinafter this complex of six causes will be denoted by "bacterial meningitis". This information has been analyzed in terms of race, age, sex, and socioeconomic parameters by county of residence, and indicates those groups at greatest risk of dying from this group of diseases.

Materials and Methods

Age, sex, race, and date, county, and state of death for persons who died from bacterial meningitis during 1962–1968 were obtained from data from the coded file on death certificates filed in the States and other registration areas. This information was listed according to the type of bacterial meningitis (excluding tuberculosis) to which death was attributed; the six etiologic categories were: *Neisseria meningitidis* meningitis; meningococcemia; *Haemophilus influenzae* meningitis; *Streptococcus pneumoniae* meningitis; meningitis due to other specified bacteria (gram-negative bacteria, gram-positive cocci, and other bacteria excluding listeria); bacterial meningitis due to unspecified bacteria.

Socioeconomic denominator data for 1960 were obtained from the United States Bureau of Census and the Office of Economic Opportunity concerning persons per room and the percentage below the poverty level by county and race in the United States. Denominator data by age, race, and county were obtained from the 1960 and 1970 decennial United States census.

Relationships between race-specific county data on persons per room (or percentage below poverty level) and the specific etiology of bacterial meningitis were sought by grouping county populations by race according to rankings of the socioeconomic data determined separately for the 2 separate socioeconomic indices.

To test the completeness of the NCHS registry in reporting deaths from bacterial meningitis, we reviewed records of bacterial meningitis cases, and subsequent deaths, in acute-care hospitals in four areas during the indicated time periods: Charleston County, South Carolina, 1961–1968;[4] Olmsted County, Minnesota, 1960–1968;[5] Bernalillo county, New Mexico, 1964–1968;[6] and the State of Vermont, 1967–1968.[7] Agreement between death certificate information and information on the hospital chart was measured, as well as the completeness with which deaths from bacterial meningitis in these hospitals were included in NCHS registration.

Results

General

The number of deaths by year for the six categories of bacterial meningitis are recorded in Table 1. The largest category is unspecified bacterial meningitis. The second largest category is a combination of deaths from meningococcal meningitis and meningococcemia. More deaths occurred in males than females for all six etiologies, in both blacks and whites (see Table 2).

The NCHS death registration for meningitis deaths was

TABLE 1—Deaths from Bacterial Meningitis in the United States 1962-1968 By Etiology and Year

Etiology	1962	1963	1964	1965	1966	1967	1968	Total
N. meningitidis	300	354	386	445	434	319	315	2588
Meningococcemia	347	374	362	443	435	311	384	2656
H. influenzae	388	429	412	390	319	270	251	2459
S. pneumoniae	522	502	586	548	594	510	396	3658
Other specified	239	258	223	239	225	201	144	1529
Unspecified	1178	1154	1243	1182	1185	1065	916	7918
TOTAL	2969	3071	3212	3247	3192	2676	2441	20808

TABLE 2—Deaths from Bacterial Meningitis by Etiology, Race*, Sex in the United States, 1962-1968

Etiology	White			Black			Indian			Other			Total		
	M	F	Total	M	F	Total	M	F	Total	M	F	Total	M	F	Total
N. meningitidis	1103	878	1981	305	224	529	18	25	43	8	4	12	1434	1131	2565
Meningococcemia	1211	906	2117	262	220	482	10	9	19	4	9	13	1487	1144	2631
H. influenzae	1055	770	1825	301	242	543	22	25	47	9	8	17	1387	1045	2432
S. pneumoniae	1307	1042	2349	635	559	1184	33	37	70	6	6	12	1971	1644	3615
Other specified	669	515	1184	160	129	289	11	8	19	7	7	14	847	659	1506
Unspecified	3075	2183	5258	1404	1009	2413	89	60	149	22	15	37	4590	3267	7857
TOTAL	8420	6294	14714	3057	2383	5440	183	164	347	56	49	105	11716	8890	20606

* Excludes 202 cases with race not recorded.

TABLE 3—Completeness of the NCHS* Meningitis Death Registration when Compared with Record Reviews from Hospitals in Four Areas

Etiology	Percentage Completeness of NCHS Listing
N. meningitidis	69% (9/13)**
H. influenzae	58% (14/24)
S. pneumoniae	58% (19/33)
Other specified	10% (3/29)
Unspecified	63% (5/8)

* National Center for Health Statistics.
** Number of deaths in NCHS/Number of deaths by record review

approximately 60 per cent complete for all categories except deaths due to other specified bacteria (see Table 3). The agreement of information recorded on the death certificates and hospital records was high for the three major causes of bacterial meningitis (see Table 4). Information was not collected concerning the completeness or correctness of the diagnosis of death due to meningococcemia.

Average annual death rates for bacterial meningitis of each etiologic group were highest in American Indians and higher in blacks than in whites (see Table 5). For all races and etiologies, the death rates were highest in children less than six months of age and fell steadily thereafter until approximately age 30 years; after this age the death rates increased with age. Average annual death rates during the first year of life are shown separately for the six etiologies in Table 6. Deaths due to other specified bacteria were frequent in the first two months of life, and relatively uncommon thereafter.

TABLE 4—Agreement of the NCHS* Meningitis Death Registration with Hospital Record Reviews from Four Areas

Bacterial Etiology on Hospital Record	Percentage Agreement with NCHS Registration
N. meningitidis	82 (9/11)**
H. influenzae	100 (14/14)
S. pneumoniae	95 (19/20)
Other specified	75 (3/4)
Unspecified	16 (5/32)

* National Center for Health Statistics
**Number of cases with same diagnosis in both records/Total number of cases reported with this diagnosis to NCHS.

Deaths from meningitis are predominantly a problem in children under the age of 5 (see Table 7). For all races, there were few deaths attributed to *H. influenzae* in children over age five. Analysis of death rates in children under five years of age, by etiology and state of report, shows no pattern in the geographic distribution of meningococcal or pneumococcal death rates; *H. influenzae* death rates in blacks were highest in the South and whites in the Southwest (Figures 1 and 2); death rates for other specified bacterial meningitis were lowest in whites east of the Mississippi; deaths due to other specified bacterial meningitis were highest in the southwestern and Pacific states in whites and in southern states in blacks.

TABLE 5—Average Annual Bacterial Meningitis Death Rates* by Race and Etiology in the United States, 1962-1968

Etiology	Race		
	White	Black	American Indian
N. meningitidis**	0.17 (0.17)+	0.36 (0.33)	0.94 (0.81)
H. influenzae	0.15 (0.16)	0.37 (0.30)	1.02 (0.72)
S. pneumoniae	0.20 (0.20)	0.82 (0.85)	1.53 (1.36)
Other specified	0.10 (0.10)	0.20 (0.18)	0.41 (0.36)
Unspecified	0.45 (0.45)	1.66 (1.59)	3.25 (2.66)

* Per 100,000 using average of 1960-1970 census data.
** Does not include death from meningococcemia
+ Age-adjusted rate using average 1960-1970 USA populations for under 1, 1-4, 5-9, and decades thereafter.

For each etiology there was no significant correlation between the race-specific average annual death rate for all ages, or for children under the age of five, with race-specific county data on either persons per room or percentage under the poverty level.

Discussion

The validity of this study depends on the accuracy and completeness with which deaths from bacterial meningitis are recorded in death certificate information. Death certificate information concerning deaths due to acute infectious disease is known to be more reliable than similar data concerning chronic diseases.[8, 9] With data from a review of records of all the 42 acute-care hospitals in four geographic areas, it was possible to test both the accuracy and completeness with which the information from death certificates has measured the occurrence of death from bacterial meningitis in four areas of the country. Three of the four study areas were counties that contained a medical school and its associated hospitals. These areas were selected because com-

TABLE 6—Average Annual Bacterial Meningitis Death Rates* by Race and Etiology for Children under 1 year, United States, 1962-1968

Etiology	Race		
	White	Black	American Indian
*N. meningitidis***	2.05	2.98	9.67
H. influenzae	3.41	7.26	20.50
S. pneumoniae	1.99	9.02	23.56
Other specified	2.84	4.22	8.46
Unspecified	7.86	24.90	56.20

* Rate per average annual births, 1962-1968, from U.S. Vital Statistics.
** Does not include deaths from meningococcemia.

TABLE 7—Percentage of Total Deaths, by Race and Etiology which Occurred in Children under 5 Years of Age with Bacterial Meningitis in the United States, 1962-1968

Etiology	Percentage of cases in children under 5 years		
	White	Black	American Indian
*N. meningitidis**	51	48	63
H. influenzae	87	90	96
S. pneumoniae	27	38	64
Other specified	58	67	79
Unspecified	47	56	76

* Does not include deaths from meningococcemia.

plete laboratory information about cases of meningitis was one of the most important components of the study. In this respect, the areas may not be representative of the nation as a whole. However, there is no reason to believe that the transcription from hospital record to death certificate (correctness) or the thoroughness with which death certificate recording measured death from bacterial meningitis (completeness) were affected by the complete laboratory information available about each case. Instead, there may be more cases with a specific bacterial etiology and fewer cases of unspecified bacterial meningitis.

It is possible to use race-specific case-fatality ratios for bacterial meningitis to translate death rates into case rates. In so doing, however, one depends on the accuracy of measures of completeness of death certificate records, reliability of the etiologic diagnosis recorded, and the case finding used in measuring case-fatality ratios. The data of Park,[11] Floyd,[12] Gold,[13] and Fraser[4] showed no significant differences due to race in case-fatality ratios for blacks and whites who died of meningitis due to *N. meningitidis*, *H. influenzae*, or *S. pneumoniae*. Using the completeness and correctness estimates for death certificate data from four areas, and the case-fatality ratios from the mentioned studies, one might estimate an annual incidence of 6,000 cases of meningococcal meningitis and meningococcemia, 9,500 cases of *H. influenzae* meningitis, and 2,500 cases of *S. pneumoniae* meningitis in the United States from 1962–68.

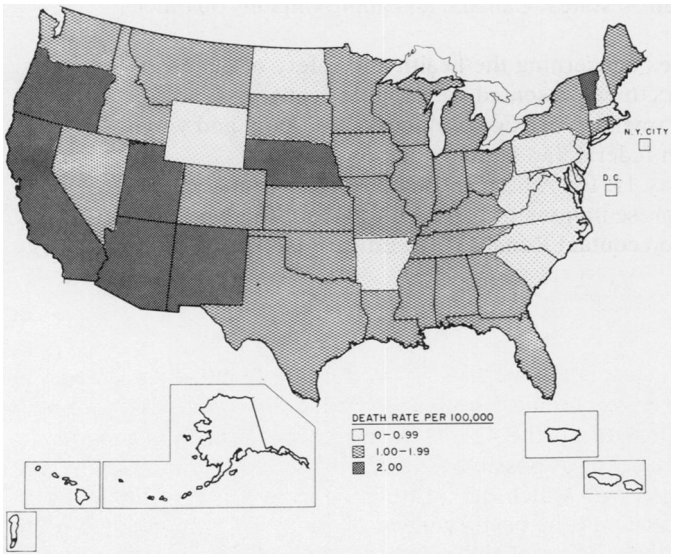

FIGURE 1—Average Annual *H. Influenzae* Meningitis Mortality in Whites, 0-4 years of age, United States, 1962-1968

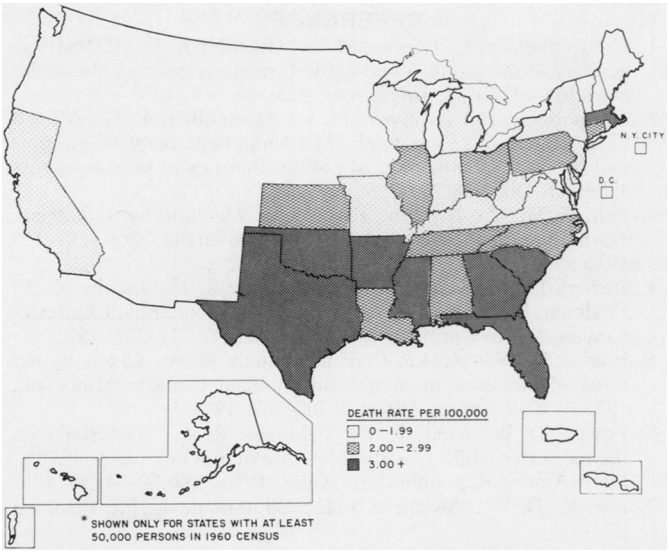

FIGURE 2—Average Annual *H. Influenzae* Meningitis Mortality in Blacks, 0-4 years of age, United States, 1962-1968

The race recorded on death certificates for blacks and whites accurately duplicates race recorded on the birth certificate. In one study of infants who died in California, however, only one-third of the infants with the race American Indian on the birth certificate had the race American Indian on their death certificate.[10] The remainder were called white. If a similar bias is true for American Indian deaths at all ages, and in other states, then meningitis death rates for American Indians are underreported, and in Arizona and New Mexico the rates for whites may be artifactually high. It is possible that the high death rates for *H. influenzae* meningitis in whites in some southwestern states are explained on this basis.

The study clearly shows that the burden of bacterial meningitis death falls heavily on blacks and American Indians, racial groups which have a high percentage of poverty and crowding. Within each race, and for each etiology for blacks and whites there were more deaths in males than females. However, within these racial groups it was not possible to relate high meningitis death rates to race-specific county characteristics concerning poverty and crowding. Other studies [4, 6] have related the occurrence of *H. influenzae* meningitis to economic or educational characteristics in the census tracts of residence.

It is evident that when vaccines for the prevention of bacterial meningitis due to *N. meningitidis*, *H. influenzae*, and *S. pneumoniae* become available, the greatest need for their use is in the American Indian and black communities.

REFERENCES

1. Goldschneider, I., Lepow, M. L., Gotschlich, E. C., Immunogenicity of the group A and group C meningococcal polysaccharides in children. J. Infect. Dis. 125:509–519, 1972.
2. Goldschneider, I., Lepow, M. L., Gotschlich, E. C., Mauch, F. T., Bachl, F., Randolph, M., Immunogenicity of group A and group C meningococcal polysaccharides in human infants. J. Infect. Dis. 128:769–776, 1973.
3. Sell, S. H. W., Karzon, D. T., eds. *Hemophilus influenzae*. Nashville, Tennessee, Vanderbilt University Press, 1–325, 1973.
4. Fraser, D. W., Darby, C. P., Koehler, R. E., Jacobs, C. F., Feldman, R. A., Risk factors in bacterial meningitis: Charleston County, South Carolina. J. Infect. Dis. 127:271–277, 1973.
5. Fraser, D. W., Henke, C. E., Feldman, R. A., Changing patterns of bacterial meningitis in Olmsted County, Minnesota, 1935–1970. J. Infect. Dis. 128:300–307, 1973.
6. Fraser, D. W., Geil, C. C., Feldman, R. A., Bacterial meningitis in Bernalillo County, New Mexico: a comparison with 3 other American populations. Amer. J. Epi 100:29–34, 1974.
7. Fraser, D. W., Mitchell, J. E., Silverman, L. P., Feldman, R. A., Undiagnosed bacterial meningitis in Vermont children. Am. J. Epid. 102:394–399, 1975.
8. Pohlen, K., Emerson, H., Errors in clinical statements of causes of death. Amer. J. Public Health 33:505–516, 1943.
9. James, G., Patton, R. E., Heslin, A. S., Accuracy of cause-of-death statements on death certificates. Public Health Roports 70:39–51, 1955.
10. Norris, F. D., Shipley, P. W.: A closer look at race differentials in California's infant mortality, 1965–1967. HSMHA Health Reports 86:810–814, 1971.
11. Parke, J. C. Jr, Schneerson, R., Robbins, J. B.: The attack rate, age incidence, racial distribution, and case fatality rate of *Hemophilus influenzae* type b meningitis in Mecklenburg County, North Carolina. J. Pediat. 81:765–769, 1972.
12. Floyd, R. F., Federspiel, C., Schaffner, W. B.: Bacterial meningitis in urban and rural Tennessee. Amer. J. Epi. 99:395–407, 1974.
13. Harvey, R. C. Jr, Gold, R.: The epidemiology of bacterial meningitis in the Hartford, Connecticut capital region. (in preparation)

World-Wide Industrial Hygiene Conference in Atlanta

The 16th American Industrial Hygiene Conference will be held at the Atlanta Marriott Motor Hotel May 16-21, 1976. More than 2500 industrial hygienists and other occupational health professionals are expected to attend the annual gathering, sponsored jointly by the American Industrial Hygiene Association and the American Conference of Governmental Industrial Hygienists. The largest world-wide meeting of its kind, it brings together representatives from all 50 states, Canada, and approximately 30 other nations.

Conference sessions will focus on a variety of issues concerning the health and safety of people at work. Subject matter of the hundreds of original papers to be presented will include heat stress, noise, asbestos, airborne particulates, work physiology, lead, mercury, toxic substances, radiation, and vinyl chloride. Attendees will also be brought up to date on federal and state regulations.

Many attendees are expected to arrive Saturday, May 15, for American Board of Industrial Hygiene certification examinations. In addition to the regular presentations of papers throughout the week, 35 refresher courses will be offered. For further information contact Ronald Watt, Edward Howard & Co., 1021 Euclid Ave., Cleveland, OH 44115.